IMPLEMENTING ICT-SUPPORTED TEACHER PROFESSIONAL DEVELOPMENT

UNDERSTANDING CHANGE: TYPES OF "ADOPTERS"

Understanding Change

IN THIS SECTION

The change associated with ICT is rapid and dramatic. In contrast, people and organizations tend to resist change or embrace it slowly. This tension demands the presence of a school-based or local "change agent"[6]. School leaders and on-site support staff (or "follow up" persons) can best help teachers—and lessen their own frustration—if they understand the change process. With this in mind, the following points should be kept in mind when implementing ICT for teacher professional development projects

- Not every teacher will react to an innovation (ICT, a new way of instruction) in the same way—some will embrace the innovation; others will reject it. In working with teachers, it is important to understand that there are "change types" who will exhibit similar patterns of behaviour toward a proposed change. Of course, not every person falls neatly into such categories but knowledge of such change types is useful.
- Even if teachers *want* to use computers or radio for instruction, they will approach this use with a number of concerns. The concerns vary in stages from how something (e.g., radio) affects them (*self concern*) to how they can use it (*management*) to how it fits with their teaching (*adaptation*). By identifying the teacher's level of concern, the support person better target assistance to the teacher. For example, if one teacher is concerned about management of 80 students and 4 computers, the support person must work with the teacher to address these management issues. If another is concerned that the radio teacher will usurp his authority in the classroom, the support person must work on allaying these concerns.
- Teachers' concerns will change in response to each new innovation or each incremental change in innovation.[7] The more dramatic the expected change, and the more intense the teachers' concerns, the more help they will need.
- Teachers' concerns around an innovation and their willingness to use it depend upon a number of factors:
  - *Complexity:* A teacher may feel more anxious about a computers, which is a complex tool, versus a radio, a simpler tool.
  - *Support*: Teacher ability to implement an innovation depends upon the amount of available support.
  - *Expectations*: The more dramatic the expected change, and the more intense the teacher concerns and the more help teachers will need.
- If ICT use is kept simple, expectations are modest, and ongoing support is provided, teachers are more likely to implement innovations at the school level.

The process of change is long and protracted (some research points to three to five years for change to occur). In creating and conducting professional development programs, it is important to be able to identify and understand change "types" in order to set realistic goals for TPD. As the table below illustrates, a small percentage of people are *innovators* and will jump on board any innovation. A slightly larger group (*resistors*)

6 This is the term used by Hord, S., Rutherford, W.L., Huling-Austin, L., & Hall, G.E. (1987). *Taking Charge of Change*. Austin: Southwest Educational Development Laboratory.
7 Hord, S., Rutherford, W.L., Huling-Austin, L., & Hall, G.E. (1987). *Taking Charge of Change*, p. 54. Austin: Southwest Educational Development Laboratory.

Innovators
These are people who, by nature, always want to try new things. They like to be at the front of the process and embrace innovation.

Innovators *are a small percentage of any group.*

Early Adopters
These are people who are typically opinion leaders. They have the respect of their colleagues and other teachers. These influential people are not as adventurous as innovators, but typically keep track of new ideas and initiatives to see what might be worthwhile. If they decide to use ICT, their opinions and actions will influence others around them.

Though not as small in number as innovators, ***Early Adopters*** are also a small percentage of any group.

Early Majority
These people are a bit more conservative than the early adopters. They are "deliberate." They adopt new ideas just before the average member of any group does, but don't tend to keep track of ideas and initiatives that might be new and exciting.

Early Majority comprise a significant portion of any group.

Late Majority
Late majority people go along with a change, not out of belief, but out of necessity or inevitability. They are concerned about doing a good job according to existing standards and methods, so they are slow to risk of a new approach.

Late Majority represent a significant portion of any group (typically one third).

Resistors
Resistors are highly resistant to and never accept change, preferring the status quo. A program may not be able to impact such people or may impact a small percentage of them, and then only in a marginal way.

