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An Analysis of a BYOD Program in a School District

RIchard J. Hackler
Grand Valley State University

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An Analysis of a BYOD Program in a School District

By

Richard J. Hackler

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Your Professor   **Date**

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Abstract

This project documents and analyzes the preparation and execution of a bring your own device program implemented in a local affluent school district. The project looks at the implementation from a cost/benefit perspective, identifying the stated goals of the program and working to develop a method of measurement for evaluation. It examines the technical infrastructure upgrades and configuration required to ensure a smooth roll-out. The project also examines bring your own device programs in several other industries, identifying the motivations and methods of measurement as means for developing recommendations based in experience.

Introduction:

This paper examines the implementation of a bring your own device (BYOD) program in a local affluent school district, performs and initial cost/benefit analysis, and presents recommendations on how to to a more complete, formal assessment of the benefits of the program in the future. In the spring of 2014, the school district initiated a pilot program with select teachers and studied the outcome as a means to best implement a district-wide BYOD program. Based on the results of the pilot, the district created promotional materials for staff, teachers, and students, which identified the logic and projected goals of the program. After the administration flushed out the details of the implementation, in the spring and summer of 2015, the technology department updated the district's IT infrastructure to support this initiative. This included the overhauling and segmentation of the network, and increasing and altering the allocation of bandwidth across the existing district network. The author of this paper was part of the team responsible for this infrastructure work. The program was rolled out at the beginning of the 2015-2016 school year across three high schools.

The analysis done for this project began with a collection of information regarding the goals of the program and information regarding the cost of the network upgrades and changes. Looking at the expressed goals of the program. A survey was distributed to staff in the three high schools. This survey served as an attempt to measure the success of the stated goals of the program as well as to solicit feedback from staff on their opinion of the program and any issues they foresaw with it. From there, the program was evaluated through looking at statistics from the district network in terms of increased unique connections and increased bandwidth useage. Finally using the insight gained from looking at other industries, a measurement of the perceived success and engagement of the program compared to the costs to implement it, as well as looking at

how other educational institutions have evaluated similar programs, a set of recommendations moving forward was drawn up for the district.

This paper first presents a look in the IT literature examining several other implementations of BYOD programs across industries. It Identifies the motivation for these and analyzes the results in order to understand the lessons learned moving forward. It then looks at the motivations and goals of the school district for this project, discusses the challenges the district had to face when planning and implementing the program, presents the open-ended survey sent to the high school staff, and analyzes and discusses the results of that survey, examines the costs of the project, and presents recommendations for the future examination of the long term benefits of the project.

An overview of BYOD and studies of implementations in other companies.

Increasingly integration of technology into personal life and interactions has spawned a emerging trend in business and organizations. In an effort to cut costs and improve employee productivity, companies are encouraging bring you own device (BYOD) initiatives. BYOD encourages employees to use their personal devices - smartphones, tablets, laptops, and other mobile devices - in place of company provided devices. The rationale for many of these programs is that they are less costly as the purchase falls on to the owner of the device. Also, with employees traversing the line between personal life and work, it is predicted that employees will become more engaged and more productive through the personalization of their work and the ability to be reached and complete work at any time. (2)

BYOD programs also come with their share of costs. Creating or updating the existing IT infrastructure requires an initial investment which can often be quite high. Security is also both an increased risk and a cost with BYOD programs. As employees have access to company data on their own devices, the risk of mishandling it increases. Developing safeguards and implementing solutions poses a cost and a challenge to the company. Also, personal devices are not locked down under the same protections as company devices. Users devices often are more easily compromised by malware, phishing schemes, etc. This increased risk transfers over to the company. If an infected device has access to networked company resources, those resources are now jeopardized.

It is easy to look at the benefits afforded by a BYOD solution and assume that the costs are negligible compared to the projected long term benefits. It's also easy to look at BYOD as a fits all solution to providing technology resources in institutions where they are lacking, outdated, or just need to be increased. As with any business plan, a proper analysis must be applied in order to determine the best fit for a company in terms of cost, benefit, and integration into the company culture. Below are three industry examples,

from the literature, of BYOD implementations and their evaluations. All providing lessons that can be applied to other companies looking to do the same.

Cisco:

In 2012, Cisco conducted a study looking at the benefits and drawbacks of BYOD programs by conducting a financial analysis of BYOD programs in in six countries. (CITATION) Cisco found that IT industries in general support BYOD in some capacity. Overall, companies are getting some benefit from BYOD, however, the report argues taking a more strategic approach would dramatically increase the return on these programs. Cisco refers to the latter approach to BYOD as "Comprehensive BYOD" and defines a formulaic approach to defining this. Cisco looked specifically at the benefits for the following categories of employees:

- Mobile employees moving from corporate devices to BYOD
- Mobile employees moving from corporate-paid data plans to employee-funded plans
- Mobile employees who have already adopted BYOD
- Employees adopting BYOD to gain the benefits of mobility for the first time.

Cisco also calculated the costs of BYOD programs broken down into the following categories:

- Software (including additional collaboration tool licenses)
- Support and training (including help-desk support and self support)
- Policy and security (including policy management and mobile device management)
- Telecommunications (end user and corporate WAN)
- Network and operations (Wi-Fi access points, network management, maintenance)

The Cisco study found several common benefits from BYOD programs. Even with basic BYOD programs lacking in strategic planning, companies are gaining more productivity from their employees. Employees main device of choice has been mobile devices. Employees benefit from this by gaining some freedom in melding their personal life into their work day by way of taking care of personal business, keeping in touch with family and friends, etc. The ability to do this on the device used for work leads to greater net productivity as the transition from personal business to work is seamless. Cisco discovered that on average, BYOD programs increase employee productivity by 37 minutes per week per employee. A large part of this increase in productivity results from employees utilizing new tools and resources to find innovative ways of working. As a result, increase in productivity transcends simply doing a job quicker, but instead results in doing a job differently and more effective.

This study also found that on a whole, BYOD programs save companies money. This savings comes in three ways. First, companies save on hardware costs by shifting the burden onto employees now responsible for the purchase of their own devices. Secondly, companies can save on support costs by building community-based support systems. This can take the form for wikis, shared forms, and knowledge bases. Finally companies can save in telecom costs by removing employees from corporate data plans and placing them on their own. This study discovered that employees on average spend $965 purchasing their own devices for work, as well as $734 per year on mobile data plans, a cost per employee now taken away from the company.

Companies are largely responding reactively to BYOD programs, developing ad-hoc solutions to support BYOD initiatives. Cisco defines a more thoughtful approach to BYOD. An approach they argue can create a far greater return for companies, through strategic implementation and planning. The tenets of this approach are as follows:

- Ability to monitor and remotely "wipe" corporate data
- Automatic application and enforcement of corporate access and use policies, based on company-defined criteria
- Dual personal and device configuration (PERSONAL AND WORK?)
- Ability to move among networks seamlessly and securely
- Ability for users to log in using multiple devices simultaneously
- Corporate collaboration tools that work on all end-user device types and brands
- Simple and user-friendly authentication for all devices
- Secure access to the corporate network through wired, Wi-Fi, remote, and mobile means

Cisco estimates the cost savings with a basic BYOD approach to be about $350 per employee, however, applying the principles of comprehensive BYOD produces a savings of $1650 per employee ANNUAL NUMBERS?. This gain in savings comes from; employees being more productive, removing barriers for adoption of BYOD, and decreased support costs. Cisco recommends that, in order to actualize these savings, IT and business leaders should approach implementation and support through the lens of cost-savings. Policies should simultaneously take security and employee enablement and innovation into consideration and develop well planned and well supported solutions. (2)

 Governments:

The next case study examined was an examination of three BYOD programs implemented by different government agencies. The first program examined was put in place by the Alcohol and Tobacco Tax and Trade Bureau. During a hardware refresh cycle, the department was seeking to cut costs. Previously the department spent about

$2 million every 3 to 4 years in hardware refreshes. With limited funding, the department identified that they could deploy a virtual desktop solution that interfaced with centralized servers running the corporate applications and hosting corporate data. This solution put the responsibility of the device in the employee's hand with the company being responsible for access and applications. This solution cost the department $800,000, resulting in a saving of $1.2 million. (1)

The program went off with relatively few issues. The largest being problems with devices that do not support the necessary virtualization technologies. Moving forward the IT department should approve specific devices as supported in running the client. There were also several issues that arose due to unique/outdated devices being utilized

The next BYOD implementation examined came from the Equal Employment Opportunity Commission (1). Similar to the previous example, this department experienced a 15 percent reduction in budget, leaving the department with insufficient funds to continue their existing program of supplying employees with Blackberry devices. The department first audited the way the devices were being used. Overwhelmingly, these devices were only used for email communication, with the majority of users never making a single call. Recognizing the redundancy and costs to have a separate device that was largely only used to access email, the department identified the the original reasons this program was created and investigated if a BYOD solution could meet the same requirements. From there a plan to address the security concerns that prompted the move to corporate devices was drawn up. Employees were presented with the choice to use their personal devices for work. Employees choosing BYOD were required to sign an acceptable use form, stipulating how government data could be accessed and stored, as well as agreeing to allow inspection of the devices at any time. The BYOD option resulted in reducing recurring costs for the department by 20-30% per year.

Moving forward, the department recommended that the idea of BYOD be socialized, meaning that the BYOD concept must have buy in from senior staff members and the executive council. Companies should invest in user education by way of training and support from senior employees. Legal counsel should be engaged from the onset, allowing for the creation of policies that are possible to implement. Finally, potential security issues should be identified and addressed while developing policies. (1)

The final case study examined was based on the state of Delaware's BYOD initiative in 2012. This took a similar form to the BYOD program implemented by the Equal Employment Opportunity Commission (1) in that this was a transition from state issued BlackBerries to personal devices. Again, this came as a result of limited budgets and a recognition of the lack of use of these devices. Instead of offering total access on personal device as in the previous study. The state of Delaware was much more selective. Employees whose jobs required consistent use of a cell phone for work purposes were offered reimbursement for the use of their personal device. all other

employees were left with no device and no reimbursement as it was determined their job would not require the use of such a device to complete their jobs. As a result, the department saw a reduction in device cost of 45 percent. (1)

Common across all of these studies is that the motivation for moving to a BYOD solution was derived from a need to cut costs. As a result, these programs were mostly reactive, in that they did not address strategic needs, but rather were stop gap measures to maintain programs already in existence. As the motivation for these efforts was financial in nature, so was the evaluation of success. None of these studies addressed productivity, innovation, or anything other than if costs were reduced. Giving only a partial analysis of the success or failures of the programs.

Ottawa Hospital

The final case study looked at examined the Ottawa Hospital, the largest acute care hospital in Eastern Ontario. (3) In order to provide patients with full care solutions within one location, this hospital structured the locations into geographic silos, with all resources needed for treatment, research, and related staffing all centrally located. As a result, cross-departmental communication took the form of electronic correspondence, and access to patient information moved to the Internet. Recognizing the benefits of having access to patient charts, the ability to view diagnostic test images, and having any other information accessible immediately, the hospital issued iPads to all of the physicians in the organization. The Ottawa Hospital found that while expensive, this program was beneficial in that it allowed for the strongest security as devices were not shared, they could be remotely wiped if lost or stolen, and additional security measures were able to be installed.

After seeing the success of this program, the hospital identified several other areas that would benefit from staff having a mobile device able to access information and tests at any time. residents working in the hospital were required to work on-call positions for overnight shifts. During this time, if a patients status became critical, the resident had no way to order required testing and treatment on their own, as they lacked a device able to access the appropriate information. Nurses also were identified as an area of staff that would benefit from having access to patient data and being able to communicate with physicians, however, it was impractical to share devices amongst nurses, as well as cost prohibitive to purchase a device for every nurse.

