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Telementoring and Project-Based Learning: An Integrated Model for 21st Century Skills

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Abstract: While common models of telementoring (ask-an-expert services, tutoring, and academic and career telementoring) can serve a variety of learning objectives, these models are limited with respect to sustained inquiry learning such as project-based learning (PBL). To reach the full potential of PBL with telementoring, this chapter proposes a telementoring model that integrates inquiry learning, information literacy, and digital media literacy and is implemented by a team of experts – subject matter experts as telementors, classroom teachers, school librarians, and instructional technology specialists. The model provides for multifaceted learning experiences for students that involve disciplinary knowledge and habits of mind, critical thinking, collaborative problem solving, and information, media, and technology skills. Brief overviews of inquiry learning approaches, information literacy, and digital media literacy are described in relation to telementoring. Design considerations, the benefits and challenges of the model, and broader implications for educational change are also discussed. Using the integrated telementoring model, the PBL team exemplifies the interdisciplinary collaboration and new literacy skills that students need in today's workplaces and communities.

Keywords: telementoring, telementoring models, project-based learning, inquiry learning, information literacy, digital media literacy, new technologies, online learning, curriculum team, subject matter experts, teachers, school librarians, information technology specialists

INTRODUCTION

Often associated with apprenticeships in a community of practice, mentoring is the age-old process of wiser, more experienced persons taking younger protégés under their wing. As role models, mentors guide their young initiates into the art, craft, ways of thinking, and values of their community, helping to shape not only knowledge and skills but also the identity and personal and professional maturity of their protégés. Mentoring is rewarding for both the mentee and the mentor. The mentee has a deepening relationship with a special person in his/her life - not a parent, teacher, or friend, but a wise guide who listens, cares, encourages, and gives advice. For the mentor, this is a unique opportunity to make a difference in a young person's life and give back to one's profession and community.

Since the rise of the World Wide Web in the 1990s, a variety of online tools has been available to support mentoring beyond the barriers of time and place. Telementoring, also known as online mentoring and e-mentoring, can be defined as:

> … using telecommunications technology (including e-mail, conferencing systems, or telephones) to develop and sustain mentoring relationships where face-to-face ones would be impractical. In the field of education, telementoring often involves linking students up with knowledgeable adult volunteers who have an interest in fostering their development. This sort of arrangement allows the participants to take part in intellectual partnerships that would not otherwise take place. (O'Neill, 2000, p. iii)

While communicating online makes telementoring different from traditional face-to-face mentoring, telementoring offers some distinct benefits. Mentors are not limited to the local community and can be drawn from any profession, organization, or geographic location around the world where adults are willing to help a young person develop. And mentors and mentees can communicate at any time, using a wide range of online tools.

Telementoring uses various mentor group configurations to provide different kinds of expert support to students seeking help. MENTOR/National Mentoring Partnership's "Elements of Effective Practice" (http://www.mentoring.org/find_resources/elements_of_effective_practice/) identifies these five types of contemporary group mentoring: (1) traditional mentoring (one adult to one young person); (2) group mentoring (one adult to up to four young people); (3) team mentoring (several adults working with small groups of young people, in which the adult to youth ratio is not greater than 1:4); (4) peer mentoring (caring youth mentoring other youth); and (5) e-mentoring (mentoring via e-mail and the internet).

Expert support online comes in many forms – ask-an-expert services for one-time, discipline-based questions; tutoring for supplementary or remedial study; telementoring for career guidance and academic advice; and telementoring for inquiry learning. Examples of each of these types, as well as their strengths and limitations, will be discussed later in the chapter.

This chapter's main focus is on telementoring for sustained inquiry in the classroom through project-based learning (i.e., project-based telementoring). It is written at a time of extraordinary economic and technological changes and associated challenges to the U.S. educational system. The Partnership for 21st Century Skills, a group of leading education, business, community, and government organizations, has identified essential skills beyond reading, mathematics, and science that students need to "increase their marketability, employability and readiness for citizenship" (Partnership, 2008, p. 10):

- Thinking critically and making judgments about the barrage of information that comes their way every day – on the Web, in the media, in homes, workplaces and everywhere else.
- Solving complex, multidisciplinary, open-ended problems that all workers, in every kind of workplace, encounter routinely.
- Creativity and entrepreneurial thinking – a skill set highly associated with job creation (Pink 2005; Robinson 2006; Sternberg, 1996). Many of the fastest-growing jobs and emerging industries rely on workers' creative capacity – the ability to think unconventionally, question the herd, imagine new scenarios and produce astonishing work.
- Communicating and collaborating with teams of people across cultural, geographic and language boundaries – a necessity in diverse and multinational workplaces and communities.
- Making innovative use of knowledge, information and opportunities to create new services, processes and products. The global marketplace rewards organizations that rapidly and routinely find better ways of doing things. Companies want workers who can contribute in this environment.