Resistors *are a small, but often very influential, percentage of any group.*

will simply refuse to embrace whatever change is being promoted. Most people fall in the middle of these two positions as *early adopter, early majority* and *late majority* types.

This schema is not fixed in stone. Individuals can fall into different categories for different innovations. A teacher may be an *early adopter* of IRI but a *resistor* when it comes to computers. The rate of change is impacted by ease of use and the available support.

Even though innovators may be most likely to embrace change, they are **not always** the best models for other teachers who may think that the innovators are too innovative, different, or talented to be emulated. Instead, teachers are often more willing to follow the example of the early adopters, who are often considered reliable barometers of the validity of innovations and also tend to be faculty leaders in other areas.[8]

COMPUTERS IN CLASSROOMS OR LABS?
Getting Computers into Classrooms

Computers are only valuable when they are being used. Teachers will only use computers when they are available, in proper working order, and when they are seen as *adding value* to their regular scope of work.

The eventual goal of any TPD project focused on *integrating* computers into teaching and learning should be to place computers in teachers' classrooms. This is the most effective way to help teachers and students to integrate computers into the learning process and indeed to transform that process itself. However, the notion of computers in classrooms may be viewed with alarm or with overt skepticism because of the many logistical, instructional and physical challenges that such an idea raises.

8 Dimock, K.V., Burns, M. & Heath, M. (2001). *Applying Technology to Restructuring and Learning: How Teachers Use Computers in Technology Assisted Constructivist Learning Environments*, p. 55. Austin: Southwest Educational Development Laboratory.

What are some of these challenges?

- **Infrastructure**
  Providing electricity and security for classrooms. Many schools, especially traditional structures, cannot accommodate computers.
- **Security**
  Equipment may break or be stolen.
- **Classroom management**
  How can teachers distribute use of 5 computers among 75 students?
- **Instructional**
  How can teachers use computers to improve student learning?
- **Conceptual**
  Computers in classrooms contravene dominant paradigms of ICT as a separate area of study in the curriculum

	Well suited to:	Considerations
Computer labs	• Traditional instruction • Computer-aided instruction (drill and practice software) • Easy maintenance and security • Lower capital and recurrent costs[9] • Equalizing access (everyone can use the lab) • Good for teaching ICT skills	• "Pull" factor: Teachers must bring students to the computer lab. • 45-60 minutes per week access to a computer does little to enhance teacher and student ICT skills • Integration of ICT into subject areas is difficult with labs (lab is "booked" and classes must wait to use computers) • Labs tend to focus instruction on "one size fits all" approach • Skills instruction tends to be divorced from content • "Tragedy of the commons:" Keeping ICT in a lab makes computers the private domain of lab manager or teacher and removes responsibility for their care and use from classroom teacher • With 1:1 student to computer ratio, students tend to interact with computers instead of collaborating with classmates • Once the novelty wears off, teachers may be less inclined to bring students to lab
Computers in the classroom	• Integration of ICT into subject areas • Learner-centered instruction • Many schools in developing countries have successfully integrated computers into the classroom (e.g., public schools in Latin America, the Caribbean) • Provides anywhere anytime access to ICT • Enables much greater use of ICTs for "higher order'" skills (fewer computers in classrooms may enable even more use than greater numbers of computers located in separate computer labs[10]). • Ever-present physical reminder that computers must be used (students will agitate for their use.)	• "Push" factor: Computers are brought to teachers and students. • Must be more than one computer in a classroom. If only one, teacher tends to regard it as his/her private property. • Adding computers to classrooms alone does not ensure improvement of student achievement. • Intensifies importance of professional development and on-site/local technical support • Teachers need to learn to use and integrate technology in their classrooms. This process results in changed beliefs about how to improve students' understanding, competence and performance.[11] • Typically more expensive than a computer lab