Recognizing the cost limitations of purchasing a device for every nurse as well as for every resident, but also seeing the benefit using such a device would bring, The Ottawa Hospital began a calculated implementation of supporting BYOD solutions for staff members. As access and privacy of patient data is crucial in a medical setting, security was the largest concern of rolling out a BYOD program. To alleviate some concerns, users were required to register their devices with the identity and management

group, and were not able to access sensitive data on BYOD devices. As the BYOD program was still in its early stages, iPads are currently the only supported BYOD device as the hospital is currently in the works of building capacity to support a more robust program.

Moving forward, the case study makes the following recommendations (3):

- Senior management and IT professionals must work collaboratively to design an appropriate mobile device policy that details codes of conduct and expectations. All staff must be made aware of these policies and the potential risks of BYOD to both the organization and the employees themselves.

- Robust security systems and contingency plans must be implemented, taking into consideration any additional risks associated with employee-owned devices. At the Ottawa Hospital, for example, the staff already use two-factor authentication grid cards, but security tokens may be required to provide enhanced security for a BYOD program.

- Management must anticipate changes in work flows and routines and institute corresponding organizational change initiatives.

Commonalities in motivations and solutions:

In the case studies above, there are several common motivations for implementing BYOD solutions. The most pervasive of these motivations is the desire to cut costs. Comparing the cost of refreshing of purchasing new devices to the a BYOD solution, in most cases a BYOD solution will be less costly as it displaces the purchase cost to the employee. It should be noted however, that most of the organizations reviewed above were able to push BYOD devices into a pre existing infrastructure, resulting in little transition costs.

The next common motivation for implementing a BYOD solution is that it is predicted to increase employee productivity. The Cisco study was able to quantify this increase in terms of productivity percentages. The Ottawa Hospital study was able to demonstrate this increase in productivity through increased access to tools needed to complete tasks and a removal of barriers, allowing staff to do more on their own, in less time. (3)

In the examples above, the motivation for a switch to a BYOD solutions came in response to both financial considerations, as well as recognition that a different approach plugged into an already existing process or program could yield better and more productive results. The studies found the necessary infrastructure largely existing,

with the exception of some security aspects. As a result, these programs had clearly stated goals that were easy to evaluate by comparing the new approach to the old.

The school district studied in this paper defined rationale for implementing a BYOD program that overlapped in many of the areas the case studies presented above outlined. All of the institutions saw BYOD as an avenue to cut costs (Figure 1). Cisco went further and identified proof and rationale for BYOD to improve both productivity and engagement for its employees. The Ottawa Hospital on the other hand, had a preexisting program in place and saw BYOD as a tool to enhance it. The district's rationale overlapped in all areas but supplementing an existing program. The district did not have an existing program needing replacement or supplementation. The district believed that with increased access to technology, innovation and discovery would rise from increased engagement enable by the BYOD program.

Table 1: a comparison of motivations across industries

	Cost Savings	Productivity	Engagement	Supplement pre-existing program
Cisco	X	X	X	
Governments	X			
Ottawa Hospital	X			X
District	X	X	X	

Trying to identify the motivation to implement BYOD in the district

Spawned from a growing desire for more technological tools in the classroom and a desire for the district to stay relevant through strategic implementation of 21st century teaching methods and tools, the school district began laying the groundwork for the implementation of a BYOD program in 2013. This program was dubbed "eAchieve" which, according to the chief innovation officer with the district, was an intentional branding decision with the goal to take the emphasis off of the device. According to her, the e in eAcheive "represents a multifaceted approach to educate, engage, enlighten, encourage, and empower our learners". Prior to the implementation of eAcheive, The district had been actively introducing technology into the classroom by way of three educational technology trainers who worked with staff to identify and incorporate appropriate technology into their classrooms. In addition to that effort, the IT department began a large refresh and updating of the district's existing technology.

Building on the momentum and groundwork laid, the district launched a pilot program in the spring of 2014 targeting specific high school and middle school classrooms. The purpose being, to test the waters for a district wide BYOD initiative.

The pilot program's goal was to gauge staff and students' reaction and usage for a BYOD program. Nine teachers at both the high school and middle school level participated in this pilot. According to a promotional Principal's update distributed district wide, the district was undertaking a BYOD approach to technology in the classroom in order to:

- Be a leader in student achievement.
- Prepare students for life after high school.
- Allow creativity and flexibility to deliver tailored instructions to all levels.

The district further expounded on these reasons by drafting a stated goal of a BYOD program. In the same update distributed to staff in the district, it was stated the the goal of a BYOD program was to:

"Intended to enhance the educational experience by allowing teachers the most effective way to deliver instruction and by empowering students to choose how they are going to learn.eAchieve encourages individually created responses allowing everyone to reach their individual potential."

Further explaining the rationalization for a BYOD solution over simply integrating district devices to meet the stated goals, the district did a comparative analysis of BYOD vs district provided devices focusing on a cost savings and student usage perspective. Table one is the district comparison.

Table 2 - Comparative Analysis of District VS. BYOD devices

BYOD	District provided
Very low cost.	Not enough available devices (SHOULD THIS BE A FUNDING ISSUE?)
Quick to deliver	Start up time lengthy
Students take more responsibility for their own devices	Increase to tech support staff
Students know more about their own device and can focus on the learning	High cost to purchase, maintain, replace, and track
Students devices are more likely to be cutting edge	Students do not have ownership of the device
No asset tracking	Standardized technology - every student has same type of device and operating system
No maintenance cost	Students first have to get to know their device and usage - slows focus on learning
Reduced tech support	Teachers more likely to be asked to provide tech support
Realistic preparation for higher ed - Students learn to manage their own device and their actions prior to leaving high school	
Students individualize their own device.	

The rationale for moving away from district provided technology to a BYOD solution fell largely into two categories. The first being cost. Looking at the potential in reduced investment, support and upkeep, BYOD appears to offer a less costly alternative. The second theme is the idea that familiarity and comfort with a device will increase the amount of time actually given to instruction.

This pilot laid out the expectation that teachers: integrate at least two new digital tools into their instruction per month, monitor integration of technology for effect on student understanding and individual instruction where needed, and identify what the

technology enables them to do that could not be done prior to the pilot. The pilot was was then monitored via periodic gathering of feedback, an idea sharing google site, and an end of project survey and evaluation.

The results of the end of program survey largely reinforced the notion that the e-achieve program met the aforementioned goals. The survey examined three groups of participants; teachers, students, and parents. Teachers were asked to indicate the top uses of BYOD technology within their classroom. The top five uses were as follows:

- Email with other staff: 98% daily usage
- Attendance: 96% daily usage
- Word Processing: 64% daily usage
- Collaboration with peers: 62% daily usage
- Entertainment: 60% daily usage.

The usage of technology in the classroom, from a teacher perspective was primarily directed toward efficiency, with the most common usages being for logistical tasks such as communication and records keeping. Following those, a little over half of teachers used technology to increase and encourage participation with peers, which would later be an expressed goal of the eAchieve program. It should also be noted that the same number of staff members responded that one of the top uses of technology in their classroom was for entertainment, as responded that the their top use of technology was student collaboration. From these responses, it can be deduced that the main functions of technology in the classroom at the time were for rote tasks with some emphasis on innovative teaching.

In contrast to the reported use of technology being mainly for rote tasks, when asked about the impact on students, teachers reported overwhelming success and optimism. In response to the question "Allowing students to bring their personal devices to school will…" 82 percent said it would allow for more differentiated instruction, 85 percent said it would allow for more opportunities for communication, 79 percent said it would allow for more opportunities for collaboration, 75 percent said that it would increase students engagement in their learning, and 79 percent said it would create more opportunities for creativity. Teachers did, however, expressed several potential obstacles to successful integration of technology into their classrooms. The top five reported obstacles being:

- Limited time to become comfortable with technology software and resources
- Limited access to electronic devices
- Not enough professional development
- Lack of understanding of how to integrate technology into the curriculum.
- Ability to restrict what resources the student uses when he/she is on an electronic device.

While teachers felt that the program offered benefits in several areas of instruction they identified a few common concerns about limitations of a BYOD approach. Staff indicated that they required more training and support, as many reported not knowing how to integrate the new devices into the curriculum. Teachers also echoed the common complaint that the district needed to provide more technology to fill in the gaps for the BYOD program. The BYOD program included attempts to resolve these issues.

Compared to the teacher pilot group, parents had a less optimistic opinion on the pilot program. Only 36 percent of parents thought that their student would be more engaged by bringing their own device into the education setting. Parents also questioned the use of devices in the classroom as they questioned if students were likely to collaborate with peers or world-wide experts. Parents expressed concerns over a variety of issues related to their viewpoint as participants in the program. The top five concerns being:

- Fear of the device being lost, damaged, or stolen
- Concerns about their student using social media with their device
- Concerns about the financial burden
- Concerns about safety and security of students using online resources
- Feeling that the district should be providing these resources

Overall, the BYOD pilot program appeared to be a success. Teachers and students both reported that the addition of personal devices to the classroom created a more engaged classroom. Teachers added, however, that cell phones did prove to be a distraction while students were more engaged while using laptops. Parents expressed concern over the safety of devices but there were no reports of stolen devices during the pilot program. Finally many students and teachers complained about the speed and lack of reliability of the network, an issue that would have to be addressed when the BYOD approach was applied to the entire district.

Building off the mostly positive feedback from the pilot program, the district began mapping out what a full scale implementation of a BYOD approach would look like, what obstacles would need to be overcome to execute this, and what goals and benefits would be met and gained from this approach. To identify and address these issues, the district created a road map of milestones and objectives to be completed before the full scale implementation of the BYOD program.

The district began with a series of promotional documents and FAQ's championing the benefits of a BYOD approach to educational technology and the success of the pilot program. In the FAQ, the district addressed many of the concerns brought up by parents during the pilot program. These concerns included:

- "What about the distraction factor for students; won't they be able to use social media networks, play games, and watch YouTube video's during class?"
- Is my child protected from Internet content that is harmful?
- What about theft, accidental damage, and accidental loss?
- What is the ideal device for student learning?

One of the repeated concerns from parents was the a BYOD program necessitated the purchase of a device for a student for dedicated school use. While this was explained in the promotional material as not true as students could utilize floated devices in the buildings, the technology department did develop a strategy to help with costs and decisions of parents interested in purchasing devices.

In order to maintain some level of standardization and supportability, the technology department developed a plan to provide pre-approved and supported devices at a discount to students and faculty via a chosen vendor. This process began with first the technology department soliciting bids from vendors in the form of an exclusivity contract that stated the district would only purchase from this vendor in exchange for discount pricing. The technology department identified specific areas and hardware specifications and required the vendors to submit devices for display that fit the criteria. Devices were set up and displayed in the three high schools as well as in the administration building. Teachers and staff were invited to come view and offer feedback on the devices. The technology department then reviewed the feedback and evaluated the devices themselves. A vendor was chosen and a communication went out to parents suggesting that they purchase devices from the preapproved list.

The second common concern centered around instructional support and proper professional development in order to provide teachers with resources to best utilize these programs. With this in mind, several staffing changes occurred in the 2014 school year to prepare for the 2015 roll-out of the BYOD program. The middle school and high school media specialists were given the new title of "Teacher Librarian and Technology Integrationist" This new position both oversaw the media centers of their respective grade levels, as well as were responsible for coordinating and training teachers on instructional technology. In each of the high schools, one teacher was removed from their teaching role part time to serve as another technology integrationist. They were responsible for working with fellow teachers and demonstrating new tools, how to incorporate them into the classroom, and delivering lessons and curriculum around these tools.

