Note: Judi Harris is noted for expertise on telecollaborative uses of the Internet in schools. She contributes to a continuing column in *Learning and Leading with Technology* and has authored three texts on curriculum-based e-Learning, most recently *Virtual Architecture: Designing and Directing Curriculum-Based Telecomputing*. In 1996, Judi received ISTE's SIGTel Educational Telecomputing Outstanding Achievement Award "for pioneering vision and development of innovative curricular design and K-12/University collaboration models that stimulate and showcase cooperative telecomputing activities in classrooms worldwide."

The following paper was presented in May, 2001 as a keynote address for the Open Education Association's annual conference in Seoul, South Korea. It synthesizes her work on designing telecollaboration and teleresearch that has been published in a number of venues during the past decade.

Teachers as Telecollaborative Project Designers: A Curriculum-Based Approach

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Successful technology-using teachers function more as instructional designers than lesson planners. This is especially true when they seek to incorporate the use of forward-thinking, computer-mediated innovations such as telecomputing tools into existing curricula. New tools require new techniques, incorporated into new models of teaching and learning processes, if the tools' most powerful attributes (Clark, 1983) are to be exploited. When attempting to encourage meaningful curricular infusion of telecommunications into elementary, middle-level, and secondary-level learning, teachers must pay careful attention to key ideas both from diffusion of innovations research and from the education of instructional designers.

The Diffusion of Interactive Communications Innovations

Everett Rogers (1986) has qualified his well-known work on the diffusion of innovations to address the special nature of the diffusion process occurring when communications innovations are adopted. Meta-analytic synthesis of communications studies results has revealed three ways in which the adoption of telecommunications innovations differs from similar processes with other innovation types.

- A *critical mass* of adopters must be using the innovation to persuade potential adopters to do the same; "the usefulness of a new communication system increases for all adopters

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with each additional adopter" (p. 120).

- The *degree of use* of a communications innovation, rather than the decision to adopt it, is the dependent variable that will indicate the success of the diffusion effort.

- New communication technologies are *tools* that can be applied in many different ways and for different purposes. Therefore, adoption of these innovations is an active process that involves much *re-invention,* or "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation" (Rogers, 1995, p. 174).

It is the importance of re-invention that must not be overlooked when seeking to ensure the meaningful integration of telecomputing tools into school curricula. Innovations that are more flexible, with many possible applications (like telecommunications innovations), and those that are shared via a decentralized diffusion network (like eLearning tools), are more likely to be re-invented than those that are less flexible or are diffused according to a centralized plan (Rogers, 1986). Also, re-invention appears to be important psychologically to adopters of such innovations (Rogers, 1995); adopters must take the innovation and "make it their own" if they are to continue using the innovation. When helping teachers to learn to use telecomputing tools, educators must anticipate, stimulate, and encourage teachers' re-inventions of curriculum-based telecomputing applications. Sadly, this is not what usually occurs.

Teacher as Instructional Designer

Most teachers, working alone in a classroom, are both the designers and the deliverers of instruction (Briggs, 1977). This implies that teachers are expected to design learning activities for their students on an ongoing basis; selecting, adapting, and using instructional materials and activities according to the learning needs and styles of each unique group of students. The extent to which this design process is effective determines, in part, students' eventual learning success.

When new teaching/learning tools are presented to teachers for possible adoption, what happens? Once the initial technical and procedural aspects of use are presented (preferably through hands-on experience), curriculum integration is addressed. This sequence is appropriate, because powerful educational applications of new technological tools with unique media attributes (Clark, 1983) cannot be conceived until potential adopters are aware of the full range of those attributes (Rogers, 1995).

But what happens then? In many cases, the now-technically-facile teacher is presented with a plethora of application ideas, often in the form of lesson plans or project reports, usually separated by content area and/or grade level. Educators are then asked to choose from many different activities that were created to fit the needs and preferences of groups of students *different* from their own, and adapt these activities for use in their own classrooms. With no guidance in the *design* of powerful innovation applications, it is no wonder that so few initial curriculum integration attempts with educational technologies exploit the unique characteristics of the innovations. It should not be surprising that so many applications seem similar to those that were implemented with more traditional media--for example, the early proliferation of one-to-one penpal letters sent via electronic mail (Riel & Levin, 1990).

