

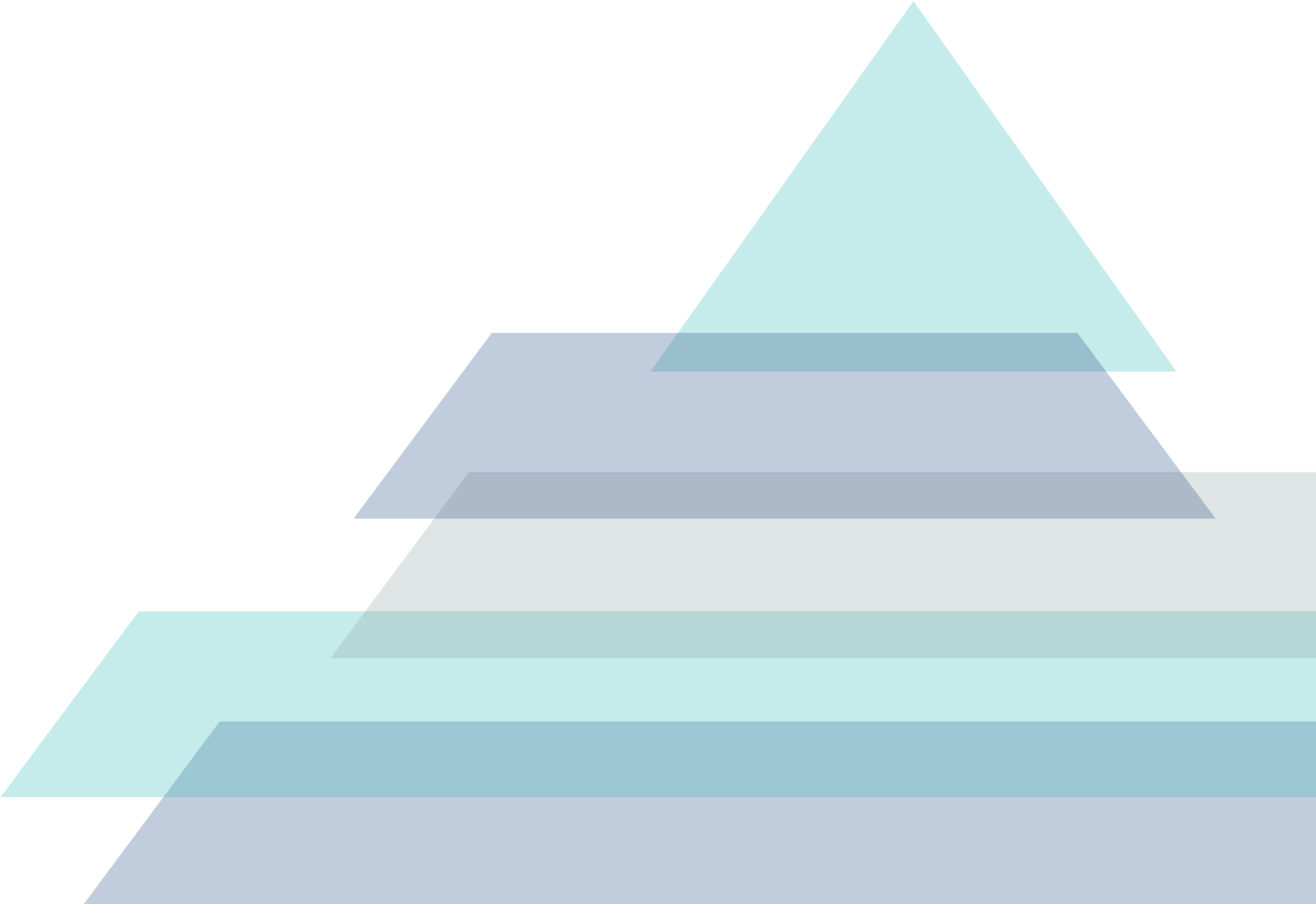


The 1:1 Hierarchy of Needs

Building the Foundation for Future Educational Technology Success

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Introduction

Educators have been grappling with the advantages and disadvantages of adopting technology in educational spaces ever since the first calculator. Although the technologies have changed, and the conversation has evolved, access to devices—and which devices should be accessed—remain central topics of almost every discussion about the potential for technology to enhance educational outcomes.

Access, of course, can mean several things—cost, availability, usability. As such, there are any number of factors that might limit either access to or the use of these technologies, and the opportunity cost of those factors could be high, given student's need to be prepared for today's modern work environment. Indeed, given the rapid pace of technological advancement there is a reasonable trepidation that devices are becoming an integral part of the educational experience, and that students without easy access to them will lose out on key opportunities for success in the classroom and beyond.

This is why, for many stakeholders, the vision for the classroom of the future starts with an assumption that every single student has access to a device.

In this classroom, teachers no longer have to try to reserve the laptop cart weeks in advance, only to find out that they are unavailable, leaving them to return to their old (paper) curriculum notes. Students will no longer hope that the laptop that they receive from the cart actually turns on or loads the program so that they don't have to face the dreaded “share with the person next to you” approach to learning on devices. Instead, teachers

can design their curriculum with the expectation that their students can use devices exactly how and when they need to. Teachers will be able to connect students to other students across the globe so they may discover each other's experiences, versus cracking a textbook and hoping a student finds interest in a 20-year-old description of another culture.