The other answers to the questions raised in the FAQ document focused on individual responsibility for the safety of devices when brought into school, as well as on the role of the technology department in regulating access to undesirable portions of the

Internet. This FAQ document also was the clearest articulation of the goals of the E-achieve program:

- Provides development of skills for the 21st Century job market
- Increases opportunity for student/teacher and student/student collaboration
- Increases student interest, motivation, and engagement
- Allows more opportunity for innovation both by teachers and students
- Increases student research opportunities, skills and abilities
- Encourages peer review, peer editing, and peer critiquing
- Encourages teacher/student learning partnerships
- Allows classes to take advantage of and be involved in university lectures, scientific and medical experiences, virtual tours and museums, etc.
- Promotes collaborative, student-directed, student-centered learning
- Improves our students' ability to access information, to take and organize notes and to view and listen to multimedia content during class
- Enables students to use the Internet and other electronic sources to contribute to discussions and lectures
- Allows students to access and turn in homework and assignments electronically
- Increases student collaboration on projects
- Promotes student engagement
- Develops critical thinking, communication, and problem solving skills
- Facilitates different learning styles and multi-sensory learning
- Builds technological fluency
- Embraces the learning styles of today's student

Outside of staff development and education, the larger obstacle to implementing a BYOD program in the district was altering and updating the technology infrastructure to be able to support an influx of new devices, as well as developing a strategy to handle security and access concerns when connected to the district network. The technology department had been playing catch up after an evaluation indicated the district was well behind other districts in terms of technology. The structure of available technology and the network design was built to facilitate centralized labs and media centers, a structure that would need overhauling in order to work with the new BYOD program.

IT costs and involvement

In order to support the predicted influx of devices and the movement from centralized labs to mobile solutions, the IT infrastructure required both a reevaluation and a restructuring to support this new model of technology. Traditionally, the district had provided technology resources by way of centralized computer labs. Each building had 1 - 3 dedicated general purpose labs, and a scattering of specialized program specific labs. Mobile devices were in use, however, they were supplemental to the lab

schema. As a result, the wireless infrastructure throughout the district was outdated and ill equipped to handle a large quantity of connections.

Recognizing this deficiency in infrastructure, the district issued a request for proposal in the summer of 2014 to overhaul their wireless infrastructure for the district. This was proposed to be completed in three waves. The first wave was an overhauling of the Eastern High and Middle school building, as a quasi pilot for implementation. This wave was completed by November 30th 2014. The second wave of the wireless infrastructure upgrade was to upgrade the two remaining high schools in the district. This kicked off on January 1st of 2015 and was completed in August of 2015, just in time for the roll out of the e-achieve program.
The third and final wave has yet to be kicked off as it is slated to begin in 2016 and will address the remaining middle and elementary schools in the district.

This project seeked to replace the outdated 802.11n access points throughout the district with newer dual band 802.11ac access points. Not only were these access points to be updated, the total number and coverage was to be increased in order to provide a density of one access point per classroom. With the increase of access points, additional cabling in the buildings also needed to be run in order to provide connectivity. Two additional switches were added to the networking closets at Eastern and Central High. After a two month period of soliciting and reviewing proposals, a vendor was selected and the replacement project proceeded. The comparative breakdown of old access points and new access points is as follows:

Table 3: Wireless access point upgrade

School	Previous Number of APs	New Number of APs
CMS	21	66
NHMS	23	61
Eastern	61	112
CHS	36	104
NHS	49	108

Outside of the the hardware updates, the district also needed to restructure the segmentation of its network. Previously, the network was divided into two segments, public and staff with the staff network allowing access to network resources and requiring authentication through active directory. The public network could be accessed by anyone, and was largely unregulated aside from basic Internet filtering and a firewall. Each building in the district was further segmented into individual VLANS used to differentiate resources and management.

In order to accommodate students bringing devices from home, several issues needed to be addressed. First, an additional network segment outside of the public and staff networks needed to be created in order to allow students access to dedicated network resources. This was achieved by creating a BYOD network divided up into new individual VLANS for each building. Doing this allowed management via access control lists in the core data center restricting and allowing specific internal services.

The next challenge was to address how to have students authenticate to the network using non-district owned devices. Initially, this was attempted using open authentication on the BYOD SSID where the web content filtering system (iBoss) would direct users to a page requesting authentication. After about two weeks, there were significant reports of student devices not receiving the authentication page. With no simple resolution available, authentication was shifted to utilizing tools built into the new wireless access points. Currently students authenticate by leveraging the Ruckus access points integration into the Active Directory environment. Students are prompted with a Rukus splash page and authenticate using their credentials. This queries Active Directory for the user information and then grants or restricts access accordingly.

The last network upgrade made in order to accommodate the eAchieve program was increasing the bandwidth of the network in order to prevent slowdown when large numbers of simultaneous connections occurred. The inadequacy of the original network became increasingly apparent in the two school years prior, as the IT department had to restrict access to sites and applications requiring high bandwidth usage. In order to preempt this issue from occurring again, an additional 200 mbps of bandwidth was added.

Costs:

Measuring the actual true costs of the E-achieve program is a bit difficult. Breaking down the costs into two categories, hard costs, and soft costs, makes this a little easier. Hard costs are fairly easy to define given the concrete measurements available. The latter category of soft costs, however, proves to be a bit more tricky, as this encompasses more intangible costs such as increased workloads, distraction from normal work etc.

The most evident costs to implement the e-Achieve program, come in the way of the IT infrastructure upgrades that had to be undertaken. We can break down these costs as follows:

- Wireless AP Upgrades: $333,773
- Additional cabling: $300,727
- Increasing of bandwidth: $13,484

- IT Consultant Salary: (½ year) $35,801
- Two Cisco Catalyst Switches: $11,730

       Headcount changes was another easily measured cost. In order to prepare staff for the the roll-out of the e-achieve program, the district implemented a staff development plan. In this plan, one teacher at each high school was removed from their classroom for one third of the day. This time was to be used to develop and demonstrate innovative ways to incorporate technology into teachers curriculum. With these teachers out of the classroom, the district was required to hire part-time teachers in order to cover their course load. Adding another staffing cost.

- Part time teachers: $36,000
- Building IT funds: $30,000[1]

       Total Hard Costs: **$761,515**

       The total hard cost calculated is not the total price of the program. Several of the costs are recurring, requiring yearly payment. While included in the total hard costs, they also persist yearly. These costs are are follows :

- IT Consultant Salary: $71,602
- Part time teachers: $36,000
- Building IT funds: $30,000

       Total recurring costs: 137,6023

       Outside of concrete, tangible costs, the implementation of the eAchieve program also incurred costs in a few less direct and more difficult ways to measure, namely, technical support and teacher workload. The technology department has seen a slight uptick in tickets, and while published policy states that BYOD devices are not supported, if BYOD is not explicitly stated in the request, these tickets are usually accepted and resolved by support staff. This takes up time that would normally go to other forms of support. There has also been an increase in the workload of the district's network engineers. Responding to reports of slow network connectivity, inability to authenticate the the network, and continual adjustments to the allotment of bandwidth have taken a significant amount of time away from the network engineering team's normal operations.

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[1] (Part of the implementation of the eAchive program included reallocation of funds from the IT department's budget to the buildings. The IT department now largely supports the standalone labs, while buildings use the new funds in order to purchase devices that fit in with their building technology plan)

Another soft cost associated with the program has been increase in staff workload Outside of specific teachers who have gone above and beyond to develop effective curriculum based on the use of technology, the technical fluency of most of the staff is relatively low. This was initially intended to be addressed by having a teacher at each high school assigned to work with fellow staff on developing innovative content to utilize tech tools. This approach was limited due to the time limitations on the teachers assigned to these roles. Moving forward with the e-Achieve program, responsibility has fallen to both the instruction department and the two Media Center overseers. As with any additional workload added, there is work that is lost. With the instruction department and the Media Specialists devoting large amounts of time to assist, advise and bring staff up to date, there is a soft cost associated with the loss of work incurred by this shift.

The soft costs described above are necessarily difficult to identify, as well as to affix a concrete number to. For the sake of accuracy and transparency, costs in this assessment will therefore only refer to the calculated hard costs. This gives the e-Achieve program a start up cost of : $761,515 and a recurring cost of $101,801 per year.

A proposed way to measure benefit

The eAchieve program articulated clear goals and motivations for its introduction into the district. For ease of reading, these are repeated below:

- Provides development of skills for the 21st Century job market
- Increases opportunity for student/teacher and student/student collaboration
- Increases student interest, motivation, and engagement
- Allows more opportunity for innovation both by teachers and students
- Increases student research opportunities, skills and abilities
- Encourages peer review, peer editing, and peer critiquing
- Encourages teacher/student learning partnerships
- Allows classes to take advantage of and be involved in university lectures, scientific and medical experiences, virtual tours and museums, etc.
- Promotes collaborative, student-directed, student-centered learning
- Improves our students' ability to access information, to take and organize notes and to view and listen to multimedia content during class
- Enables students to use the internet and other electronic sources to contribute to discussions and lectures
- Allows students to access and turn in homework and assignments electronically
- Increases student collaboration on projects
- Promotes student engagement
- Develops critical thinking, communication, and problem solving skills
- Facilitates different learning styles and multi-sensory learning

- Builds technological fluency
- Embraces the learning styles of today's student

In order to accurately measure the cost/benefit, the completion of the stated goals of the program need to be evaluated in order to calculate the benefit gained. In the pilot program conducted prior to the full release of eAchieve, a post pilot survey was administered to participants.The purpose of this survey was to gauge the tweaks required to roll out the district wide program. Little was evaluated in terms of the pilot meeting the goals of the program. Some questions pertaining to the impact on students education were asked, such as "Allowing students to bring their personal devices to school will…" and "How often do you use each of the following collaborative tools for school- related purposes?" The purpose of these questions is not to identify the success of the stated goals, but rather to predict and identify what tools are in use and what support teacher will require for a boarder implementation. Other questions focused on the physical security of the devices, the comfort level of the users, and logistical useage. As stated by the follow up report; the key findings from the pilot are as follows:

- Nearly all staff, parents and students said are comfortable using technology. A higher percentage of students (81%) said they are above average or expert users of technology than parents (69%) and staff (45%).

- Parents said they are most concerned about safety and security of devices. Students expressed this concern in the first survey, but were less worried about safety and security of their devices after the pilot as reflected in the results of the follow-up survey. According to teachers, there were no issues related to safety and security of devices during the pilot.

- Although students mostly brought phones and the students felt that these devices worked well for them, teachers felt that students were distracted when using phones.

- Teachers felt that students were more engaged and not as distracted when using laptops.

- Students and staff both indicated the most ideal device would be a laptop with a 10-13 inch screen and have a dedicated keyboard.

- Many students with phones used their cellular data rather than connect to the Public Wifi. The students said this was due to the slow speed of the Public Wifi and because and many Websites were blocked.

While useful information for identifying issues with the pilot and improving participation and performance moving forward, the post-pilot assessment did little to actually evaluate the stated goals of the program. Instead, this evaluation critiqued the existing available technology and made several recommendations for providing staff with better assistance and planning for the coming year. Now that the BYOD program has been initiated, an initial assessment of its impact is needed. A survey was created and distributed with this goal in mind.

Many of the program goals stated are items that require long term observation, such as if this program better prepared students for life after high school, while others require access to comparative test scores and content creation from students. Acknowledging that only a short period of time has gone by since the program was initiated, the following questions were built into a survey and sent to teachers at the three high schools.