9 A McKinsey & Company study, found that classroom model with a computer for every 5 students and a high speed T-1 connection would cost about four times as much as computer lab model in up-front investments and a little more than 3 times the per student recurrent cost. Project analysis in Egypt found that significant economies of scale were possible if larger laboratories were used. See Bakia, M. *The Costs of Computers in the Classroom: Data from Developing Countries.* In *TechKnowLogia* 1 (4). Available: http://www.techknowlogia.org/TKL_active_pages2/CurrentArticles/main.asp?FileType=HTML&ArticleID=370
10 InfoDev. (March 2005). *Knowledge Map on Information & Communication Technologies in Education Topic: Impact of ICTs on Learning & Achievement.* Available: http://www.infodev.org/files/1152_file_KnowledgeMap_ICTsEducation_impact.pdf
11 Sandholtz, J.H., Ringstaff, C., Dwyer, D.C. (1997). *Teaching with Technology: Creating Student-Centered Classrooms.* New York: Teachers College, Columbia University.

Arguments against computers in classrooms have been used in every country where classroom integration of computers has been proposed. Solutions to infrastructural and financial challenges—including security, electricity, and even the cost of hardware—can in many cases be found through proven alternatives. Instructional issues—ranging from how to manage use of a few computers in a crowded classroom to how to properly integrate computers into teaching and learning—are *better* addressed when computers are readily available in classrooms than when access is restricted to computers labs.

Research demonstrates that when it comes to technology *less can be more*: A smaller number of computers placed in classrooms can be used more effectively for teaching and learning than *more* computers in a computer lab. Teachers and students are more likely to improve their technology skills when they have immediate and frequent access to technology and when it is used in the service of a curricular task.[12] Students can explore, conduct research, write reports, and create presentations, all within the context of a particular subject area. And because computers can allow students to learn in a variety of ways, computers in classrooms can move instruction away from a passive, teacher-centered model of instruction to one that is more conducive to student problem solving, written communication, and creativity—skills identified as necessary for 21st-century success.[13]

Computers in classrooms demand space, suitable infrastructure, and a secure environment (burglar bars) all of which add to cost and may be difficult to introduce on a large scale. Most schools likely do not have the facilities to permit a computer anywhere, least of all in classrooms. But some schools do have such facilities, or could create such upgrades. Therefore, policymakers can begin with these schools in a phased in basis, over a period of several years. This may be accomplished through the following strategies:

Smart or Model Classrooms Model: A "pod" of four computers and a projection device in one-to-two classrooms per school. These classrooms are identified as "smart (or model) classrooms" based on certain criteria. Teachers in these classrooms receive intensive TPD in integration and serve as models for their colleagues.

Characteristics

- Some variation of this approach can be found in numerous developing nations—for example, computer clusters in public schools in Mexico and the Caribbean.
- These teachers receive ongoing TPD (basic computer skills and integration of ICT for student learning), technical and instructional support, and agree (through written means if necessary) that computers will be used as part of instruction and taken care of or they will be removed and given to another teacher.
- To ensure equity, incrementally build capacity, and properly phase in such an approach, schools could rotate classrooms, assigning two new teachers to the "smart classroom" each subsequent year.

Strengths

- Places ICT in classrooms where students can access it as needed for learning. This helps with integration.
- Pilot version of "computers in classrooms." Policymakers and leaders can evaluate strengths and weaknesses of approach and fix it.
- No need for major remodeling or reconstruction of whole school to accommodate computers in all classrooms.

Limitations

- High student to computer ratio may create classroom management problems for teachers.
- How helpful are four computers for 80-100 students?
- May not be the physical space for computers.
- Teachers may resist the idea, fearing they will be blamed if computers are damaged.