In short, the ideal classrooms of the future use technology to actually improve learning outcomes and enhance global digital citizenry rather than just “occupy” the students while a substitute teacher covers a class, or fulfill some arbitrary bureaucratic mandate. This future that we are describing, where schools are able to allocate one device per student, is known as the 1:1 paradigm.

Although the debate continues about which combination of devices and software best enhance the educational experience, there is a growing understanding that the 1:1 paradigm will be essential to fulfilling students' potential. They are, after all, likely to be using a personal device of some kind outside of the classroom already. As more and more schools move toward a 1:1 future, educators, IT pros, and school administrators will confront a new set of key questions and challenges regarding education technology and its impact on learning outcomes and the well-being of students.



This research paper offers a conceptual rubric for actualizing the benefits of technology in the classroom.

The research is grounded in qualitative research, using 20+ hours of interviews with educational IT professionals from around the world, as well as established theories of psychological health and well-being, and an open question survey of over 200 IT professionals and 170 education administrators.

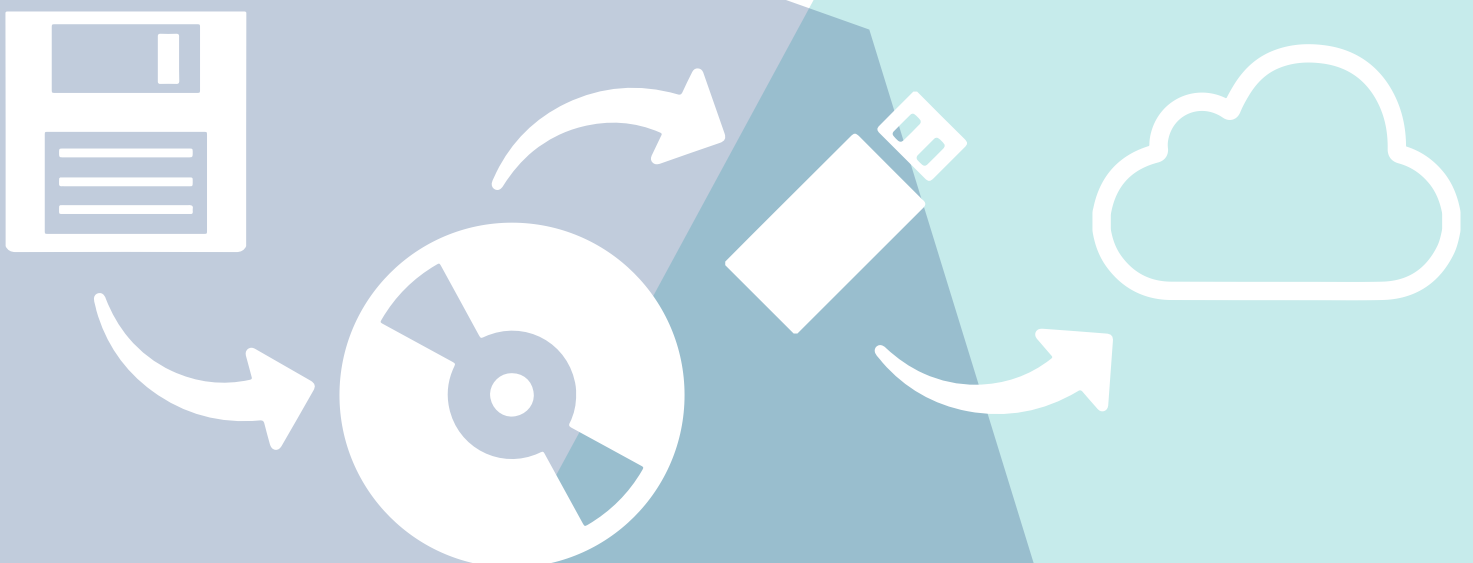
Many might see the vision of educational spaces where students only engage with technology in appropriate ways, where teachers have ample time to learn the technology themselves, and where the curriculum is centered on the integration of devices as a way of improving the learning outcome, as utopian ... or optimistic at best. It doesn't have to be. In this paper we describe a hierarchy of needs that may well determine the success of the 1:1 paradigm as a way *toward* that optimistic future. And we will conclude with detailing how new devices make this shift toward a robust 1:1 future not only possible, but likely.

Not surprisingly, this is good news. Almost all of the IT professionals expressed a baseline optimism. Chris, for example, said succinctly,

“1:1 would be amazing!”

The research, however, shows that having access to quality devices is only the first step in achieving successful outcomes. For decades, this first step often seemed insurmountable. Now, however, we are entering a period when access to devices is becoming a priority for educators while a competitive market place and key innovations are lowering price points. The first calculators were considered expensive in their day, though they did shrink both in size and in price until they were accessible to nearly every student. Today, we're seeing that same trendline with educational computers.

As affordability of educational devices improves, and as new device profiles—like devices designed for Windows 10 in S mode, as well as higher-end Chrome devices—enter the scene, the stage is set for the next big suite of decisions. As such, 2018 represents a pivotal moment to evaluate the necessary components to actualize the benefits of the 1:1 paradigm.



A Hierarchy of Needs | From Maslow to 1:1

The adoption of technology in educational spaces presents a challenge for stakeholders. On the one hand, for some students, the classroom may be one of the few places they can engage meaningfully with devices—beyond social media—to use them to improve learning outcomes. The availability of technology in the classroom could be essential to improving academic performance and improving overall digital literacy. It is no wonder that the National Educational Technology Standards and the Common Core State Standards (CCSS) include goals and assessments for digital literacy.¹

That said, for teachers and students to actualize the benefits from technology in the classroom there has to be real buy-in (both literally and figuratively). It does not do anyone any good to purchase devices that sit locked in a cabinet because the teachers do not believe the devices will actually help them with their curriculum. Likewise, until very recently, the cost of the devices themselves has often meant that stakeholders have to buy the cheapest device, even if that device is inadequate.

