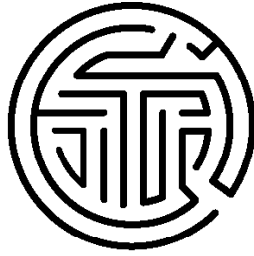




**A STUDY ON THE EFFICACY OF
A THIN CLIENT SCHOOL
TECHNOLOGY
INFRASTRUCTURE**

EXECUTIVE SUMMARY



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CENTER FOR CHILDREN & TECHNOLOGY

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INTRODUCTION

This report presents findings from an evaluation of a thin client networking system developed for schools by ClassLink Technologies. The evaluation was conducted by the Education Development Center's Center for Children and Technology (EDC/CCT) in three urban schools from the same school district with comparable student populations. One school uses a ClassLink thin client network and the other schools have variations of Local Area Networks (LAN). One school's LAN has a mobile wireless component (identified as LAN 2), and the other uses a more typical LAN model with no wireless component (identified as LAN 1). The three infrastructures were evaluated in terms of their ability to enable classroom and schoolwide network management, and to allow for timely and cost-effective maintenance and upkeep.

The report draws on key findings from teacher and student surveys conducted in three schools, and on interviews with students, teachers, technology coordinators in each school and with district leaders in curriculum and technology.

Our evaluation indicates that ClassLink's thin client infrastructure provides considerable benefits to schools in which learning depends on a healthy, flexible technology infrastructure.

- We found that the thin client infrastructure *makes it easier to effectively maintain and troubleshoot the network. Consequently, technology-support staff is freed to concentrate on providing pedagogical assistance to teachers.*
- Teachers in the thin client school reported fewer problems in a number of key areas where technical difficulties can impede teachers' abilities to use technology with their students. *The thin client infrastructure makes it easier for teachers to implement effective technology-supported pedagogy.*
- Finally, the thin client model *eases some of the maintenance- and obsolescence-related costs that can make technology infrastructure a significant burden to school budgets.*

A brief overview of the three subject infrastructures

1) **The thin client school.** This server-based infrastructure is designed with an emphasis on expanding accessibility to the network beyond classroom or school boundaries, and on consolidating resources on a central server. A thin client (these will be referred to as "thin clients" or "thin client terminals") is a small hardware device replacing the traditional CPU that connects to a monitor and a keyboard. Thin client terminals connect to the central server where all the network's software is stored. Individual computer stations function as outposts of the central server. Through a password-accessible account, students, teachers, and administrators can store and access saved documents, personal settings, and a ClassLink email account on the server. Because all files and programs are stored centrally, users can access their work from any computer on the network. In addition, the school's ClassLink network is password-accessible via

the Internet and can be accessed from any Internet-ready computer (at home, the library, etc.). In addition to its thin client terminals, the school we studied has many full-fledged computers and two classroom sets of wireless networked laptops. While almost all of these have been converted to Classlink terminals, they can also be taken off the network and used as individual machines with CPUs and hard drives.

- 2) **LAN 2 school.** This LAN infrastructure is designed to allow flexible deployment of hardware and a maintain network accessibility throughout the school building. The mobile LAN model combines a hardwired LAN of desktop computers with multiple carts of wireless laptops that can be wheeled into any room, allowing teachers to have 10 to 20 additional machines in their classroom for technology-enabled lessons. These laptops connect to the network via a wireless networking system. All computers and printers in the building connect to the same network and can access the central servers. Software is run from individual machines, but students and staff save their work to a folder on the network that is accessible from anywhere in the building.
- 3) **LAN 1 school.** Like many schools, the typical LAN school developed an extensive infrastructure over many years and thus has multiple generations of machines and processors with diverse capabilities as well as multiple versions of software. Software is housed on individual machines, and while students and teachers can save their work to network-based folders, these folders are not always accessible building-wide.

KEY FINDINGS

Infrastructure and network management

The thin client model can significantly reduce the time technology-support staff spends on troubleshooting and maintenance, freeing time for pedagogical support. Technology coordinators and staff have multiple responsibilities – troubleshooting, upkeep and renewal of infrastructure, and pedagogical support. Because they are urgent and require short-term action, troubleshooting and upkeep responsibilities can usurp the majority of technology staff's time. This is the case in the LAN 1 school, where the technology coordinator reported spending the majority of her time on these tasks, with a backlog of requests that creates a week's delay for "most repairs." In the thin client school, the technology coordinator reported that her centralized network frees her from devoting her time to troubleshooting and routine maintenance: "Because of thin client I'm able to do my administrative [work]. If we do any software installs, for example, thin client does it on the server.... I [also] do a lot of development work here because thin client has freed me to do that."

Thin client teachers and students report a high level of satisfaction with the technical support they receive. One hundred percent of teachers in the thin client school rated the effectiveness of technical support as "good" or "excellent"; 91% rated the timeliness of technical support as "good" or

excellent.” These numbers are comparable to responses in the other two subject schools (see Table 1); what is notable, however, is that teachers in the thin client school reported these high levels of satisfaction while the technology coordinator reported spending less time on technical support than she did before the thin client model was implemented. The thin client model allows the technology support staff to supply timely and effective technical support in less time.

TABLE 1. HOW EFFECTIVE AND TIMELY IS TECHNICAL SUPPORT?

Infrastructural model	Timeliness: (% good to excellent)	Effectiveness (% good to excellent)
Thin client school	91%	100%
LAN 1	92%	97%
LAN 2	93%	96%

When students were asked a question related to technical support about the frequency of computer breakdowns, only a small percentage of students (2%) in the ClassLink school felt the computers were often broken.