12 Harrison, C., Comber, C., Fisher, T., Haw, K., Lewin, C., Lunzer, E., McFarlane, A., Mavers, D., Scrimshaw, P., Somekh, B. and Watling, R. (2002) *ImpacCT2: The Impact of Information and Communication Technologies on Pupil Learning and Attainment*. London: DfES and Becta. See also Leach, J. (2004.) *The Potential of Hand Held Computer Technology to Serve the Needs of Teachers' Education in Africa Rural Settings*. OpenNet. Available: *http://www.ece.uth.gr/OPENnet/conferences/ecer2004/fullpapers/Leach.pdf*; and Dimock, K.V., Burns, M. & Heath, M. (2001). *Applying Technology to Restructuring and Learning: How Teachers Use Computers in Technology Assisted Constructivist Learning Environments*. Austin: Southwest Educational Development Laboratory.
13 These skills were identified by a panel of Delphi experts assembled for the creation of this Handbook.

Computers on Wheels: These are carts which, typically, securely store 20 laptop computers which can be wheeled from classroom to classroom. (They may include a printer).

Characteristics	Strengths	Limitations
• COWs can be stored in a safe secure area and wheeled to classrooms as needed • Or laptops may be distributed among several classrooms, thus transforming several classrooms into "smart classrooms".	• Can be shared among classrooms as needed • Laptops are portable and have a 2-hour battery life • They provide access to computers even within crowded classrooms, without significant remodeling or installation of additional electrical outlets, or needing to reserve space • COWs can be also used in support of ICT-embedded teacher professional development programs.[14] • Teacher is only responsible for computer when using it. • Shares the strengths associated with labs (one secure centralized storage area, localized infrastructure) but are also available to classrooms.	• May be difficult to wheel carts across rough terrain or up and down steps • Laptops are portable and more easily stolen than a desktop • More expensive than desktops to repair • Laptops have a higher unit cost than desktops. • Can suffer from the same "tragedy of the commons" situation where as communal property, no one is seen as responsible for their upkeep and maintenance.

Teacher leasing system for laptops: Rather than providing computers to schools, policymakers may wish to create laptop leasing programs for teachers.

Characteristics	Strengths	Limitations
• Offer teachers their own laptop with low or no interest loans • Use available funds to purchase projection devices that connect to laptops • Comes with the stipulation that the laptop be used as part of instruction for students.	• Help diffuse technology skills by providing teachers with increased access to computers both at home and in school, • Frees schools from having to purchase computers • More feasible given the increase in refurbished equipment and the promise of low-cost laptops.	• Guarantees that computers will be used in a traditional, teacher-centered way (as a lecture tool) with students having no hands on access to hem • Will only work where there is reasonable absorption capacity—enough people with enough money to want to buy a computer • Responsibilities for upgrading and maintenance issues must be settled

14 Rusten, E. (2002). Configuration of School Technology: Strategies and Options. In *Techknowlogia*. Available: http://www. techknowlogia.org.

Alpha Smarts: *Alpha Smarts* are portable word processors into which students and teachers can type text.

Characteristics	Strengths	Limitations
• Text is inputted into portable *Alpha Smarts* and can then be transferred into any software application that contains a blinking cursor via a cord or through an infrared connection.	• *Alpha Smarts* have a very long battery life • Much less expensive than both desktops and laptops • Portability • Can allow for classroom-based computing if desktops or laptops in classrooms are not an option. • Sturdy, lightweight, low cost • Share the strengths associated with labs (one secure centralized storage area, localized infrastructure) but are also available to classrooms.	• Where *Alpha Smarts* are to be employed in classrooms (in concert with computers), TPD must help teachers understand how to coordinate and integrate the use of both the handhelds and computer. • Ease of theft • Not as versatile as desktops or laptops • Do not provide Internet access or other software applications • Lack of local language versions

Handheld computers: "Handhelds" (In this instance, Palms Pilots, Portable Digital Assistants) and "tablets" (Tablet PCs, digital tablets, e-slates) are used extensively in the U.S., Canada and Europe as a lower cost alternative to computers (Palm pilots and other PDAs can be used with computers. They must be periodically connected to and "synched" with computers so their information can be safely stored in the event of battery dying). Teachers who use handhelds are generally positive about them. The *EduVision* project in western Kenya uses "E-slates" (a wireless digital tablet) that connects to a base station in the school and a satellite radio receiver. The base station processes the information from the satellite transmission and turns it into a form that can be read by the handheld E-slates.