What we are describing here is the difference between having technology available and adopting technology in the classroom.

The difference hinges on notion of actualization. When we *actualize* the potential benefits of technology in the classroom, we move beyond the mere presence of technology to finding, developing, and incorporating the benefits of technology to improve learning outcomes. Access is a starting point; it does not guarantee actualization. What we

are grappling with is the difference between something that is necessary and something that is sufficient. Access to devices is a necessary component of the 1:1 paradigm, but it is not sufficient for achieving actualization of the 1:1 paradigm.

Thankfully, this paper is not the first to ponder the quandary of actualization. Many researchers have analyzed the differences between something that is necessary and something that is sufficient. One of the clearest analogies to our discussion of the 1:1 paradigm is Abraham Maslow's famous "Hierarchy of Needs." Maslow's theory, put forth in a 1943 article and developed into a book in 1954, was simple yet profound:

Every human has a basic set of needs that must be satisfied first before we can move on to worry about another set of concerns.^{2 3}

In other words, people who are worried about having access to food and water do not have the luxury of worrying about fulfilling their creative potential. Often depicted as a pyramid, Maslow theorized three basic categories of human behavior: basic needs, psychological needs, and self-fulfillment needs. Within each category, Maslow explained a series of motivations that occupy a person's interest until they have found fulfillment of that category. Once they have fulfillment, they can advance up the pyramid to a new set of concerns. At the top of the pyramid is self-actualization, where a person can focus on fulfilling their own potential.



Figure 1: Maslow's Hierarchy of Needs

The beauty of Maslow's Hierarchy of Needs is that it has helped generations of researchers, policy makers, scholars, and activists develop priorities. If a community does not have access to food and water, then satisfying those demands should take priority over investments in programs designed to develop the esteem of individual members of the community.

For our purposes, the key takeaway from Maslow's Hierarchy of Needs is that actualization only happens when all of the intermediary stages have been satisfied.

In other words, a person with food and water does not all of a sudden have self-actualization. Instead, a person's journey must take them through the

various stages of behavioral motivation that enable them to move up the pyramid. As a result, a person cannot "jump" to another level without having satisfied the demands of each of Maslow's categories.

The question we are engaged with here is this: what is the analogous hierarchy of needs that represents the path to actualization in the 1:1 paradigm, in which actualization signifies improved learning outcomes? In other words, are we assuming that access to devices (a "basic need" in Maslow's terminology) will automatically lead to actualization of the 1:1 paradigm? Our fear is that for too long people have assumed that access to devices was so prohibitive that few people considered what to do, beyond providing the devices themselves, to adopt the 1:1 paradigm and find actualization in the classroom.