To ensure the adoption and maximally powerful, continued use of educational innovations, teachers (and students) must have opportunities to *re-invent* educational applications as

instructional designers. But since the unique attributes of the new tools imply that specialized applications must emerge if powerful use is to be made of the innovations, instructional design cannot be modeled solely upon the structures of educational activities that make use of more traditional media. New *models* for activity design must be provided for all but the most creative and innovative educators, if new tools are to be used in new ways.

Instructional Design: A Models Approach

The work of Joyce and Weil (1972, 1986) and their advocates (e.g., Gunter, Estes, & Schwab, 1990) suggests that teachers' planning for instruction is greatly facilitated by their taking a *models approach* to instructional design. With this approach, teachers choose from a variety of structures (e.g., direct instruction, Socratic inquiry, class discussion, or cooperative learning) the model that, given the learning needs and preferences of a particular group of learners, will best help the students to accomplish specified educational goals. An important assumption of this approach is that there is no one "best" model for any student, teacher, or group. Rather, a variety of models; a "cafeteria of alternatives" (Joyce & Weil, 1972, p. xiv), carefully selected and consciously applied, will help to create optimal learning environments for students.

Much of what has been published about using models in instructional design addresses selection in terms of type of teacher-student and student-student interaction (e.g., lecture, recitation, small-group cooperative learning), and asks the teacher to design specific learning activities that are appropriate in the selected classroom environment. While this level of guidance may be sufficient for teachers who are using instructional media familiar to them, it is probably insufficient for the teacher who seeks to infuse powerful use of *new* educational innovations with unique media attributes. Models for the design of forward-thinking, cross-curricular, multi-level *activities* must also be provided if educational innovations, such as eLearning tools, are to be used meaningfully in elementary, middle-level, and secondary curricula. Strain (1986) characterized this distinction in level at which model application occurs as the difference between a general "curriculum plan" and a specific "instructional procedure" (p. 287).

The use of models in the instructional design of educational activities, rather than the replication/adaptation of existing lesson plans and activity ideas, allows for the large amount of re-invention necessary to make long-term innovation adoption probable in a majority of classrooms. The more *unlike* a previously employed tool an educational innovation is perceived to be, the more important it is to provide models of activity frameworks, purposes, and specific instructional procedures to potential innovation adopters. This design assistance can be called "wetware"; thinking tools for teachers that help us to create effective opportunities for student-centered learning,

Structuring Open Education Spaces

Teachers create spaces for their students' learning. Like interior designers, who can suggest furniture choices and placements. Teachers plan learning activities aimed at helping their students achieve curriculum-related goals. The structures of these learning activities are like the furniture and its arrangement in a particular room. When doing either kind of design,

people-centered but goals-oriented decisions must be made. What functions will the furniture/activities serve? What preferences do their eventual users have? How well-suited are the choices to those functions and preferences? How well do the choices fit together in the space? How well do they fit the larger environment of which this space will be a part?

Skillful, student-centered teachers create spaces for learning that accommodate multiple possibilities for student action. Like interior designers, teachers can predict a range of probable actions within a particular furnished/structured space, but they cannot predict minute-to-minute movements of the people who will use the space. Rather, since teachers will be present within the learning spaces they design for students, they plan to use careful observation of learners, tempered by awareness of curriculum requirements, informed by past experience, and heightened by present sensibility, to shape emerging learning experiences. Teachers structure learning spaces, like they furnish rooms, to facilitate and encourage desired processes and outcomes.

Spaces for Understanding Performances

Student-centered learning activities, unlike traditional "lesson plans," are *structured* more than they are *scripted.* How do teachers go about structuring a flexible, but focused, learning activity? According to a powerful model developed by Stone Wiske (1998), teachers must first decide what their students should *understand* as a result of engaging in a learning activity. What is "understanding?" According to Wiske,

> Understanding is being able to carry out a variety of actions or "performances" that show one's grasp of a topic and at the same time advance it. It is being able to take knowledge and use it in new ways. (Wiske, 1998)

Wiske and her colleagues suggested that teachers "teach for understanding." Wiske's "Teaching for Understanding" framework is built upon four questions that undergird what teachers must consider as they design and function within learning spaces:

- What topics are worth understanding?
- What about these topics needs to be understood?
- How can we foster understanding?
- How can we tell what students understand? (Wiske, 1998)

When designing learning activities, teachers are addressing all four questions, but primarily the third. Wiske calls learning activities "performances of understanding":

> Performances of understanding are activities that require students to use what they know in new ways or situations to build their understanding of unit topics. In performances of understanding students reshape, expand on, extrapolate from, and apply what they already know....Performances of understanding help students build and demonstrate their understanding, Although a "performance" might sound like a final event, performances of understanding are principally learning activities. They give both you and your students a chance to see their understanding develop in new and challenging situations over time....Performances of understanding require students to show their understanding in an observable way. They make students' thinking visible. (Wiske, 1998)

Structures for Learning Spaces

Many possibilities exist for structuring performances of understanding or learning activities. When teachers brainstorm these possibilities, they unconsciously use models of learning activities with which they are already familiar. Many times, these familiar activity structures serve students' understanding needs well. Yet when attempting to integrate use of online tools and resources into students' curriculum-based, understanding-focused learning activities, familiar models do not seem that powerful. They do not often exploit new tools' distinctive attributes. If traditional tools could support a learning activity just as well or better than new tools could, there would seem to be no advantage in taking the time and effort necessary to learn to use, then implement instructionally, the new tools.

From a shortsighted perspective, this could be used as an argument against designing curriculum-based learning activities in which students make powerful use of eLearning tools and resources. "Students have been learning just fine in my class with the activity structures that I already know how to use," a teacher might think. While probably true, this way of thinking can inadvertently limit what and how students *can* learn. Would they not be best served if teachers were familiar with *more,* rather than *fewer,* ways to structure learning experiences? From this better-informed perspective, the learning spaces that can be configured for students to bring to life could only be more powerful and more appropriate to their needs and preferences.

Needed are new, flexible frameworks that can be used to structure understanding-focused learning activities that help students make powerful, worthwhile use of online tools and resources. I have proposed these as telecollaborative activity structures, teleresearch activity purposes, and sequences of student actions (Harris, 1998). How can these combine to help teachers to design students' learning spaces?

Choosing Structures, Purposes, and Sequences

Once teachers decide what their students should understand after engaging in one or more learning activities, they can decide how these activities could best be structured. Using students' content and process needs and preferences as criteria, how do teachers select from many options a combination of structures, purposes, and sequences to use to students' maximum educational benefit?

The answer: by focusing now upon what students should *do* to build understanding while they are engaged in the learning activities being planned. In essence, telecollaborative activity structures, teleresearch purposes, and student action sequences are "wetware"—mental design tools that help teachers think concretely about students' learning *processes.* These structures, purposes, and sequences can be used to configure the ways in which teachers will ask students to engage with content and with each other in learning space designs that teachers sketch and students bring to life.

The remainder of this paper will suggest a collection of 18 such activity structures, 6 such activity purposes, and 7 such student action sequences that can be used by teachers, functioning

as instructional designers, in the re-invention (and therefore successful adoption) of telecomputing tools.

Telecollaboration and Teleresearch

Curriculum-based eLearning can take many forms, but is essentially either *online collaboration,* also called 'telecollaboration,' or *online research,* also called 'teleresearch.'　Telecollaborative learning activities are those in which students communicate electronically with others. Teleresearch learning activities are those in which students locate and use online information. Online collaboration and research are frequently combined in larger-scale educational projects. Both can be done using text, still images, animated images, and sound. Both are available in either synchronous (immediate) or asynchronous (delayed) modes. Both can reproduce what students already do when they collaborate and do research using earlier-vintage learning materials. Yet to make these new opportunities worth the time, effort, and other resources necessary to bring them into the classroom, it is important to use the new tools in new and powerful ways.

Collaborative online learning activities can offer many educational benefits to their participants. The nature of these benefits depends, in large part, upon the specifics of each activity's design, and how well the skill the activity makes possible educationally matches the needs and preferences of participating students. In general, curriculum-based telecollaboration is most appropriate when students can be well served by

- Being exposed to multiple points of view, perspectives, beliefs, interpretations, and/or experiences.
- Comparing, contrasting, and/or combining similar information collected in dissimilar locations.
- Communicating with a real audience using written language.
- Expanding their global awareness.