- 1. What has your involvement with the eAchieve program been?
- 2. To what level has student collaboration increased due to the eAchieve program?
- 3. To what degree has teacher innovation increased due to the eAchieve program?
- 4. How has this program allowed for differentiation of learning techniques?
- 5. What professional development opportunities have you had related to this program?
- 6. What tools do you use for this program?:
- 7. Do you allow electronic submission of assignments?
- 8. What negatives have there been to this program?
- 9. Any other comments?
-

The intent of this was to get a temperature check on staff perception of the program, as well as staff perception on meeting a few of the more simple goals that are measurable. This initial survey focused on how student collaboration has increased, to what degree has teacher innovation increased and how has eAchieve allowed for differentiation of learning techniques. The other questions not pertaining to specific goals

were devised as a means to gauge how teachers are interacting, flush out the support provided, and allow for expressed critiques of the program.

With regards to the specific questions tied to the stated goals staff response was as follows:

Figure 01:

Q2 To what level has student collaboration increased due to the e-Achieve program?
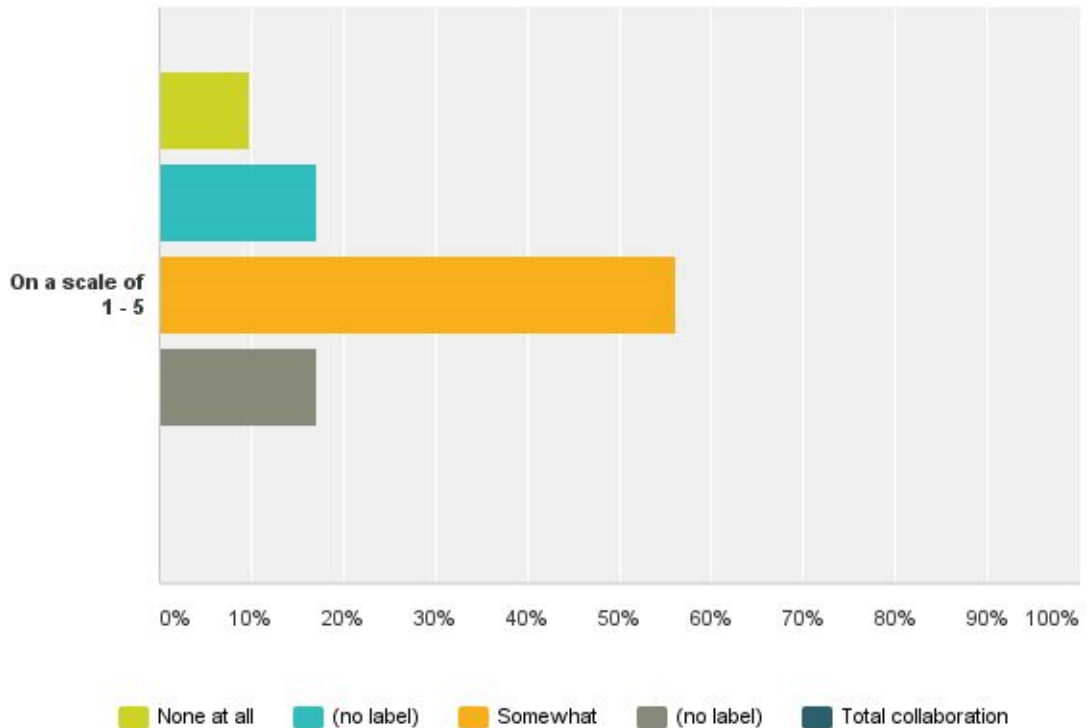
Answered: 41   Skipped: 0

On a scale of 1 - 5

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

None at all   (no label)   Somewhat   (no label)   Total collaboration

Figure 02:

To what degree has teacher innovation increased due to the e-Achieve program?

Answered: 41   Skipped: 0
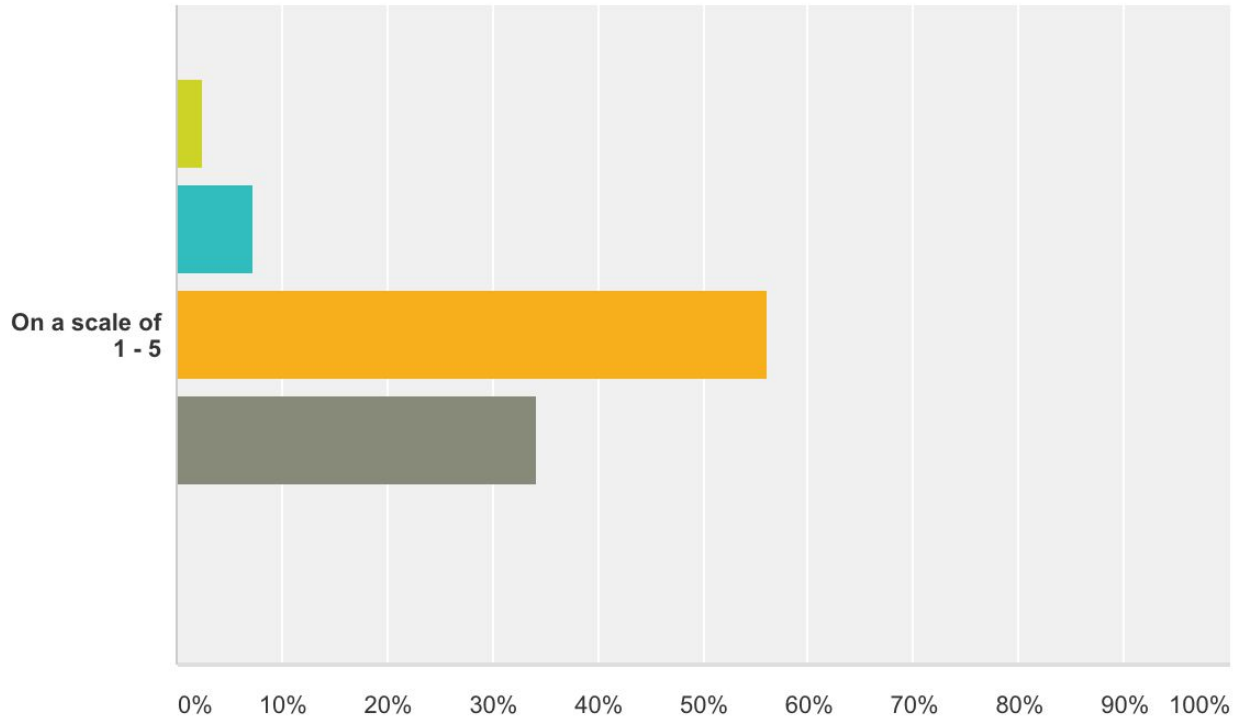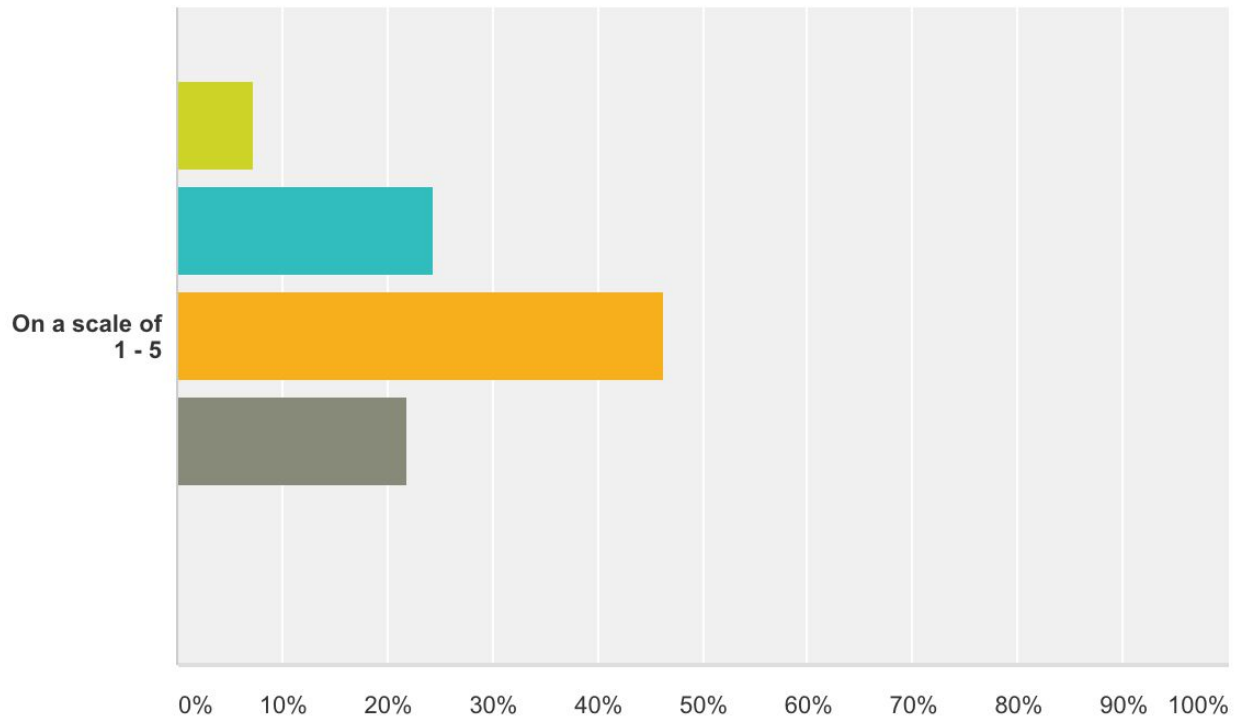

On a scale of 1 - 5

Figure 03:

How has this program allowed for differentiation of learning techniques?

Answered: 41   Skipped: 0

Feedback from these questions in the survey indicate that the largest impact of this program has been the increase in teacher innovation. Teachers mentioned that tools such as google classroom, online assignments, and teacher/student sites have contributed to a more fluid and innovative classroom. Teachers also stated that the number of tools available to them allow them to continually try new approaches, utilizing technology as the tool to do so.

The perception on student collaboration and differentiation of learning techniques is much less clear. On the question of if eAchieve has increased student learning, 27 percent of teachers thought this not to be the case, with 56 percent saying it only did so in a limited capacity. Comments as to why this is suggest that teachers are still sticking to individual work as instructions and projects are not being developed to allow for collaboration. On the issue of differentiated learning, 31 percent of teachers stated that

eAchieve did not accomplish this, with 46 percent stating that it only somewhat did. Feedback on this goal was limited, and stated that differentiation only came by way of offering different Internet tools to different students.

One of the recurring critiques of the pilot program was lack of training and professional development opportunities for staff in learning strategies to utilize the tools provided. This time around, few teachers felt that training was insufficient, however, most echoed a common theme in the training received in that it overwhelmingly focused on one tool: google apps for education. As mentioned previously, one teacher per high school was removed from their classroom to work with staff on developing lessons and curriculum to utilize the various tools available to staff. As the district is a google apps for education district, meaning they utilize the google app suite for collaborative work, much of this development came by way of training on google products. Professional development for staff to engage eAchieve took the form of several google "boot camps" organized by fellow staff throughout the year, as well as one professional development day at the start of the school year. Staff found these to be useful and adequate in gaining working understanding of using google apps in their classrooms.

With much of the focus being on training in google apps, the tools used for eAchieve reflect this. Staff responses to what tools the are using repeated the following: Google sites, Google calendar, Google docs. With the majority of training available being focused on one tool, teachers are being directed to use a defacto one size fits all approach in terms of technology tools to bring to their classroom. Instead it would be more beneficial to train not on a specific tool set for everyone, but rather on the skills to identify what tools will work for teachers individual goals.