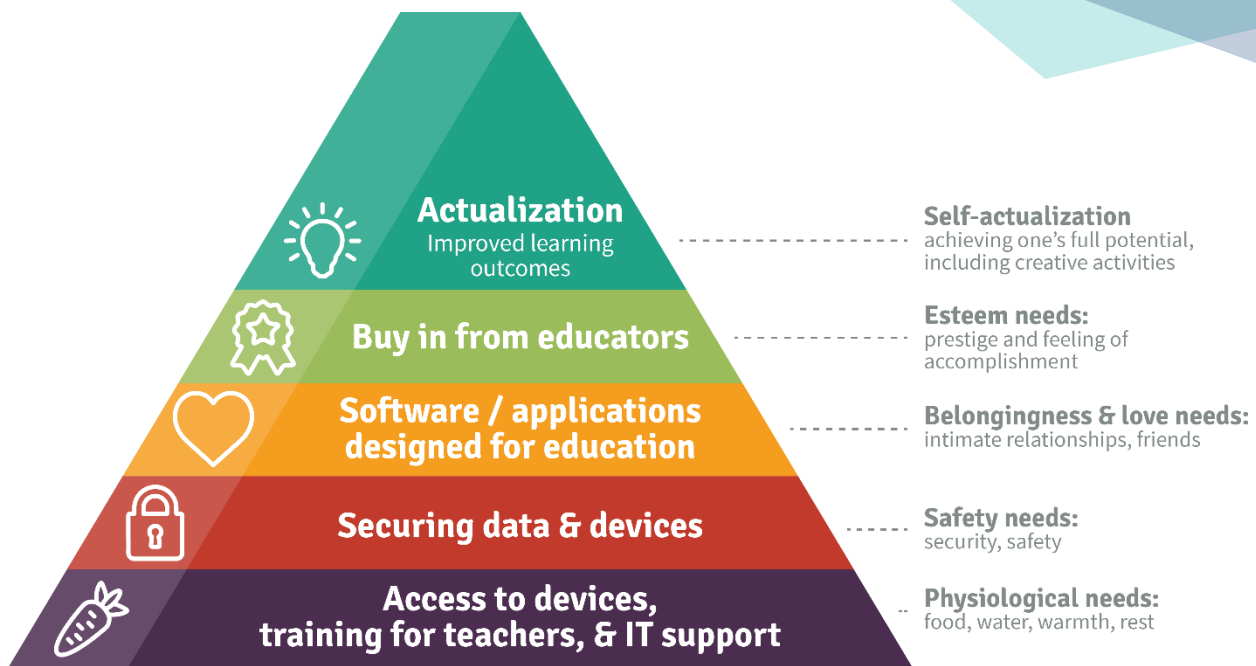


Figure 2: The 1:1 Paradigm Hierarchy of Needs



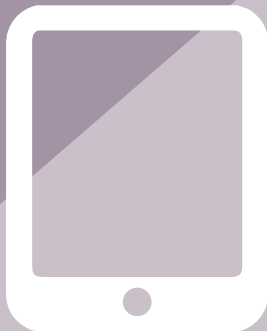
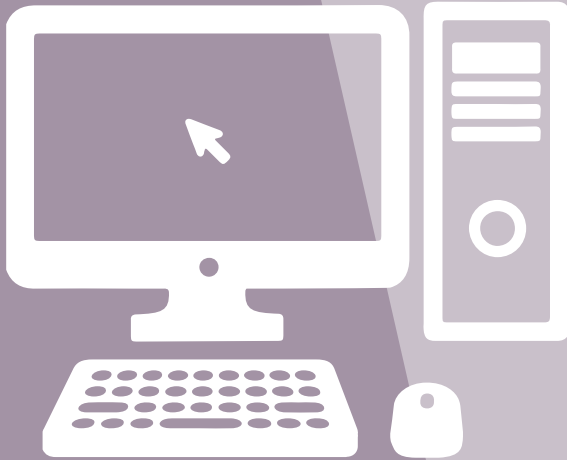
The Physiological Needs of the 1:1 Paradigm

ACCESS TO DEVICES, TRAINING, & IT SUPPORT

For Maslow, the most basic physiological needs dominate because a person cannot waste precious time and energy thinking about higher order issues like esteem when they are lacking food and water. The equivalent for the 1:1 paradigm is access to devices, which includes training teachers to use devices and preparing IT to support the use of devices. The 1:1 paradigm, where every single student has their own device, is often dismissed as impractical. What good would it do to have every student have a device if the teacher does not design a

curriculum to incorporate the devices and the school does not have an IT support plan?

As IT Professional Ellen from Virginia describes, “For the last five years our biggest problem has been access. Just not having enough. Our teachers would go to workshops, and they’d learn about this really great tool. And then they’d come back to school and say, ‘Oh, I can’t get laptops.’” That’s where the story ended for many schools, until recently.



Our research indicates that stakeholders from across the educational spectrum, from teachers to IT pros and even state and federal legislators, are increasingly supportive of the investments needed to overcome barriers and make the 1:1 paradigm a reality. According to the Department of Education,

“The United States government has spent billions of dollars for technology infrastructure in schools, and, as a result, the national ratio of students to instructional computers with Internet access has decreased to approximately 3:1...”⁴

One of the key barriers, device cost, has greatly reduced since conversations about the 1:1 paradigm began years ago. The market for education specific technologies has become fiercely competitive, reducing costs, and increasing focus on innovations for the classroom environment.

Additionally, scholars agree that technology is becoming such a ubiquitous part of our lives that full classroom adoption is becoming easier for everyone to accept. According to Cheung, Alan, and Slavin, “Technology has infiltrated every aspect of modern life. Classrooms are no exception. School districts across the country have been investing a substantial amount of their annual budgets on educational technology in an effort to boost academic performance in the past two decades.”

Beyond the investment in the technology itself, they find that “Many teachers now are more experienced and willing to use educational technology in their classroom instruction...” leading them to conclude:

“Undoubtedly, educational technology will continue to play an increasingly important role in the years to come. So the question is no longer whether teachers should use educational technology or not, but rather how best to incorporate various educational technology applications into classroom settings.”⁵

We agree with Cheung, Alan, and Slavin that the trend lines suggest that there is a real potential for the full adoption of the 1:1 paradigm and that now is the key moment to move the conversation beyond “can this be achieved?” to “what decisions do we need to make now to actualize the benefits of the 1:1 paradigm?”

As device costs continue to decline, a six year meta-study of educational technology indicates that there are two important challenges to the full and successful adoption of the 1:1 paradigm: teacher training and subsequent time for successful teacher adoption.⁶ According to the study, “Although it may appear intuitive that training and support needs to be a salient component for delivering an effective intervention program, the lack of mention of this design aspect in more than 55% of the studies sampled here suggests that training and instruction needs to be a greater focal point in design.”

This study, and others, demonstrate that we have approached an important moment in the discussion of the 1:1 paradigm, where we must focus on a new set of questions to ensure that the paradigm has an opportunity to live up to its full potential.

Research reveals that satisfying the basic needs of the 1:1 paradigm involves much more than access to devices: educators are not receiving the training they need to fully understand the technology, and

there is insufficient IT support for the teachers that do work to introduce the technology in the classroom. According to Caleb, an IT professional from Kentucky, “What we’re dealing with now is that we don’t have a really good means of actually instructing our teachers on how to integrate all these devices that we’ve given to the classes. That’s our current pain point—how do we actually teach the teachers how to use the technology?”

There is a real risk that the 1:1 paradigm won’t get off the ground as teachers struggle with adoption. Despite advances in device management through software like Intune for Education and Chrome Management Console, simply having the devices in the classroom is not enough. Access to devices, teacher adoption, and education IT support are necessary fulfillments to resolve the challenges confronting educators and educational technology on the most basic level.