TABLE 2. STUDENT PERCEPTIONS OF HARDWARE PROBLEMS

	How often are the computers in your classroom broken? (% often)
Thin client school	2%
LAN 1	14%
LAN 2	32%

Infrastructure and management of student work products

Teachers in the thin client school report that they experience markedly fewer instances of several important technology-related problems that can impede technology-supported work with students.

The thin client system enables teachers and students to easily manage student work. Teachers in the thin client school felt notably more confident that students can manage their work on the network than do teachers in the other schools we studied. Only 5% of thin client teachers reported that their students “often” have trouble saving their work, compared to 21% in LAN 1 school and 27% in LAN 2 school. Only 2% of thin client teachers reported that their students “often” lose their work, compared to 21% LAN 1 school and 15% in the mobile LAN 2 school. Lastly, only 10% of thin client teachers reported that their students “often” have trouble keeping track of revisions, compared to 21% in LAN 1 school and 27% in LAN 2 school. The students’ perceptions mirror that of the teachers. Eleven percent of sixth grade students using thin client report “sometimes” or “often” having trouble keeping track of revised work. Student in the other environments reported rates of 57% and 46% experiencing problems with revisions. Only 2% of the stu-

dents in the ClassLink environment report “often” losing their work, compared to 15% and 35% in the other environments.

TABLE 3. STUDENT PERCEPTIONS OF PROBLEMS SAVING AND RETRIEVING THEIR OWN WORK

	How often do you have trouble keeping track of revised computer work? (% sometimes or often)	How often does work get lost? (% sometimes or often)
Thin client school	11%	2%
LAN 1	57%	15%
LAN 2	46%	35%

Classwork in the thin client school was less often delayed by infrastructure and network-related problems. Teachers in the thin client school reported fewer delays in accessing the school server. Only 6% of ClassLink teachers report often having trouble logging on to the server compared to 14% and 26%. Ten percent of teachers in the ClassLink environment feel the server is often slow compared to 17% (LAN 1) and 33% (LAN 2) in the other environments. Ten percent of ClassLink teachers reported frequent printing problems compared to a low of 5% in LAN 1 schools and a high of 16% in the LAN 2’s environment.

Students’ work was less “often” hampered by technology-related problems. Sixty-eight percent of thin client teachers said that students “seldom or never” hand work in late due to technical problems, as opposed to 58% in LAN 1 school and 49% in LAN 2 school. Additionally, only 4% of thin client teachers said they “often” had to deal with student work created on one platform (Mac or PC) that would not open in another, as opposed to 16% in LAN 1 school and 12% in LAN 2 school. Working across multiple versions of the same software was also less of a problem in the ClassLink school. Only 5% of thin client teachers said they “often” had problems with student work created in one version of a software product that would not open in another version, as opposed to 16% in LAN 1 school and 20% in LAN 2 school.

Teachers made use of some but not all of the thin client network’s potential to facilitate communication beyond the classroom. Fifty-six percent of teachers in the thin client school said they access the network from home – a markedly higher rate of home-to-school interaction than at the typical LAN 1 school (13%) or the LAN 2 school (38%). However, thin client teachers were not yet tapping into the network’s potential to enable communication with students and parents via email. Eighty-nine percent of the teachers said they “never” or “seldom” exchange email with individual students; 82% said they “never” or “seldom” use email to contact students’ parents or guardians; and 97 and 99% said they “never” or “seldom” use email to assign or collect homework from students.

Centrality and accessibility may increase the likelihood of certain network-related problems. Both thin client teachers and teachers working with the wireless LAN reported a higher frequency of

students accessing and tampering with each other's work. Thirteen percent of thin client teachers and 15% in the LAN 2 school said that student work is "sometimes" or "often" stolen or copied by other students, as opposed to 10% in the LAN 1. Twenty-two percent of the teachers in the LAN 2 school and 16% of thin client teachers said that student work is "sometimes" or "often" tampered with by other students, as opposed to 10% in the LAN 1 school.

Storage space remains an issue. Fewer (64%) thin client teachers said they "never or seldom" run out of space to save student work than did teachers in the typical LAN school (81%) or the LAN 2 school (78%).

Infrastructure and the school budget

The thin client system appears to lower maintenance and hardware replacement costs, freeing funds for professional development. Because the thin client system runs software off the central server, older computers with out-of-date CPUs can still function as effective workstations and technical problems can be centrally serviced. The technology coordinator in the thin client school – who is responsible for the school's technology budget – reported that the low cost of maintaining this centralized infrastructure has allowed her to allocate funds toward professional development: "[M]y repair bill has gone down really low because of thin client. The hardware doesn't suffer as much.... Teacher training is where my money goes."

The thin client system can be supplemented by full-capacity computers to create an infrastructure to serve all of a school's needs. The ClassLink desktop is a Microsoft Windows-equivalent operating system that runs a vast array of software but does not support non-NT compliant software. One solution to this problem is to maintain a complement of full-capacity computers that can run on the network as ClassLink terminals and be taken off-line to run non-ClassLink-supported software. Creating this balance of inexpensive thin client terminals and full-capacity computers is this district's strategy for reaping the benefits of thin client's centralized infrastructure while maintaining access to educational technology not supported by the ClassLink system.

CONCLUSION

The thin client network offers significant advantages over other infrastructural models in its ability to support an effective technology-rich learning environment. By simplifying the work of maintaining and troubleshooting hardware and software, the thin client network allows technology-support staff to concentrate on providing training and professional development to teachers. By making it easier for students and teachers to organize and access technology-supported work, the thin client network enables teachers to use technology effectively with their students. The thin client network also appears to decrease the cost of maintaining the network and dealing with hardware obsolescence.