Finally, staff were given an opportunity to express any negatives they have encountered with eAchieve, as well as to offer suggestions moving forward. Classroom management and appropriate usage of devices was commonly brought up. Teachers expressed that students often seem more disengaged with lessons as they are easily distracted by making use of their devices for non-school related items. The other prevailing critique has been related to the technology and support provided by the district itself. Teachers have stated that students are not bringing devices, presumably due to not being able to afford them, and that the supplemental devices provided by the district are not enough. Also, staff have regularly been complaining that the district network is slow and unreliable, creating another obstacle in the way of delivering instruction.

Network usage:

As detailed previously, in order to prepare for the roll-out of the BYOD program, the wireless network at the district underwent a massive retooling. Comparing data from last year to this year, there is a measurable upkick in connections per day.

Previous to the wireless infrastructure upgrade, all unique connections were tracked via the Cisco monitoring system:

Figure 04: Unique Connections 2014 School Year
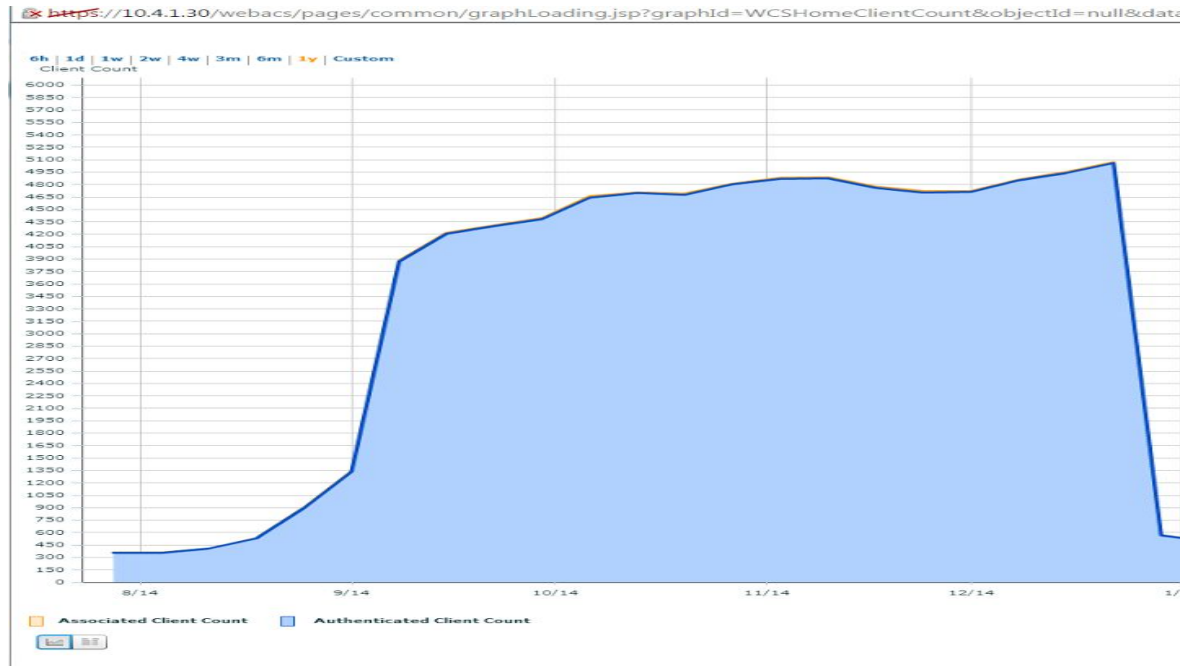
The large dips in connections coincide with breaks in the year, with the graph showing normal connections around 4500 - 5000 in the first half of the year.

Post wireless upgrade, clients could connect via Cisco wireless access points or Ruckus wireless access points, depending on the location in the building, as not all Access points were updated. To get an accurate count, the data had to be combine. The following two graphs must be taken into account:

Figure 05: Unique Connections on Ruckus AP's

Ruckus Simply Better Wireless.   **SmartCell Insight**   Thursday, 5th of November 2015
Timezone is GMT-05:00

### Number of Unique Clients

Period **1 Sep 0:00 – 31 Oct 23:59**   Number of Unique Clients **19,911**   Traffic Volume Transferred **53.7 TB**   Avg Session Duration **00:05:51**

Period: 2015-09-01...2015-10-31   System Name: All   Controller: All   AP Group: All   Access Point: All   SSID: All   Session Type: All

Number of Unique Clients

— 2.4GHz — 5GHz

Show 10 entries   Export

Sample Time	Number of Clients		Radio
2015-10-31 19:00:00		425	2.4GHz
2015-10-31 19:00:00		251	5GHz
2015-10-30 19:00:00		993	2.4GHz
2015-10-30 19:00:00		590	5GHz
2015-10-29 19:00:00		6,917	2.4GHz

Figure 06: Unique Connections on Cisco AP's
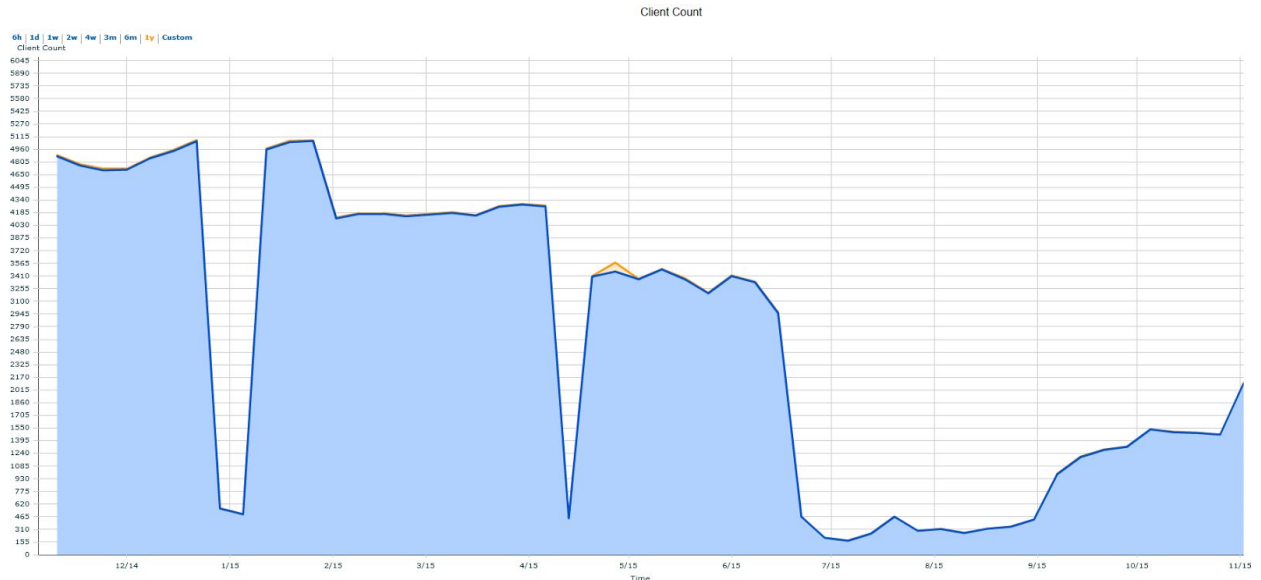
Taking the sum of the two networks, the average number of connections are now around 5700 per day. An increase over the year prior. Spread out over three large high schools, this is a substantial increase in traffic. Bandwidth usage throughout the district, however, has not increased dramatically as there has only been a 10 - 15 percent increase. These numbers would suggest that students and staff are taking advantage of the expanded network capabilities and that there has been an influx of devices. Given that the district also rolled out around 1000 supplemental mobile devices, this size of the increase seems reasonable.

Examining the types of devices used on the network base on operating system on the BYOD network reveals the following numbers:

66% iOS
13% Android
11% Windows
9% Mac

This shows that 79 percent of devices utilizing the BYOD network are mobile devices. This could suggest several things. First, perhaps students are choosing to use their phones for school work. It also might indicate that students and staff are using the network for a quicker connection for their phones. This explanation might corroborate teachers' claims of students using their mobile devices for non-school related items.

Regardless, the capabilities afforded by the preparation for eAcheive are being utilized. Measuring the amount of usage for the type of productivity imagined by the district, however, is difficult to accomplish solely by examining the usage data. Instead the district should look to creating measurements for the goals set out by the programs. For example, an examination of firewall logs could reveal common usage of bandwidth.

Evaluation and recommendations moving forward:

Coupled with the push for greater integration of technology into classrooms, there has been a push for identifying effective methods of measurement for the success or failures that accompany these programs. Often school districts simply purchase devices or roll out a program and expect the innovation and results to manifest simply from the presence of these resources. One of the more extreme examples of the failure of this approach is the recent debacle of the iPad program with the Los Angeles school system.

In 2013 the LA school district spent 1.3 billion dollars on purchasing iPads loaded with Pearson curriculum materials for all students in the district (6). The implementation of this program lacked any strategic planning, and failed to answer a fundamental question an organization should pose before rolling out technology, that is asking "what problem is this tool going to solve" Instead the answer to this was assumed to be obvious. The end result of the LA school district's program was that teachers and students are largely not using the iPads for the intended purpose. This speaks volumes to the need to identify how and why technology will be used before attempting to institute a onesize fits all solution divorced from any actual evaluation.

While an extreme example, the LA schools' failure shows the necessity of proper evaluation of proposed programs before and after their deployments. According to the ERIC clearinghouse on teaching and teacher education, assessments of technology programs in education should be based on measurements derived from observable performance (4). The ACT organization also offers some insight into properly evaluating technology programs in education (5)
.
They identified three crucial steps to technology implementations:

- Identification of educational needs
- Specification of implementation goals
- Design of instructional strategies to create effective learning environments

At the start of a program, the specific changes in teaching and learning should be identified. From there the changes should be detailed and specific enough that recognizing when change has occurred should be a simple task. The evaluation should also bear in mind the kind of data required, who the stakeholders and partners are, how

the data will be used, and what the scope of the evaluation is. In developing tools for evaluation, the ACT organization recommends addressing the following questions :

- How and when will evaluation of technology's impact on teaching, learning, and achievement be done?
- Who will be responsible for collecting ongoing data to assess technology's effectiveness?
- How will accountability for implementation be assessed?
- How will the level of technological proficiency of students and teachers be assessed?
- How will technology be used to evaluate teaching and learning?
- What is the key indicator of success for each component of the technology plan?
- How will the effectiveness of disbursement decisions in light of priorities be analyzed?
- How will implementation decisions to accommodate for changes as a result of new information and technologies be analyzed?

The eAchieve program does address the first question in that the goals of the program were clearly articulated with regards to impact on education. It falls short in presenting a plan for measuring the effectiveness of the program once implemented. As the program is still young, this is correctable and explainable. The initial focus was to make sure the infrastructure and underlying IT framework was in place. Given the completion of the wireless upgrade and subsequent tweaks and changes to the district network, as well as the ability of IT support staff to absorb eAchieve issues into its normal operations, this step of the project has been a success. The district now needs to look forward to both identifying ways to measure and evaluate this program as well as to solicit feedback from staff, students, and parents, and make changes accordingly.

The ACT organization stresses that "Administrators and teachers should receive adequate, tailored, and continuing education about how to best integrate technology into their schools and courses and should be evaluated on their proficiency in doing so." Given the student focus of the eAchieve program, teachers ability to translate available tools into effective teaching methods is crucial for the success of the program. One of the more prevent critiques in the response to the survey administered was that teachers have not received sufficient professional development opportunities for developing effective uses for technology in the classroom. This has resulted in some stratification in that teachers who are comfortable with technology and exploration are embracing the eAchieve program, while those that are not are tech-savvy are not able to reap the benefits hoped for from eAchieve. The outcome being different educational experiences for students.