Now is the key moment to move beyond to the conversation “can this be achieved?” to “what decisions do we need to make now to actualize the benefits of the 1:1 paradigm?”





The Safety and Security Needs of the 1:1 Paradigm

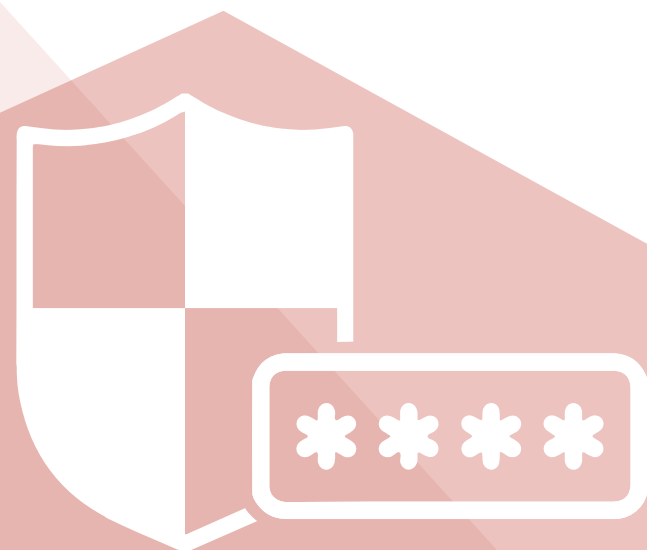
PRIVACY AND DATA STORAGE

For Maslow, food and water are the start, but security is the next basic need that must be satisfied. In the 1:1 paradigm, security is essential because we are talking about putting devices in the hands of minors. While the concern used to be limited to what the students might stumble onto using unsecured devices, a new set of security concerns have developed around the fact that students themselves may be providing access to their data.

“One perspective describes data as ‘the new oil.’ That analogy may work when the data in question relates to such things as commodity prices, the weather, or warehouse inventories. But when it comes to people, and students in particular, that perspective is troubling.”⁷

The concern for educators and administrators today is that we are approaching an inflection point that risks a collective back tracking on the growing support for the 1:1 paradigm. On one hand, all the trends show more and more technology use in the classroom. On the other hand, the qualitative and quantitative impact of these changes in the educational settings has not been as clear or as substantive as industry leaders would like. Additionally, there is a growing awareness at a social and cultural level that educational technology does not come free of opportunity costs. It is this last component, the potential invasions of privacy and the acquisition of student data, that present a new set of challenges to the 1:1 paradigm.

Dr. Chris Gillard outlines the tension between the breakneck speeds of innovation in EdTech with the increased reliance on data from students to make these innovations possible. He argues, “Predictive analytics, plagiarism-detection software, facial-recognition technology, chatbots—all the things we talk about lately when we talk about EdTech—are built, maintained, and improved by extracting the work of the people who use the technology: the students. In many cases, student labor is rendered invisible (and uncompensated), and student consent is not taken into account. In other words, students often provide the raw material by which EdTech is developed, improved, and instituted, but their agency is for the most part not an issue.”⁸



Dr. Gillard's concern is that,

“Increasingly, corporations, researchers, and colleges take it as a given that they are entitled to the extraction, retention, remixing, and continued use of that data—and we do not have adequate language or institutional policies in place to push back. When it comes to collecting student data, the notion of informed consent is simply not a part of the model. At every stage of our interaction with current digital technologies, consent is systematically stripped from people, often referred to as ‘users,’ in a telling bit of terminology.”

Although Dr. Gillard's critique is directed at higher education, the widespread adoption of the 1:1 paradigm will inevitably invite a deeper conversation about what, if any, rights students have to their data and what, if any, consent their legal custodians should give for their children to participate in the sharing of that data. After all, the majority of the college students that Dr. Gillard is referring to are legal adults.

Beyond the question of who owns the data, there is the concern about privacy and data breaches. Organizations ranging from credit bureaus to social media giants have faced data hacking despite huge investments in protecting that information. Actualization of the 1:1 paradigm relies, in part, on students having the opportunity to interact with networks that can introduce them to communities across the globe. Without a clear set of guidelines about data protection, the education technology industry risks a public relations disaster if they find themselves having to explain why sensitive information about minors was revealed or stolen. We can all imagine angry parents demanding to know

what steps were taken to ensure the safety of the data that was just stolen from their children.

If a backlash becomes more sustained or if these concerns for data ownership and privacy become more serious, then it is not unreasonable to assume that schools might simply decide that the risks are not worth the investment. School administrators facing tight budgets might rationalize that further investments in digital literacy, student familiarity with technology, teacher training, or technical preparation for higher education or the workforce should be given a lower priority because the risk of litigation issues associated with privacy and data storage are too high to justify the 1:1 paradigm.

Actualization of the 1:1 paradigm relies, in part, on students having the opportunity to interact with networks that can introduce them to communities across the globe.