Characteristics	Strengths	Limitations
• Used extensively and successfully within the U.S, Canada and Europe as a more mobile, personal and cost-effective alternative to desktop computers • South Africa and Egypt, the Digital Education Enhancement Project (DEEP) demonstrated the efficacy of handhelds for teacher professional development in rural and urban schools • Digital tablets allow user to write by hand with stylus (pen-like instrument). Handhelds can recognize handwriting and can also use a portable keyboard. • Digital tablets cut down on the need to teach typing and keyboarding skills	• Handhelds, such as Palms, are much less expensive than both desktops and laptops. Tablet PCs are comparable to laptops in expense. • Portability • Sturdy, lightweight • Can increase time using technology, motivation and collaboration and communication • Study with 100 US teachers indicated that they are perceived as 'effective instructional tools', with the potential to have a positive effect on pupil learning.[15] • Shares the strengths associated with labs (one secure centralized storage area, localized infrastructure) but can be distributed to classrooms.	• TPD must help teachers understand how to coordinate and integrate the use of both the handhelds and computer. • Ease of theft • Not as versatile as desktops or laptops • Small screen makes viewing difficult • Though increasingly powerful, handhelds don't offer the range of software applications of computers • Must be "synced" on a regular basis with laptop. When battery dies, information is lost. • As cell phones become more powerful, they will offer same applications as handhelds. • Digital tablets are more expensive than handhelds or Alpha Smarts

15 Leach, J. (2004.) *The potential of hand held computer technology to serve the needs of teachers' education in Africa rural settings.* OpenNet. Available: http://www.ece.uth.gr/OPENnet/conferences/ecer2004/fullpapers/Leach.pdf.

CLASSROOM MANAGEMENT MODELS (MANAGING THE LIMITED COMPUTER ENVIRONMENT)[16]

Computer integration into curricular activities is the most promising route to enhancing student learning and helping students learn technology skills. Yet if computers are to be placed in a classroom, how will the teacher assure equity of access and control of the class when there are so few computers and so many students?

Unlike the *ICT as a delivery system* approach or *ICT as content* approach, the *ICT for integration* approach, especially within the context of learner-centered instruction, means that students *cannot* all complete the same assignments at the same time—management of limited computer resources is critical. The following classroom management strategies can help teachers better integrate computers into the instructional process.

- **Learning stations model (student-computer ratio: 25:1)**. Students are organized into five teams of five (the number of team members can be smaller but should not be higher than this) and are assigned to a certain "station." Each team member has a particular role (leader, recorder, time keeper, etc.). Each station represents a particular activity. For example, at station 1, students might read a passage from a textbook. At station 2, they write a group report about it. Station 3 is the computer where they type the story. At station 4, they review their work. At station 5, they add drawings to their story.

After a certain period of time (30 minutes or an entire class period), teams rotate to the next station and begin their assigned task. By the end of the day or several days, each team will have rotated through all stations and completed their assignment. Learning station models work best if each station has a roles for each team member as well as instructions for completing the tasks at that station. The computer can be one of the learning stations. For extremely large classes, the teacher can have 3 sets of learning stations (25 students each).

Learning stations are used in schools throughout the globe.