Doing research online can offer an ever-expanding wealth and variety of current information to learners. Whether this abundance helps or hinders students' curriculum-based learning depends, like online collaboration, upon the activity's design, and also upon students' information-seeking and information-appraising skills. In general, curriculum-based teleresearch is most appropriate when students can be well served by

- Accessing information not available locally.
- Viewing information in multiple formats (e.g., text, graphics, video).
- Comparing and contrasting differing information on the same topic.
- Considering emerging and very recent information (e.g., interim reports of research studies in progress).
- Delving deeply into a particular area of inquiry.

Educators can design online activities and projects that help students to experience and benefit in these ways by considering telecollaborative activity structures and teleresearch activity purposes.

Telecollaborative Activity Stuctures

Activity structures characterize a telecollaborative learning activity's framework, or "skeleton." Each structure can be found supporting learning in most curriculum areas and at most grade levels. For this reason, the activity structure serves as an instructional design tool. It is a way for teachers to think about learning processes specific to particular types of educational activities.

This paper concerns telecollaborative activity structures in particular. Of course, other activity structures exist; teachers use them, often without realizing it, every time an educational activity is designed. However, telecollaborative activities are supported by structures that are unfamiliar to many educators at the present time. This is why it is important to learn about and use them consciously and deliberately.

In an informal content analysis of hundreds of educational telecomputing activities that were shared by teacher-designers via the Internet, 18 telecollaborative activity structures organized into three genres of student action emerged. The genres of student action are labeled according to the dominant types of learning acts that each class of activity structure encompassed: *interpersonal exchange, information collection and analysis,* and *problem-solving.*

- *Interpersonal Exchanges* are those activities "in which individuals talk electronically with other individuals, individuals talk with groups or groups talk with other groups" (Harris, 1998, p. 18). Interpersonal Exchanges include keypals, global classrooms, electronic appearances, telementoring, question-and-answer activities, and impersonations.

- *Information Collection and Analysis* activities "involve students collecting, compiling, and comparing different types of interesting information" (Harris, 1998, p. 33). Information Collection and Analysis activity structures include information exhanges, database creation, electronic publishing, telefieldtrips, and pooled data analysis.

- *Problem Solving* activities promote critical thinking, collaboration, and problem-based learning. Problem Solving structures include information searches, peer feedback activities, parallel problem solving, sequential problem solving, telepresent problem solving, simulations, and social action projects.

Table 1 explains each of the 18 activity structures. They include:

Interpersonal Exchange

- Keypals
- Global Classrooms
- Electronic Appearances
- Telementoring
- Question & Answer
- Impersonations

Information Collection and Analysis

- Information Exchanges
- Database Creation
- Electronic Publishing
- Telefieldtrips
- Pooled Data Analysis

Problem Solving

- Information Searches
- Peer Feedback Activities
- Parallel Problem Solving
- Sequential Creations
- Telepresent Problem Solving
- Simulations
- Social Action Projects

Remember that these structures are *tools* to help teachers think about how the Internet may be used to enhance curriculum-based teaching and learning in classrooms via telecollaboration. They are not prescriptions for successful Internet use.

Teleresearch Activity Purposes

Teleresearch is not an educational activity unto itself. It serves different purposes for students' learning, determined by the purposes for and ways in which information is located and used. Stated according to what learners do when engaged in teleresearch, these purposes include

- Practicing information-seeking and information-evaluating skills.
- Exploring a topic of inquiry or finding answers to a particular question.
- Reviewing multiple perspectives upon a topic.
- Collecting data remotely.
- Assisting authentic problem-solving.
- Publishing information syntheses or critiques for others to use.

Designing Telecollaboration and Teleresearch

Using students' curriculum-related content and process needs and preferences as criteria, how do

teachers select from many options a combination of telecollaborative structures and teleresearch purposes to use to students' maximum benefit?

The answer: By focusing upon what students should *do* to build understanding while engaged in the learning activities that teachers plan. Not only must the activity be structured; teachers need to predict, to some extent, the *sequence of student actions* necessary to complete the activity in ways that promote students' learning.