The Love and Belonging Needs of the 1:1 Paradigm

SOFTWARE AND APPLICATION DEVELOPMENT

For Maslow, love and belonging are essential needs that must be satisfied once a person has met their demands for safety and their physiological well-being. Friendship, family, and human connections are essential because they help a person connect to something bigger than themselves and give meaning to a person's life. In the 1:1 paradigm, the specificity of software and applications for students in an educational environment shows that the devices have a specific meaning. The relationship between the devices and the educational space cannot go undefined or else the devices simply become glorified web browsers or notetaking machines. As Caleb, an IT professional from Kentucky, explains,

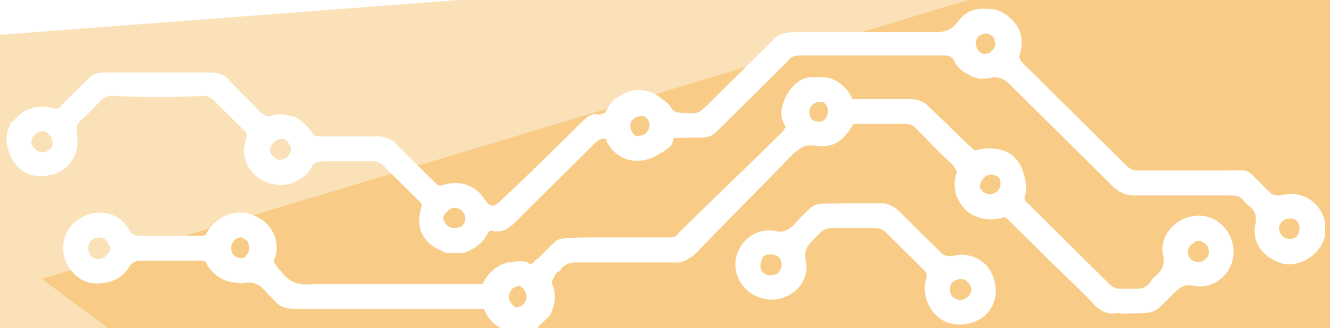
“In terms of deploying educational software or devices, typically deployment of devices is very easy, deploying of software is much more delicate.”

“I’m not necessarily an expert when it comes to showing a teacher how you can use software in

your classroom; that’s not necessarily my background. My challenge again is focusing on how I can bring in resources to do that, and especially now that I don’t have the money to do that. It’s very challenging,” said Caleb.

Unfortunately, new costs come into play when differentiating between a school’s devices and the unique software and apps those devices hold. Danielle from North Dakota explains, “When it comes to software, or programs, or apps, they often have a minimum licensing fee and we can’t come near that. So, it’s cost-prohibitive for us to utilize because we may have to buy four times the amount of licenses we would need to be able to do that. That’s where we have a problem.”

In a classroom where the first two components of the 1:1 paradigm hierarchy are fulfilled—a classroom is stocked with devices, teachers know how to use them, and IT is at the ready to help—actualization cannot occur unless teachers can successfully integrate specialized educational software or subject-specific apps into their larger pedagogical approach.





The Esteem Needs of the 1:1 Paradigm

EDUCATOR BUY IN

The Esteem Needs, like the Love and Belonging Needs, fulfill a person's psychological wellbeing requirements. It's not enough to love and be loved; to achieve actualization, we must feel as though we earned that love. In the 1:1 paradigm, educator buy-in is the equivalent to esteem.

Frank from Pennsylvania explains, "We can put everything out and we can get them anything that they want, but teachers are the ones that have to do it, they're the ones who are going to be in front of the kids, so that's probably the biggest challenge I think."

Educator buy-in is complicated. Educators must feel there is sufficient need to adopt technology, not only by completing necessary adoption trainings, but spending the time to find a place for the technology within their curriculum. If they don't see a need, why commit to the work needed to fully adopt the technology? "I have a few teachers who are completely resistant. And they say, 'My test scores are good, why should I change anything?'" said Ellen from Virginia.

Like esteem, educator buy-in deals with notions of respect. Integrating technology into existing curriculums, or developing new curricula, is time-consuming work. Educators who do not feel supported in this work are less likely to do it. Likewise, education IT professionals must feel supported to provide the training and technical support to teachers.

Without buy-in from educators or education IT professionals, the esteem need is not met, and actualization—improved learning outcomes—cannot occur.

Barbara from North Carolina explains the need for buy-in from leadership:

"The challenge has been getting the respect, and the input, and the inclusion from my principals. He said, 'Now I want to meet with you, so we can go over our vision of a technology plan for our school.' And we've never met."



Buy-in also means confidence. When teachers are familiar with technology, they are able to apply it to teaching in ways that are creative and effective. “I don’t necessarily think that kids learn better because technology exists. I think that it allows educators to look at things in different ways and push kids to think and express themselves in different ways. And when they do that, the learning is deeper and more meaningful,” said Susan from Connecticut.

Scott from Texas offers another view—of the explicit need for educational IT professionals’ buy-in, as well.

“I would say that the most important thing that helps us be an innovative district is the fact that curriculum and instruction work hand in hand with all major decisions and most minor ones. If a teacher says, ‘Hey, I want to use this specific software,’ our principal doesn’t just say, ‘Yeah, go ahead.’” She brings me in on the decision to say why wouldn’t we want to do this, or what would be the benefit of it. And I can provide that feedback.”



Actualizing the 1:1 Paradigm

WHY LEARNING OUTCOMES ARE AT THE TOP OF THE PYRAMID

Everyone and everything in education is being measured on learning outcomes. Calls for increased assessment have led administrators and teachers to search for ways to gain whatever advantage they can in moving the needle on learning outcomes. In the same way that calculators freed up time for teachers to focus on more advanced mathematics, stakeholders today are hoping that a wider adoption of technology in the classroom can improve learning outcomes.