- **Distributed task model (student-computer ratio: 15: 1)**. This model is useful for carrying out more complex projects that require different skill sets and levels of expertise. It is also a good model of peer-based computer instruction. Students are organized into teams of 15 and given a task (for example, creating a newspaper). The team further subdivides according to topic: Some will report on the environment, some on sports, some on a local issue, etc. They write their story by hand and organize a time to sit at the computer with writers who guide them in typing and formatting their portion of the newspaper article on the computer. When they finish, the next set of reporters meets with writers who guide them through the same process. The remainder of the team edits the final copy.
- **Collaborative groups model (student-computer ratio: 15-to-1)**. In the collaborative groups model, each small group is responsible for creating some component of the whole group's final product. For example, a team may be assigned a project-based scenario: how can we ensure clean water in our community?[17] Students are organized into 5 teams of 15. One subgroup of the team designs the water filtration system, another gathers materials, another documents the process and another group creates a *PowerPoint* presentation of it. Each has contributed a different piece of the larger final product.

Clearly, the above sorts of activities could not be conducted in a computer lab, in part because computer placement provides little area for groups of students to work comfortably on and off the computer. Further, there simply would not be enough time, and the low student-computer ratio or 1:1 student-computer ratio would result in students interacting with the computer and not with each other. For this reason, providing teachers with a few computers in their classrooms—at least in a few classrooms—leads to integration in a way that computer labs could not.

16 Burns, M. (June 2002). *Technology, Professional Development and Changing Practice.* Technology Horizons in Education Journal. Available http://www.thejournal.com/magazine/vault/A4070.cfm

17 This is based on an actual activity in which students at Amilcar Cabral Primary School (Conakry, Guinea) created a water filtration system using items from home.

LEARNER-CENTERED INSTRUCTIONAL METHODS

Learner-centered instruction may not be a well understood concept. Is it one instructional method or several? What do learner-centered classrooms look like? Learner-centered instruction is indeed a "suite" of instructional methods, all of which have the student, not teacher, doing most of the work. The following table presents four of the more common learner-centered methodologies used in primary (and secondary) instruction.

Another learner-centered model is case-based instruction, though this is most commonly employed at a tertiary level and in professional schools, such as law and medical schools.

Project Oriented Learning	Problem Based Learning	Inquiry-based Learning	Collaborative Learning[18]
• Begins with organizing issue: Builds on students' knowledge or interests • Provides a meaningful and authentic context for learning • Students design the process for reaching a solution. • Students are responsible for accessing and managing the information they gather • Evaluation occurs continuously. • Students regularly reflect on what they're doing. • A final product (not necessarily material) is produced and is evaluated for quality. • The classroom has an atmosphere that tolerates error and change.	• Begins with a problem situation • Is ill-structured—there is no one way to solve problem • Problem is a real world one so the context is meaningful and authentic (real) • Focuses on higher order skills (problem solving, analysis, evaluation) • Learners must be self directed • Students work collaboratively to solve problem • Evaluation occurs continuously. • Students regularly reflect on what they're doing. • A final product (not necessarily material) is produced and is evaluated for quality. • The classroom has an atmosphere that tolerates error and change.	• Open-ended learning that begins with a question for inquiry or investigation • Emphasizes the development of questioning and problem-solving skills • Students take the role of scientists or mathematicians. • Observe and question; hypothesize; conduct tests to support or contradict their theories; analyze data; draw conclusions from experimental data; design and build models; • Engage in trial and error • Analyze and reason carefully • Students work collaboratively to solve problem • Evaluation occurs continuously. • Students regularly reflect on what they're doing. • A final product (not necessarily material) is produced and is evaluated for quality. • The classroom has an atmosphere that tolerates error and change.	Team-based learning that focuses on students learning together. It contains the following characteristics: • Interdependence: Everyone has a role and everyone's contribution is important in the overall product • Participation is unique and necessary: Everyone is accountable • Individual and group responsibility • Comfortable atmosphere: mistakes are tolerated and different viewpoints are respected Cooperative learning is a variation on collaborative learning, requiring less collaboration and more independent work among team members.

18 Johnson, D.W. & Johnson, R.T. (1991). *Learning Together and Alone.* Englewood Cliffs, N.J.: Prentice Hall.