The process emphasis of the design tools presented here—telecomputing structures, purposes, and sequences—is immediately apparent when reviewing the range of *student action sequences* evident in curriculum-based, eLearning activities teachers have created and used successfully in their classrooms:

- **Correspond:** Prepare a communication locally then send it to others. They respond, and the process continues.
- **Compete:** Register to participate, then do an activity locally. Submit completed work by a deadline, then receive feedback.
- **Comprehend:** Locate online resources, then make primarily local use of them.
- **Collect, Share, and Compare:** Create something locally, then add it to a group of similarly created works, combined to form a centrally located collection.
- **Chain:** Do an activity locally, create records of that activity, then send something on so that the next group can do something similar.
- **Come Along:** Shadow others as they travel either physically or cognitively, perhaps communicating briefly in the process.
- **Collaborate:** Work with remotely located others to realize a common goal.

Multiple action sequences are usually evident within a particular curriculum-based telecomputing project. Activity structures often work together to form the project's overall structure. In any telecollaborative and/or teleresearch project, therefore, there are one or more activity structures, teleresearch purposes, and action sequences working together that describe the plan and its implementation in the classroom.

Combinations of Structures

Following are several student-centered project examples that help learners make particularly powerful, curriculum-based use of eLearning tools and resources. Notice how each combines multiple activity structures, purposes, and sequences to achieve an engaging, inquiry-based, open educational experience.

Project Atmosphere Australia Online (PAA)

This site (http://www.schools.ash.org.au/paa/student_activities.htm) offers a veritable virtual smorgasbord of meteorology-related resources and activities, from which participating teachers can select one or more, thereby building customized weather projects for their classes. The "Weather Recording" information exchange activity, for example, brings daily weather observation data via an e-mail distribution list from many classes around the world. Each

participating class measures and reports the following at approximately 1 pm local time:

- Current temperature
- Percentage cloud cover
- Cloud type(s) evident
- Rainfall for last 24 hours
- Wind direction
- Wind speed
- Relative humidity (if possible)
- Barometric pressure trend
- Recent weather conditions
- Outlook for next 24 hours
  (http://www.schools.ash.org.au/paa/recording.htm)

The PAA activity "Weather Experts On-line," offers question-and-answer services by professional meteorologists in Australia and the USA "Weather Folklore" is a global (classroom) information exchange of stories and proverbs that are weather related. "Weather Headlines" and "Weather Writing" are information exchanges in which students report, respectively, on significant local weather events and how the weather affects daily activities and moods. More than a dozen such simple, yet potentially powerful activities are facilitated through this well-organized site. Students enact the action sequences "correspond," "collaborate," and "collect, share, and compare" while actively learning about the weather.

From the Arctic to the Desert

This site was a multidisciplinary project planned for third and fourth grade students in Alberta, Canada (http://www.2learn.ca/projects/projectcentre/pages/Nunavut/MainPage.html). Combining the telecollaborative activity structures of keypals, global classrooms, telefieldtrips, question and answer activities, and electronic publishing with teleresearch for exploring topics of interest and publishing information syntheses, students used the action sequences of "correspond," "comprehend," and "come along" to, in their teachers' own words,

> ...learn about the lifestyle of the people who lived in our icy Canadian northern desert and in the hot, sand desert of Arabia . We also wanted to learn about how animals adapt to these two environments. We hoped to make connections with people who live in these two harsh environments to learn more about the animals and landscapes of these two types of deserts.

Ducky 2000

Ducky 2000 (http://www.cadvision.com/nlbrown/ducky2000.htm), another project from Alberta, helped elementary students in nine classes across Canada, plus one class each in Australia and in the US have rich learning experiences centered around hatching duck eggs. This student-inspired, emergent project used global classroom, information exchange (e.g., duck/chick

comparison charts) and electronic publishing activity structures, plus teleresearch to find out more about ducks and solve authentic duck care problems. Students in participating classes comprehended, corresponded, and collected/shared/compared all kinds of duck-related information, experiences, and reflections. A visit to this delightful site is definitely recommended.

Primary Focus: Process or Content?