Decision makers are increasingly pointing to the 1:1 paradigm as a way of helping improve key learning outcomes. This comes at a time when everyone from parents to tax payers to school administrators are demanding that educational institutions prove they are improving learning outcomes.

The definition of “learning outcomes” varies from stakeholder to stakeholder, but in almost every case there is the potential for technology to help. Our research indicates that for some stakeholders, learning outcomes are about developing measures to determine how students are retaining information and the ease with which they can recall and apply it in a given situation. For others, learning outcomes are about teaching students how to think critically and develop the habits of lifelong learners. Interestingly, our research indicates that IT Professionals and educators have a similar view of learning outcomes and the role technology can play in helping improve them.



For example, an IT professional, Scott from Texas, articulated that “Our goal with learning outcomes is that the kid truly understands the content, knows how to apply the content, and can extend that learning in real-world circumstances.” Scott’s definition is very similar to an anonymous teacher who wrote that learning outcomes “means that the students show through writing or verbally what they have learned, how to apply this to real life and whether they were engaged and connected to the subject matter.”

In both situations we find the stakeholder emphasizing the need to determine both what the student

has actually learned *and* whether or not they can apply that knowledge beyond the traditional classroom. IT professional Susan from Connecticut summarizes the connection succinctly:

“Access to certain technology can definitely improve your learning outcomes if it helps you to immerse yourself in what you’re learning. And I think that technology could help kids share what they know in different ways.”

Technology has the potential to radically change learning environments so that students can continue to learn well after the last bell has rung. Scott explains,

“...if we’re going to integrate technology into the classroom more and give kids the opportunity to learn outside the class and extend that learning at home, but they don’t have the access to do it, then they’re not going to enjoy it as much, or they’re not going to be as productive at school because they didn’t have the opportunity to extend that learning at the house.”

With the right technology in place, students can transition from outmoded conceptions of busy work to integrated learning that extends beyond the classroom environment. Silvia, an IT professional from Brazil, summarizes, “The main thing with technology that really improves student’s outcomes is that they learn that learning is something nice and fun. We want to give them the sense that they have to be a lifelong learner, and with technology their learning process is bigger than the classroom walls.”

The phrase “beyond the traditional classroom” has also evolved as stakeholders now see the global implications of student learning outcomes. There is an increased emphasis on digital citizenship as a way of teaching our students the privileges and obligations they have as global citizens. It is no longer the case that educators conceive of “beyond the traditional classroom” as a reference to the local community where students live and play when they leave school. We now find that as devices are connecting students to the global community that there is an increased emphasis on teaching how students should think about, interact with, compete against, and respond to global communities.

IT professional Lucas explains this new emphasis like this:

“We’re really putting a big push on digital citizenship. We’re trying to teach what’s good etiquette online and what it is to be a good citizen, and we’ve actually found a comparison with what is being a good citizen and what is being a good digital citizen and how it kind of lines up across what it means to be both.”

The notion of global digital citizenship is so pervasive that there is strong support for making sure that all public school students have internet connectivity through programs like the 2013 ConnectED initiative which aims to ensure 99% of public school students are connected to the Internet at school by 2018.⁹ Digital citizenry as a learning outcome also strengthens our analogy to Maslow’s hierarchy. Logically, once more pressing needs are taken care of, teachers and students can get to work on themselves as citizens.

Educators, IT professionals, and school administrators are all working to improve learning outcomes in the age of global connectivity. The key is that we work now to build the necessary components of the pyramid to ensure success. As IT professional Caleb from Kentucky reminds us, “There’s a difference between teaching the child math and teaching them how to use an app. When we talk about the difference in technology, it can be a double-edged sword, because if you’re not doing it well, then you’re not actually helping to teach the kids, you’re just teaching them how to use the technology.”

Educators, IT professionals, and school administrators are all working to improve learning outcomes in the age of global connectivity.



Fulfilling the 1:1 Hierarchy of Needs

In other words, it's never been more important to make the decisions that will help actualize the promise of a 1:1 future. In 2015, one in five American students attended a 1:1 school. Of the roughly 20 percent of students who were provided with a device to use as their own throughout the school year, the most common devices provided were Chromebooks, iPads, and Windows devices. Too often, the decision of which devices to supply have more to do with personal preference or short-term budgetary calculations, which results in a more myopic perspective than might be warranted. As a result, it sometimes doesn't facilitate improved learning outcomes. By focusing on the hierarchy of needs outlined above, we believe schools can make smarter decisions.

So what is the current state of device options?

One of the most common operating system in education is Chrome OS, which works as a closed ecosystem. The devices tend to be inexpensive and cheaply made, and the OS is designed for web applications accessible via the Chrome browser. Google has historically found significant success with this option, as it fits well with budget-conscious schools and its more limited ecosystem is significantly easier to manage than a more open ecosystem in which any program can be installed independently.

As such, Chrome devices do well in the bottom two layers of the pyramid, albeit with some qualification. The devices themselves tend to be less durable, which compromises access, and historically, they've been very low end, which means that the quality of hardware isn't there to support a broader range of applications. That is why Chrome OS gets more problematic from the perspective of

the hierarchy at the third layer, where the quality and range of applications live. If we think about the sorts of applications and skill sets we would link to digital literacy for today's generation of students, the capacity to do photo and video editing, for example, might prove too taxing for many of the Chrome devices. In addition, G-suite for education offers solid functionality and a light footprint, but it is missing essential features that are useful in higher education and in the workplace (automated reference management, more robust spreadsheet functionality, etc.). Teacher buy-in appears to be strong, but research has recently suggested that the relative lack of familiarity with the Chrome OS outside the classroom¹⁰ is more likely to have teachers feeling like they have insufficient time to incorporate technology in their classroom.