Below are recommendations for the measurement the effectiveness of the eAchieve program moving forward. These are derived from the stated goals of the program, identifying indicators showing the goals are being met, establishing benchmarks for the goals, and identifying a measure that can then be used to evaluate if a goal has been met.

Goals	Indicators	Recommended Targets	Measures
Provides development of skills for the 21st Century job market	Post graduation, students will have higher hire-in rates than the average.	In 5 years students will have a 10 percent increase in employment rate.	- Graduate employment rate - National employment rate
Increases opportunity for student/teacher and student/student collaboration	Teachers will increase the usage of curriculum that increases the integration of collaboration among student and students and teachers.	Teachers will deliver collaborative lessons and assignments at least once a week.	- Review of teacher lesson plans - Classroom observations - Teacher/student surveys.
Increases student interest, motivation, and engagement	Student participation and excitement about classes will increase.	By the end of the school year students will increase participation in classroom discussions by 5 percent and participation in extracurricular activities related to class by 3 percent	- Student classroom participation - Extracurricular participation - Student survey
Allows more opportunity for innovation both by teachers and students	Teachers and students will deliver lessons and solve problems in previously untried ways	Teachers will incorporate one new teaching method or tool per week. Students will solve one assignment in a new manner each week	- Review of teacher lesson plans - Review of student assignments
Increases student research opportunities, skills and abilities	Teachers will deliver more research oriented assignments. Students research skills will increase throughout the years	Teachers will incorporate two research opportunities for students per month. These lessons will be progressively more difficult, building students skills	- Teacher lesson plans - Assignment reviews - Students completed assignments

Encourages peer review, peer editing, and peer critiquing Encourages teacher/student learning partnerships	Students will use technology to complete peer reviews and peer critiques	Teachers will use google docs for collaboration and review for students writing at least once a week	- Teacher lesson plan - Students google drive activity
Allows classes to take advantage of and be involved in university lectures, scientific and medical experiences, virtual tours and museums, etc.	Teachers will increase the use of the mentioned resources as sources in student learning	Teachers will incorporate a minimum of one listed source into their lessons once a month	- Teacher lesson plans - Field trip applications
Promotes collaborative, student-directed, student-centered learning	Students will increasingly lead and dictate the direction of learning	Teachers will deliver at least two lessons a month either taught by students or driven by student interest	- Teacher lesson plans - Classroom observations
Improves our students' ability to access information, to take and organize notes and to view and listen to multimedia content during class	Increase in students organization, memory, and retention	Teachers will deliver at least two self investigative assignments a month and quiz students on them.	- Teacher lesson plans - Students test scores - Students notes
Enables students to use the Internet and other electronic sources to contribute to discussions and lectures	Students will have increasing access to Internet resources immediately during lessons	Students will utilize the Internet in real time at least once a month to contribute to lessons	- Teacher lesson plans - Device usage in terms of connections
Allows students to access and turn in homework and assignments electronically	Teachers will increase the amount of lessons able to be turned in electronically	Teachers will allow all lessons to be turned in via google docs	- Students google drives - Teachers google drives
Facilitates different learning styles and multi-sensory learning	Teachers will differentiate the delivery of material based on classroom need	Teachers will use at least two different delivery methods for each educational standard taught	- Required educational standards - Teacher lesson plans - Classroom observations

Builds technological fluency	Teachers will become increasingly technically literate	By the end of the year teachers will increase their use and understanding of technology	- Assessment of teachers computer skills - Assessment of teachers use of technology
Embraces the learning styles of today's student	Teachers will understand modern learning styles and incorporate them into their lessons	Teachers will utilize at least 2 new learning styles per year	- Assessment of learning style research - Teacher lesson plans

Outside of developing strategies of measurement, based on lessons learned from other industry implementations of BYOD programs as well as from feedback from staff, below are a series of recommendations and tweaks to be made to the eAchieve program

- Link technology to preexisting goals and standards

- Create baseline curriculum to get the conversation started and give teachers a jumping off point.

- Compile a publicly available list of lessons that use tech tools.

- Work with teachers to identify the gaps in technological understanding.

- Hold one professional development day a month per building that focuses on utilizing the tools provided by the eAchive program.

- Hold a bi-yearly exhibit of lessons and work done using the eAchive program.

- Establish a standard of technology integration and set achievable expectations.

- Build yearly evaluations around the stated goals of eAcheive :
    - Measure student engagement in classrooms that embrace eAchieve vs those that do not not.
    - Track students post Graduation to identify what skills they gained that were applicable to the job market, vs what gaps were left
    - Examine curriculum from teachers highly engaged in the program vs those not and examine the amount of collaboration among students in each
    - Identify areas of skills assumed to be gained (collaboration, critical thinking, research, communication, problem solving, etc) and test a sample of each group of students to identify performance enhancements.

- Do comparative analysis of students standardized test scores in high and low groups.

Conclusion

      The proliferation of low cost easily accessible technology has altered the way students interact with each other and the world outside of the classroom. With these changes in social life comes changes in the ways students learn and become engaged in their learning. In order to keep up with modern learning methods and tailor education to how students learn, schools have been actively integrating technology into the curriculum. This serves to expand on the educational experience by allowing instant access to resources, greater collaboration among students, and providing for a richer experience. Technology in education should then increase the efficiency of student learning and better prepare students with the skills they will need post graduation.

      This paper was an initial attempt to conduct a cost benefit analysis on the eAchive program rolled on in this school district. Cost was calculated using the reported costs of updating the outdated IT infrastructure as well as the cost of several new staff members and restructuring existing ones. The breakdown of these costs are as follows:

-	Wireless AP Upgrades:	$333,773
-	Additional cabling:	$300,727
-	Increasing of bandwidth:	$13,484
-	IT Consultant Salary: (½ year)	$35,801
-	Two Cisco Catalyst Switches:	$11,730
-	Part time teachers:	$36,000
-	Building IT funds:	$30,000
	Total Hard Costs:	**$761,515**

Recurring costs:

-	IT Consultant Salary:	$71,602
-	Part time teachers:	$36,000
-	Building IT funds:	$30,000

      Total recurring costs: 137,602

      Once cost was established this paper attempted to measure the benefit and success of the program. Using the goals laid out by the school district, a survey was distributed to staff to gauge initial reactions to the program. Responses to the survey revealed that while the technical roll out of the program was successful, teachers largely were not embracing this on a mass scale. According the the survey results was due to

lack of educational opportunities and unclear access to tools. In response to the feed back and the nebulous nature of the stated goals, a set of recommendations was drawn up for the district which include:

- Create baseline curriculum to get the conversation started and give teachers a jumping off point.

- Compile a publicly available list of lessons that use tech tools.

- Work with teachers to identify the gaps in technological understanding.

- Hold one professional development day a month per building that focuses on utilizing the tools provided by the eAchive program.

- Hold a bi-yearly exhibit of lessons and work done using the eAchive program.

- Establish a standard of technology integration and set achievable expectations.

- Build yearly evaluations around the stated goals of eAcheive :
    - Measure student engagement in classrooms that embrace eAchieve vs those that do not not.
    - Track students post Graduation to identify what skills they gained that were applicable to the job market, vs what gaps were left
    - Examine curriculum from teachers highly engaged in the program vs those not and examine the amount of collaboration among students in each
    - Identify areas of skills assumed to be gained (collaboration, critical thinking, research, communication, problem solving, etc) and test a sample of each group of students to identify performance enhancements.
    - Do comparative analysis of students standardized test scores in high and low groups.

Finally, this paper developed a measurement tool that can be used to gauge the meeting of the stated goals of the program. By setting recommended targets and establishing what actually needs to be measured, the district is able to evaluate if the goals it set out to accomplish have been met.

The evaluation discussed above is an incomplete evaluation. As the program is only in its first semester, developing a reliable form of measurement is not practical as there is not enough data to draw solid conclusions about. Instead a brief measurement of the most express goals was done as well as a solicitation of the perceived success and needs was gathered from staff.

Below are all the responses gathered from the survey delivered to teachers at the three district high schools. Responses have been left in their original spelling and format.

What has your involvement with the E-achieve program been?

Answered: 41   Skipped: 0
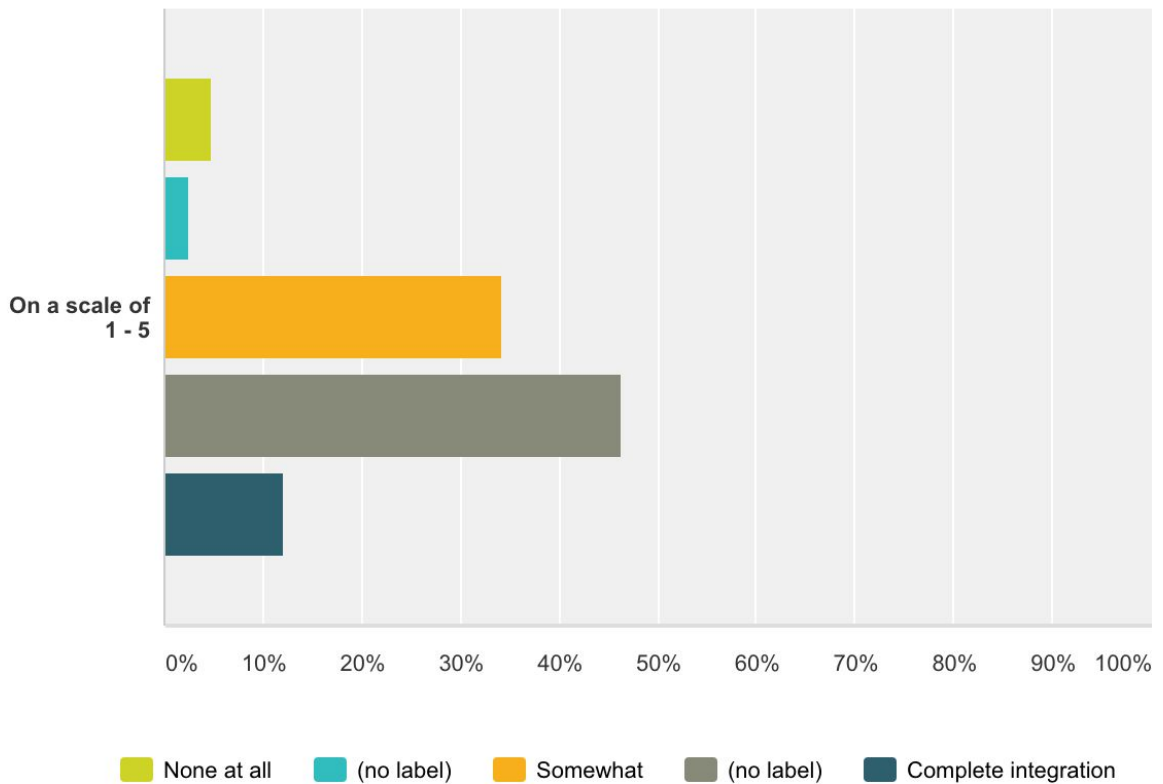
	None at all	(no label)	Somewhat	(no label)	Complete integration	Total	Weighted Average
On a scale of 1 - 5	4.88% 2	2.44% 1	34.15% 14	46.34% 19	12.20% 5	41	3.59

Comments:

I don't think that we should throw out good practices that involve paper and pencil just because students now have a digital device in front of them.

Fits the class work occasionally.

I've always used computers.