These example projects demonstrate that, as learning space/activity designers, like interior decorators, teachers combine and arrange components primarily according to how they think a space's inhabitants will behave in satisfaction of their needs. Teachers create the space to ease and support such needs satisfaction, in accordance with known learner preferences, when possible. Yet although the satisfaction of needs is the ultimate goal of any plan for the configuration of a space (whether for learning or for living), most of teachers' time and effort as designers is spent considering the "within-the-space" processes that will assist the space's occupants. Though as educational designers, teachersare responsible for ensuring the learning of content, they do so only through the awareness of educational processes that can help students develop true understanding.

First published in 1993, the structures, purposes, and sequences overviewed in this paper combine in numerous permutations to describe the wide range and variety of eLearning project designs. They also serve as planning tools that can help teachers to think concretely about facilitating students' learning processes within the context of curriculum requirements, and with an eye toward customized, motivating educational experiences. It is hoped that they will continue to be used to develop and frame the ways in which students engage with curriculum-related content—and with each other—in learning space designs that educators may sketch, but learners and teachers *together* bring to life.

Thomas Huxley said years ago, "The great end of life is not knowledge but action." It is in their roles as designers of spaces for students' actions that teachers express, through their own actions, what is most valuable and unique about the art and craft of education.

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Table 1

Summary of Activity Structures (from Dawson & Harris, 1999, p. 2)

Genre	Activity Structure	Description
INTERPERSONAL EXCHANGE	Keypals	Students communicate with others outside their classrooms via email about curriculum-related topics chosen by teachers and/or students. Communications are usually one-to-one.
	Global Classrooms	Groups of students and teachers in different locations study a curriculum-related topic together during the same time period. Projects are frequently interdisciplinary and thematically organized.
	Electronic Appearances	Students have opportunities to communicate with subject matter experts and/or famous people via email, videoconferencing, or chatrooms. These activities are typically short-term (often one-time) and correspond to curricular objectives.

	Telementoring	Students communicate with subject matter experts over extended periods of time to explore specific topics in depth and in an inquiry-based format.
	Question & Answer	Students communicate with subject matter experts on a short-term basis as questions arise during their study of a specific topic. This is used only when all other information resources have been exhausted.
	Impersonations	Impersonation projects are those in which some or all participants communicate in character, rather than as themselves. Impersonations of historical figures and literary protagonists are most common.
INFORMATION COLLECTION AND ANALYSIS	Information Exchanges	Students and teachers in different locations collect, share, compare and discuss information related to specific topics or themes that are experienced or expressed differently at each participating site.
	Database Creation	Students and teachers organize information they have collected or created into databases which others can use and to which others can add or respond.
	Electronic Publishing	Students create electronic documents, such as Web pages or word-processed newsletters, collaboratively with others. Remotely located students learn from and respond to these publishing projects.
	Telefieldtrips	Telefieldtrips allow students to virtually experience places or participate in activities that would otherwise be impossible for them, due to monetary or geographic constraints.
	Pooled Data Analysis	Students in different places collect data of a particular type on a specific topic and then combine the data across locations for analysis.
PROBLEM SOLVING	Information Searches	Students are asked to answer specific, fact-based questions related to curricular topics. Answers (and often searching strategies) are posted in electronic format for other students to see, but reference sources used to generate the answers are both online and offline.

	Peer Feedback Activities	Students are encouraged to provide constructive responses to the ideas and forms of work done by students in other locations, often reviewing multiple drafts of documents over time. These activities can also take the form of electronic debates or forums.
	Parallel Problem Solving	Students in different locations work to solve similar problems separately and then compare, contrast, and discuss their multiple problem-solving strategies online.
	Sequential Creations	Students in different locations sequentially create a common story, poem, song, picture, or other product online. Each participating group adds their segment to the common product.
	Telepresent Problem Solving	Students simultaneously engage in communications-based realtime activities from different locations. Developing brainstormed solutions to real-world problems via teleconferencing is a popular application of this structure.
	Simulations	Students participate in authentic, but simulated, problem-based situations online, often while collaborating with other students in different locations.
	Social Action Projects	Students are encouraged to consider real and timely problems, then take action toward resolution with other students elsewhere. Although the problems explored are often global in scope, the action taken to address the problem is usually local.