Project-based telementoring has the potential to address many of these important skills. Due to the widespread use of the internet and the plethora of free or low-cost technologies for online communication and collaboration, the possibilities for innovative telementoring programs are unprecedented.

Providing the environment and structural support for new types of telementoring is a significant challenge. The New Media Consortium (NMC), a community of hundreds of leading universities, colleges, museums, and research centers, sees the following as the most critical challenges schools will face as they integrate new technologies and reshape the educational experience in the next five years: (1) There is a need for formal instruction in key new skills. (2) Educational practice and materials are changing too slowly to support current student needs. (3) Learning that incorporates real life experiences is not occurring enough and is undervalued when it does take place. (4) New technologies must be adopted and used as an everyday part of classroom activities, but effecting this change is difficult. (5) The fundamental structure of the K-12 education establishment is resistant to any profound change in practice

(Johnson, Levine, Smith, & Smythe, 2009, p. 7-8). These trends indicate not only the challenges that schools face, but also the potential of project-based telementoring to contribute to needed changes in structure, teaching practice, and a more relevant educational experience for students.

The next sections of this chapter provide brief overviews of inquiry learning approaches, information literacy (including mastery of information technology), and digital media literacy (particularly with communication and collaboration technologies), as they relate to telementoring. This is followed by an assessment of strengths and weaknesses of common models of telementoring. To reach the full potential of project-based learning, I propose a telementoring model that integrates inquiry learning, information literacy, and digital media literacy and involves a team of specialists – subject matter experts as telementors, classroom teachers, school librarians, and instructional technology specialists. Because of the diverse expertise of this project-based learning (PBL) team, the model provides for multifaceted learning experiences for students that involve disciplinary knowledge and habits of mind, critical thinking, collaborative problem solving, and information, media, and technology skills. Design considerations, the benefits and challenges of the model, and broader implications for educational change are also discussed. Using the integrated telementoring model, the PBL team exemplifies for students the interdisciplinary collaboration and new literacy skills that are increasingly valued in today's workplaces and communities.

INQUIRY LEARNING APPROACHES AND TELEMENTORING

Other chapters in this book explore in depth the use of telementoring in inquiry, problem-based, and project-based learning. The goal of this section is to provide an overview of these approaches as the foundation for a discussion of how well different models of telementoring can meet the learning challenges and address the new media literacy skills needed today.

Scientific inquiry in the classroom is often simplified to a linear process of asking a question, formulating a hypothesis, performing an experiment, collecting data, and drawing conclusions. The University of California Museum of Paleontology's website, *Understanding Science* (http://www.understandingscience.org), aims to accurately communicate "the real process of science" – not only a process of exploration, discovery, and testing ideas, but also of scientific growth based on community analysis and feedback that is shaped by the benefits and outcomes for individuals and society. Science is a process that is dynamic and intensely human:

> [S]cientists often begin an investigation by plain old poking around: tinkering, brainstorming, trying to make some new observations, chatting with colleagues about an idea, or doing some reading. Scientific testing is at the heart of the process. In science, all ideas are tested with evidence from the natural world. … You can't move through the process of science without examining how that evidence reflects on your ideas about how the world works — even if that means giving up a favorite hypothesis. The scientific community helps ensure science's accuracy. Members of the scientific community … play many roles in the process of science, but are especially important in generating ideas, scrutinizing ideas, and weighing the evidence for and against them. Through the action of this community, science is self-correcting. … The process of science is intertwined with society. The process of science both influences society … and is influenced by society. ("A blueprint for scientific investigations," http://undsci.berkeley.edu/article/0_0_0/howscienceworks_03)

Scientific inquiry is clearly a social process as well as a rigorous procedure for testing hypotheses. Identifying a scientific problem and testing one's ideas through communication, collaboration, and peer review are critical aspects of inquiry often missing from the student's classroom experience. Through the partnerships and collaboration enabled through telementoring, a subject matter expert can be one of the most valuable members of the classroom's community of inquiry.

The Telementor's Guidebook (O'Neill, 2000) describes and analyzes a number of telementoring relationships with project groups from a 9th grade class that illustrate the types of guidance subject matter experts can provide. For example, two students doing a research project on earthquakes were matched with a geology graduate student who provided both intellectual and emotional support to help them reach their project goals. Other examples of telementoring by community experts can be found in the project summaries provided on The Electronic Emissary K-12 Telementoring website (http://emissary.wm.edu/project_public.php).