I missed the professional development on this topic and nobody has ofered to get me caught up on it.

I have many students still without a device. IT would be nice if the school provided it.

Special ed teacher, so I support what reg. ed. teachers do.

To what level has student collaboration increased due to the e-Achieve program?

Answered: 41   Skipped: 0

| None at all | (no label) | Somewhat | (no label) | Total collaboration |
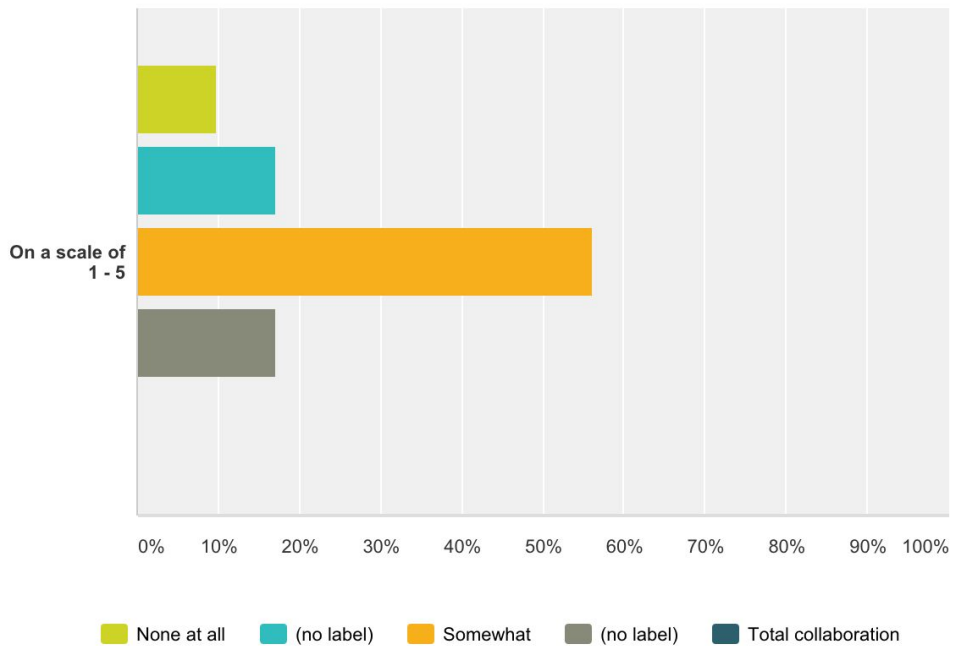
	None at all	(no label)	Somewhat	(no label)	Total collaboration	Total
On a scale of 1 - 5	9.76% 4	17.07% 7	56.10% 23	17.07% 7	0.00% 0	41

Comments:

Increased only on those things that include collaboration and only when students are taught HOW to collaborate.
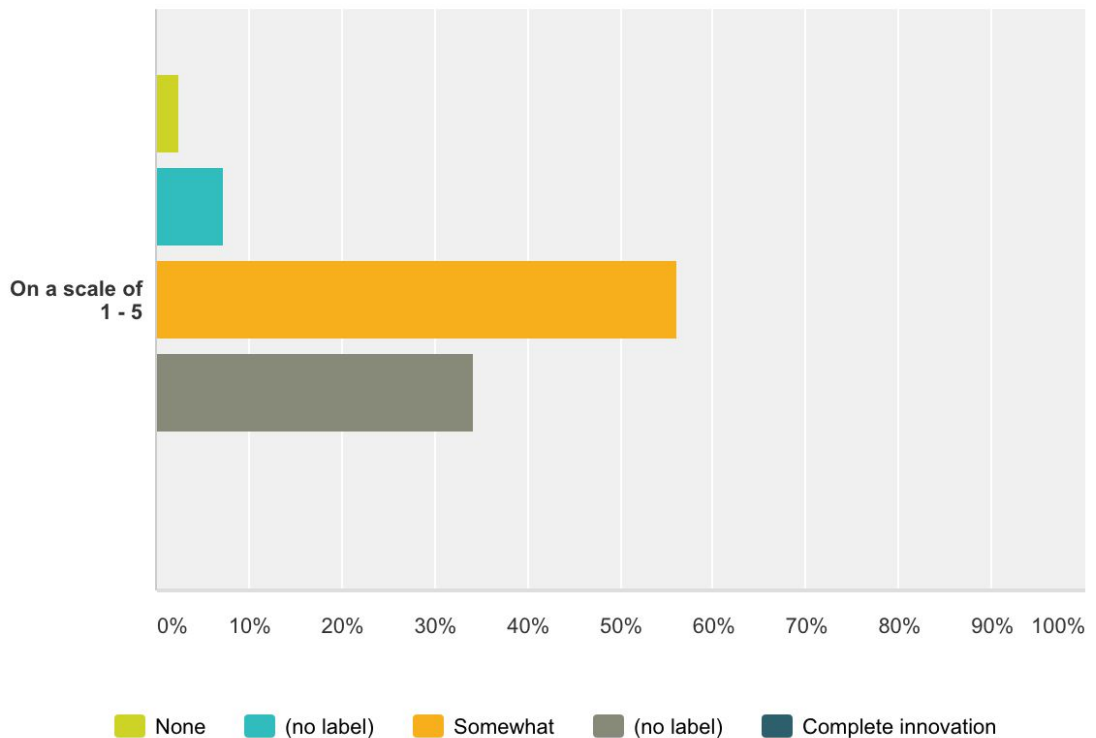
Most teachers are still sticking to individual work.

The collaboration only increases if they are given projects on which they can collaborate.

My classroom was pretty collaborative before e-Achieve.

To what degree has teacher innovation increased due to the e-Achieve program?

Answered: 41   Skipped: 0

	None	(no label)	Somewhat	(no label)	Complete innovation	Total	Weighted Average
On a scale of 1 - 5	2.44% 1	7.32% 3	56.10% 23	34.15% 14	0.00% 0	41	3.22

Comments:

I'm not sure if innovation has increased, but ease of delivering materials instead of copies and for absent students has helped me a lot!
All student having access to google classroom allows for a more involved teacher collaboration.

Technology is only a tool. If not careful it can interfere with learning.

Enjoying new ways to use technology in the classroom. Sharing ideas and new sites

There is a learning element- how to do things differently...

I've thought of a few more things, but I don't know that I'm more innovative than I was before.

I am always trying new innovative things, if I can. I feel like e-Achieve has opened some new tools, but I do not have time to sort through technology to see if there is new innovative technology to bring into my room.

I see more teachers using technology and trying new things.

I think most teachers are trying new ideas and using new tools. It's been exciting!

How has this program allowed for differentiation of learning techniques?

Answered: 41   Skipped: 0

Legend:
- None at all
- (no label)
- Some increase
- (no label)
- Complete catering to learning techniques
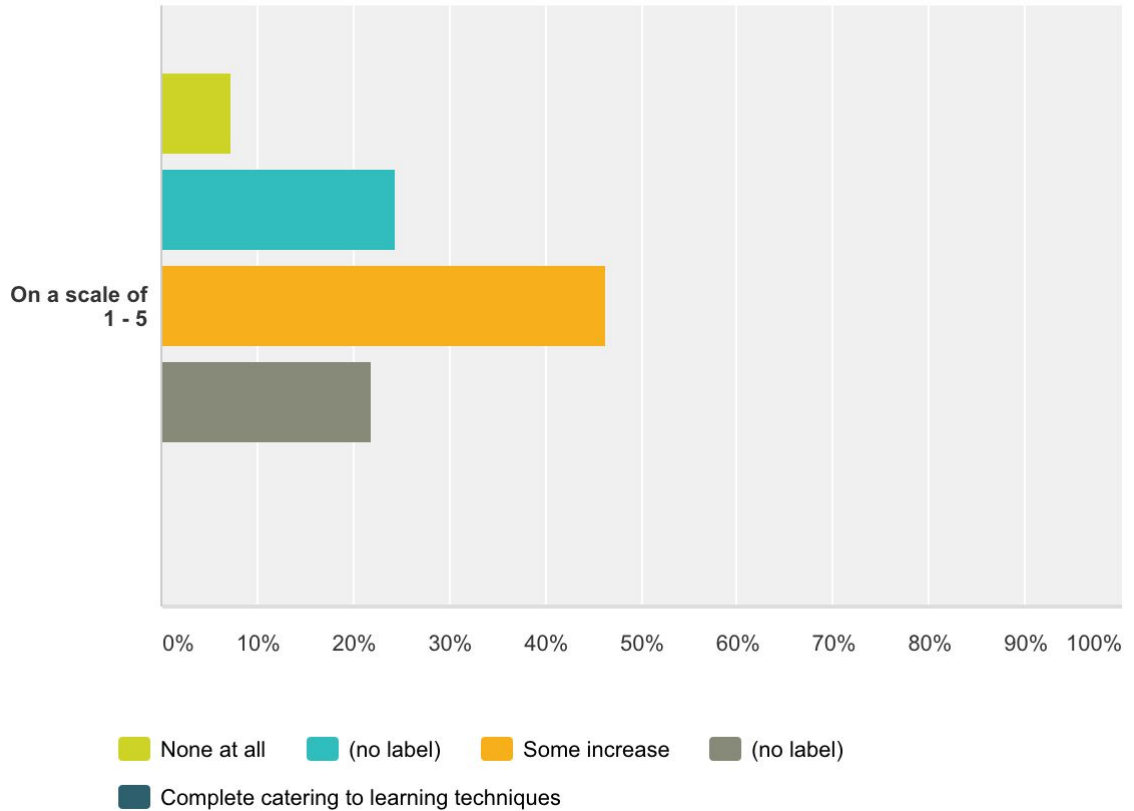
	None at all	(no label)	Some increase	(no label)	Complete catering to learning techniques	Total	Weighted Average
On a scale of 1 - 5	7.32% 3	24.39% 10	46.34% 19	21.95% 9	0.00% 0	41	2.83

Comments:

none that I can think of

Teachers now have the opportunity to provide students with a guided path to material on the internet to supplement learning.

It allows the differentiation to be a little more private

What professional development opportunities have you had related to this program?

one day (6 hrs minus lunch) of Google sheets/forms, docs, sites, and calendar training when teachers could choose two sessions to attend on those topics; one 2-hour morning session on Imagine Easy Scholar which I do not use at all

Been trained w Google websites, Google calendars & Google classroom

1 day PD training

some workshops on different programs but they were conducted at too fast a pace for me.

We had two days of training before the school year started, and various informational meetings leading up before that. Aside from those required professional development days, there have been a variety of other optional training days for teachers wishing to learn about specific programs or skills

quite a bit

Outside of school? none

The introduction to Google Boot Camp and was 16 hours of volunteer time. Our staff development revolved around learning new and various google programs to supplement our education process.

I went to some PD over the summer on how to use some different applications

1 full day of training on google chrome add ons, how to manage devices in the classroom, etc. , also free time to work on integrating technology into our own subject areas.

Google training. Also working with the Van Andel Education Institute for online lab notebooks using their "NexGen" software.

Lots of opportunities to learn new programs in google chrome: calendar, forms,documents, voice recording.

Google Boot Camp and some Google task training

We have a had a truly impressive amount of trainings ranging from basic Google apps and functions to specific programs for planning, assessing, and generating activities. I feel that many would be helpful, but it can be overwhelming, and I usually just try to implement one thing at a time.

"Google Bootcamp," as well as building-level professional development.

Learning how to use Google apps. This was information that I primarily already knew.

A few small pd sessions

e-achieve "boot camp" offered by the district. I was also a "trainer" for e-achieve because all English Language Arts teachers were responsible to train the students with a general overview of the program at the beginning of the year.