Some of these concerns are addressed by the introduction of higher-end Chrome devices, which will help to address concerns that currently impede overall actualization of learning outcomes.

The second most common device OS, Windows, has had its own share of challenges. Schools have been moving away from Windows 7 for a while, often turning to Chrome because of the vastly simpler way of managing identity and device deployment. With Windows 10, and Intune for Education, many of those gaps have been addressed by Microsoft, and now schools have the option of two robust modern device management solutions.

Windows 10 is a much more robust operating system than Chrome OS, and that offers definite functional advantages. The ability to install specific third-party programs that are useful for science courses, experiments, or coding libraries, for example, make Windows far more ideal for more advanced educational needs, which is why many schools still deploy Windows devices in specific contexts even when they have embraced a wider Chrome device distribution.

But what is a feature for many can be a challenge for some.

The same robust functionality and open architecture that makes Windows 10 so valuable also invites additional risk, from students installing or using programs they should not, to more complicated device management. Microsoft recently addressed many of these concerns with the development of their S mode functionality, which puts Windows 10 into a more secure mode that limits the ability to run or install certain types of programs, and that simplifies many of the device deployment and management processes.

Given the hierarchy we've outline here, Windows 10 in S mode represents a significant step forward. Let's start with the physiological needs of the 1:1 hierarchy, namely accessibility. Windows 10 in S Mode exists on a range of PC devices starting from some of the lowest price points on the market. A variety of school-friendly Windows 10 in S-mode laptops and 2-in-1s can cost as low as \$189. Compare that to the cheapest Chromebook, which costs \$179. Like the calculator in the 1970s, a robust marketplace and continuing technological innovation ensures that devices that started as prohibitively expensive for all but the richest of schools are now becoming more affordable.

A robust marketplace and continuing technological innovation ensures that devices that started as prohibitively expensive for all but the richest of schools are now becoming more affordable.

One of the interesting side benefits of Windows 10 in S mode devices is improved reliability. Because of the limitations placed on x86 programs, the devices run more optimally: teachers won't have to worry that devices won't boot up right away, or that students will need to idle while updates take up valuable class time. Start-ups in S mode are quick and secure and, if your devices are being managed by mobile device management software like Intune for Education, updates can be scheduled during off time. In addition, the modernized code library for applications within the Microsoft Store are much more effective at maintaining battery life, so the device will be less likely to lose battery longevity as result of repeated use.



Windows 10 in S mode devices fulfill the next level on the pyramid as well: the safety and security needs. All Windows 10 in S mode devices are equipped with the same built-in security as all Windows 10 devices. That means every app downloaded from the Microsoft Store, from Spotify to

Evernote, is Microsoft-verified for security. Windows 10 in S-mode's default browser, Microsoft Edge, offers protection for students against phishing and socially-engineered malware. Edge offers more security features that either Chrome or Firefox. To that end, achieving the safety and security needs of the 1:1 hierarchy doesn't just mean protecting students against external threats: it means ensuring their data isn't captured, catalogued, and exploited for future sales. As Dr. Chris Gillard explains earlier in this paper, the 1:1 paradigm presents a major psychological roadblock for parents and teachers aware of the dangers of unfettered access presents to their children. Microsoft has and continues to preserve students' privacy.

The love and belonging needs of the 1:1 hierarchy are obviously not fulfillable by a device alone, but the capabilities of the chosen 1:1 device does matter.

The Microsoft Store offers thousands of apps that can provide students with the meaningful educational experiences are essential in improving learning outcomes, sure, but the real benefit is that Windows 10 in S mode has both online and offline capability, which ensures students who do not have home Internet can still work on their devices outside of school.

The esteem needs of the 1:1 hierarchy, like the love and belonging needs, cannot be entirely fulfilled by the functionality of the device itself. But since educator buy-in—the crux of the 1:1 esteem needs—is so important, Windows has an advantage in that research suggests that more than 70% of educators are more familiar with Windows as an operating system outside of the classroom than they are any other OS.

The advantages of Windows 10 in S mode are not insurmountable for Google and their Chrome devices, but it does require that Google do more than coast on their low-end device strategy if they really want to play a role in improving learning outcomes, rather than merely ship devices. Investment in Chrome OS as a viable device OS outside of the school environment, for example, could do much to improve OS familiarity among educators and administrators. Exploring higher-end configurations optimized for particular sets of curricular needs would boost functionality, and potentially resolve some of the concerns over durability.

Most significantly, in the wake of the European Union General Data Protection Regulation (GDPR) and a variety of legal challenges, Google could commit to a more robust protection for student data, before it becomes a legal or policy issue imposed upon schools. There is an opportunity for Google

to join Microsoft in doing more to protect the data and privacy of school-age children, rather than merely waiting and reacting to changing legislative realities.

In the meantime, the best thing about the introduction of Windows 10 in S mode is that it provides an alternative that is, from the perspective of actualizing learning outcomes, ideally situated to address the hierarchy of needs outlined in this research. In so doing, we hope the new, more robust sense of competition pushes Google to evolve its Chrome approach to educational devices and its perspective on data. If that happens, and if Microsoft continues to up its own contributions, schools and their students are likely to enjoy the biggest benefits.



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