Inquiry learning approaches such as problem-based learning and project-based learning extend the problem beyond a single lesson or two and bring to the classroom some of the complexity, curiosity, creativity, serendipity, and communal effort that more accurately reflect the nature of scientific inquiry. The Illinois Mathematics and Science Academy's PBLNetwork (http://pbln.imsa.edu/model/intro/index.html) provides this definition of problem-based learning:

> Problem-based learning (PBL) is focused experiential learning organized around the investigation and resolution of messy, real-world problems. PBL engages students as stakeholders immersed in a messy, ill-structured, problematic situation. PBL organizes curriculum around this holistic problem, enabling student learning in relevant and connected ways. PBL creates a learning environment in which teachers coach student thinking and guide student inquiry, facilitating learning toward deeper levels of understanding while entering the inquiry as a co-investigator.

A challenging issue in problem-based learning is ascertaining problem difficulty in ill-structured problems, with respect to learners' ability to solve such problems. Jonassen (2000; Jonassen & Hung, 2008) identifies a number of factors that contribute to problem difficulty. Factors related to the learner are level of domain knowledge, experience in solving problems, and reasoning skills. Factors inherent in the problem are level of abstraction, stability of problem attributes over time, complexity, and how well- or ill-structured the problem is. Jonassen and Hung (2008, p. 16) recommend that problems should be open ended, moderately ill structured, and with a degree of complexity that is challenging and motivating to students. Appropriate ill-structured problems should "provide opportunities for students to examine the problem from multiple perspectives or disciplines; [be] adapted to students' prior knowledge; [and be] adapted to students' cognitive development and readiness" (p. 16).

An example of a problem statement for elementary students who role play being entomologists shows how problem-based learning can be approached (Goodnough & Hung, 2008, p. 90):

> Every summer, Mrs. Bartlett likes to sit in a chair and enjoy her beautiful garden where she has lots of plants and flowers with butterflies flying from one to another. However, before Mrs. Bartlett can enjoy her peaceful summers, she always has to fight with hungry caterpillars who love to eat the leaves of her plants in the spring. … You and your teammate are entomologists (bug experts) in training. … What can your team tell Mrs. Bartlett about caterpillars? What can your team do to help Mrs. Bartlett with her problem without destroying her garden? Mrs. Bartlett will choose the best solution to her problem from all the proposals. In order to produce an effective and trustworthy solution proposal, your team should use scientific methods, such as continuous, consistent observation and keep a journal of your research plan, how the plan has been carried out, and whether any revisions to your research plan are needed after a period of doing your research.

Similarly, project-based learning attempts to infuse authenticity, complexity, and community into the learning process. The Buck Institute for Education (BIE, n.d., p. 4) defines project-based learning as "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks." BIE (p. 4-5) criteria for exemplary PBL projects include:

- Recognize students' inherent drive to learn, their capability to do important work, and their need to be taken seriously by putting them at the center of the learning process.
- Engage students in the central concepts and principles of a discipline.
- Highlight provocative issues or questions that lead students to in-depth exploration of authentic and important topics.
- Require the use of essential tools and skills, including technology, for learning, self-management, and project management.
- Specify products that solve problems, explain dilemmas, or present information generated through investigation, research, or reasoning.
- Include multiple products that permit frequent feedback and consistent opportunities for students to learn from experience.
- Use performance-based assessments that communicate high expectations, present rigorous challenges, and require a range of skills and knowledge.
- Encourage collaboration in some form, either through small groups, student-led presentations, or whole-class evaluations of project results.

What does project-based learning look like in the classroom? Planning any educational effort begins with the desired outcomes in mind, known as "backward mapping" (Wiggins & McTighe, 1998). A PBL project begins with developing a project idea, deciding the scope of the project, selecting curriculum standards, working from project design criteria, and creating the optimal learning environment (BIE & Boise State University, 2005). Most projects last several weeks but some can last much longer. Information/data collection that involves library research or active research in the field, such as interviews and community inquiry, can extend the length of the projects. Successful projects usually involve adults, either experts or community representatives, as partners or mentors in a project, necessitating more time. Some projects address broad, open-ended questions with many different solutions, resembling problem-based learning. Complex projects need sufficient time for preparation and student research. Student autonomy is one of the characteristics of PBL, and students can be involved in the project design.

Examples of successful PBL projects at the high school level can be found on the website of High Tech High in San Diego, California (http://www.hightechhigh.org/pbl/index.html). The descriptions of such projects as how drugs affect your body, how human habitation affects the environment, and how math and science affect artistic expression generally include a project overview, standards addressed, a timeline and narrative of activities, lesson plans, assessment rubrics, and teacher and student reflections. Other examples of PBL projects are found in the additional resources listed in Appendix A.