We had a day of training in the summer with a variety of topics.

You Tube Creator training (on my own time) in the summer provided by the district. Some district run PD that focused upon some apps and tools we could use through Google (big emphasis on Google stuff).

We have learned of several different online tools that we can use in our classroom such as ka hoot and remind.com and training on all Google apps. I love Google calendar

Time to meet this summer and after school

How to presentations, workshops to use different formats.

To my knowledge, no e-achieve development has been offered for my area of teaching.

Google Boot Camp

Training prior to the start of the school year.

We had a Google Bootcamp and trainings for using Google

Google Basics

Summer training

very little

Several sessions focused on Google Classroom, Slides, Docs, Calendar, etc.

Google training by an FH teacher

Google training.. that's about it

Content specific technology where I can have opportunities presented to me and time to explore them. I just do not have time between planning lessons, grading, and teaching to find all the new technology coming out.

We had a day of PD, and various other opportunities.

Google boot camp plus other PD scheduled throughout the spring, summer, and this fall

Google workshops and eAchieve informational meetings

Google training

eachieve training

In service on various google programs. Some required, some voluntary.

We had training about all the different aspects of google to help us better know how to use it.

What tools do you use for this program?:

students use laptops or chromebooks for most web-based projects or research; phones are not used as much

lxl.com, Google websites, Google calendar, phschool.com, Khan academy, kahoot.com

I am a special ed teacher so I do not directly use tools for this - I do support the use of technology in my co-taught classes.

Basically the Internet, Quizlet and the on-line text.

Our learning focused mainly on the Google suite of apps - teachers were already using gmail and calendar, but we learned the basics of classroom, docs, slides, and a little bit about youtube creator studio

Google Classroom

Personally? My school laptop.

As far as equipment, students are allowed to bring devices they are comfortable with from home to use in class, and for students who are unable to supply their own devices we have chrome books available for lend. As far as programs used for assigning work or managing progress of students, we try and stay close to google for compatibility and ease of access.

Tools meaning what? Like google classroom or students own google sites?

Each classroom has 3 laptops students can use..?? Question seems unclear?

Chromebooks, Dell laptops, student's personal devices. NexGen Inquiry digital lab notebooks from Van Andel Education Institute.

All the ones listed above.

- Google Docs, Slides, Forms - online tutorial sites for practice and quick feedback - recording sites and Youtube

I have begun using Google sites, Google calendar, and Google classroom this year.

Google Classroom as well as Chromebooks for students unable to bring their own devices. I am piloting an online service called, "Learn2Earn.org"

NexGen software, Google Apps

Google classroom and YouTube

Google education suite.

I use my own website. Not that Google crap. I'm hardcore web programming and ftp posting to my own domain.

Lots of Google stuff and I've got 5 chromebooks in my room, along with a microsoft pro surface

I use lag oot, remind.com, in addition to other YouTube videos and math quizzes and worksheets that are available online. All of my classes are on Google calendar where I can post assignments and attach documents.

computer, data projector, document camera, digital cameras, cell phones.

Google Classroom, Google Docs, Kahoot, TechSmithRelay

NexGen Inquiry.org Go Soapbox Google Apps

Google, Google Classroom, Kahoot, Twitter

I use computers with cameras or phones. Students make a lot of videos

Google tools, plus a variety of websites and sim tools, presentation software, and other things

Google classroom

not much

Classroom, Google Docs, my own CMS

Google drive, Google Classroom, Google sites, email, Remind.com, Planbook.com, Exit Tix, Kahoot, PowerSchool

Webwork for Math, Khan Academy, Everything Google. Camtasia for screencast videos

Vernier LabQuests, Vernier Lab Pros, Chromebooks, laptops, YouTube, Google Classroom, Google Suite for Education, Hippocampus simulations and tutorials, timeline creators...can't remember others right now.

3 desktops in my room, along with school Chromebooks and whatever students bring...laptops, phones, etc.

Google Classroom Google Apps (ex: imagine easy scholar)

Google everything, I am in more contact with my students and get more response from them and am able to provide more access to information to both parents and students

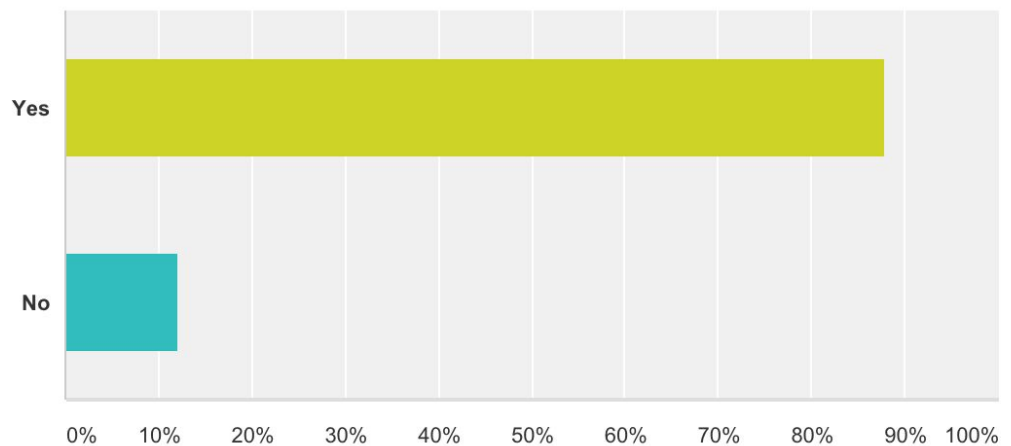IXL math practice and projects

teacher computer data projector pad camera

Google Classroom, Google Forms, Kahoot, quizlet, Google maps, Google Search, etc.

our device

Do you allow electronic submission of assignments?

Answered: 41   Skipped: 0

Answer Choices	Responses	
▾ **Yes**	**87.80%**	36
▾ **No**	**12.20%**	5
Total		41

Comments:
Sometimes - not everything can and should be submitted electronically

Our English program is almost all Google Classroom submissions.

for final drafts only. handwiritng on rough drafts is easier because of the numerous grammatical and spelling corrections it just makes more sense.

Not for all assignments as my classes come with a physical workbook.

For nearly all assignments students can turn them in online

I allow projects to be done using Google slides docs for PowerPoint. And they may be shared on line

Not presently

Difficulty training myself to remember that there is work to review since it is not sitting on my desk or in a basket.

I use digital recording only - no text.

I love the use of Google Classroom

Required on some assignments, but not all

Require them.

Through Google Classroom

What negatives have there been to this program?

Students are connected all of the time to their phones on fb, instagram, snapchat, etc. I believe it is important for students to unplug, connect with human beings in face-to-face settings, and focus on a single task. There has to be a balance. There is a definite isolation that comes with technology. It's ironic, really, that in the most connected society that we've ever known, students feel more isolated than ever and we see this manifested in various unhealthy ways but particularly with self-image issues, admittance to mental health facilities, anxiety, frequency of prescribed medications for such issues, and so forth.

Without permission, students texting or twitter during classtime

Student staying "plugged in" when they should have their devices away. Not all students have access to technology. The time it takes to get all students logged on and ready to go.

Very few - just making sure each student has a usable device.

Students do not use the technology appropriately, or they do not have devices of their own. Our network is also very, very slow.

cheating and sharing assignments

increased student distractability, increased gap between the haves and the have nots, more difficulty for students to survive in this environment without reliable Internet service at home

Some students take advantage of time in class to mess around on electronic devices.

Students rely on the school computers still; they know we have back ups so even the ones who have their own, sometimes don't bring it. Smartphones and IPads don't always work with what you are doing in the class.

only positive so far!!

Student's devices not working properly on the school's network, or issues with software. Students not having devices/not bringing chargers to school. Teacher-provided devices breaking/not cared for properly.

Not enough technology for each student

not all students have devices and the 5 I have to supplement are not enough

The only negative aspect that I've felt is a pressure to re-tool my curriculum more than I have time to do this year. The administration has been wonderful with encouraging one small step at a time, though.

Those parents who have been unwilling to send their children to school with a device.

internet speed, not every student has one, connectivity issues

Hard to organize

I question student "engagement." There is little-to-no human interaction when devices are the educational medium.

Google docs suck. The district is throwing it down our throats because it's free. You get what you pay for.

Not every student has their own device, probably about 15%-20% of students in each class either don't have a device or they forget to bring it

Obviously, kids have access to other programs on the computer.

the knowledge level of all students are not the same

Keeping students on task.

Students want to "play" on their devices instead of working on them.

Not enough computers

None so far

Slow internet connection. Not enough time to learn about new resources that are available to incorporate in our lessons.

keeping students focused .... often clicking to other sites, etc.

Distraction for students.

Technology issues and excuses, Students on devices doing things that are not assigned, Students feel more able to get out devices whenever they want than in previous years when they were banned (even when they don't need them for the current lesson)

Too much time on Computers... loosing some face to face interaction

Students want to use their phone even more than before.

Not all students have devices, and it takes time to log in to school devices as needed each hour, also not enough school devices for all hours.

Not really any!!

not all students can afford devices and not all have internet access outside of school

Not enough extra computers for students that don't have access

boundaries of technology, Google classroom doesn't allow a search by student name for assignments, I am stuck with my computer much more of the time, I have lost instructional time to technology, we don't have enough devices for students to use in some classes

Kids want their technology out all the time. They want to be able to text, etc. during class. I think it hurts their attention span. I don't think they use their higher-level thinking skills as much.

Internet issues all the time

Any other comments?

See above

No

None.

I need more TIME to research and develop new ideas.

N/A

no

Just because we ask the students to do more digitally, does not mean that we are better teachers or that they are understanding the concepts any better. I like using technology, but have to remember that the relationships I build will benefit the students more than my use of technology.

More extensive training on programs that could ensure student device security such as password encryption programs tied to the administrations network for monitoring.

High Schools or rather schools need to have a dedicated class for technology, kids are skilled when it comes to social media technology but a lot of them struggle with the useful applications that are needed in the classroom. So whether it be a class or twice a month class where we actually teach the kids; because otherwise you spend more time teaching the application rather than using it. We cannot assume b/c these kids/students grew up with technology they know how to effectively use it.

Technology when used appropriately can be a huge motivator for students. However tehconlogy for tehcnology sake is dangerous. finding the balance and the right tech tools is the key.

N/A

None

Nope!

I believe every core subject area teacher should have to have Google Classroom for his/her core subject area classes.

I love grading essays using Google. The best direct contact I've had with students

No.

Students use apple products save their work in a funky format that doesn't open on pcs. I hate macs more than google docs. The world would be a better place if we all used Microsoft Office.

No piece of technology can replace what the teacher chooses to do with it. Students and teachers need to remember that it is just another tool. Also, there needs to be times where students are not using technology throughout the day. There is benefit in that students can have ease of access to information and better communication away from school.

Obviously, kids have access to other programs on the computer. But, for the most part it has been a success in my classroom. I teach math.

Make sure every student has accessibility to the technology; internet and personal computer

There is a challenge with student/teacher communication if a student submits work after the due date and the work has already been graded. It is unreasonable to expect a teacher to continually go back into older files "looking" for late submissions.

I feel as though the proliferation of electronics in school settings will ultimately produce a student with lower grades, less ability to interact with people and information, and an overall lower level of accomplishment in all academic areas.

Some parts are useful, some are not. All require major teacher monitoring.

nope.

N/A

Nope

no

Nope

No

Overall, I believe this has made me a more effective teacher and increasing student learning in Math

None.

no

I think E-Achieve was long over due, and it's been great!

None

It will eventually be fine - rough start!

No

no

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