PBL projects center on driving questions that are "open-ended, go to the heart of a discipline or topic, are challenging, can arise from real world dilemmas that students find interesting, and are consistent with curricular standards and frameworks" (BIE & Boise State University, 2005). While the subject matter specialist may have deeper and more extensive content knowledge than the teacher, the teacher has a unique knowledge base needed for PBL: pedagogical knowledge, knowledge of the students, and pedagogical content knowledge – "the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learner, and presented for instruction" (Shulman, 2004, p. 227). PBL projects require teachers to be learning facilitators, drawing on their pedagogical content knowledge. O'Neill (2000, p. 37) provides an example of how the teacher's unique knowledge helps ensure telementoring success:

> While teachers may not participate directly in telementoring relationships, they can do a number of other things indirectly, to help them flourish. To begin with, Mr. Wagner [the teacher] set requirements for the students' investigation that gave Dan [the telementor] an appropriate role to play. If the students' assignment had been a more traditional book report, or an investigation of much shorter duration, Dan may have had very little opportunity to become richly involved. Mr. Wagner didn't simply match his students with their mentor and let them go, either: he was there

> to make decisions about whether or not the students' research proposal was solid enough to go forward, so that Dan was not forced to do this on his own. While Dan had ideas about what the students might be capable of doing, and to what level of perfection, only the teacher had intimate enough knowledge of the students to make a confident decision about this. Finally, during Andy, Cori and Bill's [the students] correspondence with Dan, Mr. Wagner offered the students a substantial amount of behind-the-scenes guidance and support himself. This included helping the students to interpret some of Dan's messages, which they weren't always able to understand easily. Even the very best telementor sometimes talks over mentees' heads unintentionally.

In PBL, teachers are also project managers who structure and guide a project to a successful conclusion while supporting students as they move through an open-ended process of discovery and reflection.

A key consideration is student readiness. Do students have sufficient content knowledge and skills to handle the project successfully? Can they take independent initiative and work collaboratively? Do they have the necessary skills with technology and access to the required tools? Technological resources can be powerful and engaging for students, but they must also be essential tools for learning. Teachers also need fluency with these resources so that the learning can focus on the central content and investigation rather than managing and troubleshooting the technology. While there is no evidence that tools such as virtual learning environments, social software, and other information and communication technologies are being extensively used for project-based learning (Dede, 2007, p. 21), new guides are appearing for how to implement PBL with digital tools, the internet, and Web 2.0 (Boss, Krauss, & Conery, 2008).

Problem-based learning and project-based learning are similar in their emphasis on student autonomy, a shared goal, authentic problems, evidence-based investigations and solutions, collaborative learning, and reflection (Savery, 2006). The primary differences are the goals and the structuring of the activity. Problem-based learning focuses on solving ill-structured problems that require learners to set their own parameters. Project-based learning focuses on an end product. Clear design criteria are essential, with teachers and other adults serving as instructors, coaches, mentors, or project collaborators who provide expert feedback in a timely manner. Ravitz (2009, p. 6) notes that although there are differences among problem-based, project-based, inquiry-based, design-based, and challenge-based learning, "the similarities are more significant, allowing them to be viewed as 'close cousins' with many similar characteristics."

In addition to teachers and subject matter experts, other experts contribute to inquiry learning – helping students think critically and creatively, access and evaluate information, investigate complex problems, and effectively express their ideas. The school librarian and the instructional technology specialist are two of these experts.

INFORMATION LITERACY AND TELEMENTORING

While school librarians are often viewed mainly as the managers of the school library resources, they are much more than that. With credentials and experience in library and information science as well as teaching, school librarians are experts in information literacy and knowing how people seek information. As the complexity of information resources and technologies increases, they are called upon to use their unique skills as learning specialists to help students develop 21st century skills (Zmuda & Harada, 2008). Their roles in PBL are as an instructional partner, a connector with a holistic view of the curriculum who facilitates integration across content areas, and an integrator who links disciplinary concepts with information resources and helps incorporate information literacy skills at various phases of the project (Harada, Kirio, & Yamamoto, 2008b).

The American Association of School Librarians (AASL) has developed new standards that address many of the much-needed skills identified by the Partnership for 21st Century Skills and the New Media Consortium discussed in this chapter's introduction. The *Standards for the 21st-Century Learner* are based on a set of fundamental beliefs (AASL, 2007):

- Reading is a window to the world.
- Inquiry provides a framework for learning.
- Ethical behavior in the use of information must be taught.
- Technology skills are crucial for future employment needs.
- Equitable access is a key component for education.
- The definition of information literacy has become more complex as resources and technologies have changed.
- The continuing expansion of information demands that all individuals acquire the thinking skills that will enable them to learn on their own.
- Learning has a social context.
- School libraries are essential to the development of learning skills.

Within the inquiry learning framework, school librarians aim to assist students with the following skills, dispositions, responsibilities, and self-assessment strategies (AASL, 2007).

Skills:

- Develop and refine a range of questions to frame the search for new understanding.
- Find, evaluate, and select appropriate sources to answer questions.
- Evaluate information on the basis of accuracy, validity, appropriateness for needs, importance, and social and cultural context.
- Make sense of information gathered from diverse sources (e.g., textual, visual, media, digital) by identifying misconceptions, main and supporting ideas, conflicting information, and point of view or bias.
- Apply critical-thinking skills to information and knowledge in order to construct new understandings, draw conclusions, and create new knowledge.
- Use technology tools to access, analyze, and organize information in the pursuit of inquiry.

Dispositions:

- Display initiative and engagement by posing questions and investigating the answers beyond the collection of superficial facts.
- Demonstrate confidence and self-direction by making independent choices in the selection of resources and information.
- Demonstrate creativity by using multiple resources and formats.
- Maintain a critical stance by questioning the validity and accuracy of all information.
- Demonstrate adaptability by changing the inquiry focus, questions, resources, or strategies when necessary to achieve success.
- Display emotional resilience by persisting in information searching despite challenges.
- Use both divergent and convergent thinking to formulate alternative conclusions and test them against the evidence.

Responsibilities:

- Respect copyright/intellectual property rights of creators and producers.
- Seek divergent perspectives during information gathering and assessment.
- Follow ethical and legal guidelines in gathering and using information.
- Use information technology responsibly.
- Connect understanding to the real world.
- Consider diverse and global perspectives in drawing conclusions.

- Use valid information and reasoned conclusions to make ethical decisions.

Self-Assessment Strategies:

- Monitor own information-seeking processes for effectiveness and progress, and adapt as necessary.
- Monitor gathered information, and assess for gaps or weaknesses.
- Seek appropriate help when it is needed.
- Determine how to act on information (accept, reject, modify).
- Reflect on systematic process, and assess for completeness of investigation.
- Recognize new knowledge and understanding.
- Develop directions for future investigations.

Guided by these standards and the imperative to connect learning to student needs, school librarians are taking a larger role in curriculum planning and instructional design. They are partnering with teachers to support inquiry learning (Harada & Yoshina, 2004) and project-based learning (Harada, Kirio, & Yamamoto, 2008a). In the school context, the need for these collaborations is not always self-evident, and the development of partnerships is a challenge under the heavy constraints on time and budget. Two of the bases for successful librarian-teacher partnerships are professional development support and the creation of communities of practice over time (Yukawa, Harada, & Suthers, 2007). When teachers and school librarians participate jointly in sustained, practice-based professional development, significant improvements can occur in the design of inquiry-focused learning and student performance (Yukawa & Harada, 2009).

School and public librarians are increasingly offering chat reference services to students that generally provide factual answers, information resources, and limited research help, much like ask-an-expert services. Among the few studies of librarians as telementors, Yukawa (2005) examined two library and information science graduate students who telementored two high school students doing yearlong senior projects and found that building rapport and relationships were critical for sustaining telementoring.

In published examples and research, it is rare to find PBL projects that are collaboratively designed and implemented with school librarians, despite the fact that the information and technology resources of the library are often essential for background knowledge, research, and the development of final products. For example, High Tech High's San Diego Field Guide project (http://www.hightechhigh.org/pbl/sd-field-guide/) is a 16-week project in which 11th grade students "conduct an environmental assessment of the fauna along the intertidal zone of San Diego Bay. They publish a comprehensive Field Guide including scientific studies, creative writing, photographs, and histories of human development, industry, environmental measures, mapping and other changes to Bay." The interdisciplinary project (biology, humanities, mathematics) is implemented by a subject matter specialist and two high school teachers, but school librarians do not appear to have a role in guiding the information seeking and research processes.

School librarians have a deep understanding of the guidance and instruction that students need to become information literate, a holistic perspective on the school and curriculum, and extensive knowledge of information resources and information technology. In collaboration with other experts on the PBL team, they can provide students with essential project-based learning experiences and resources.

DIGITAL MEDIA LITERACY AND TELEMENTORING

While there is increased use of new technologies for classroom learning (e.g., Moller, Huett, & Harvey, 2008), distance education (e.g., Huett et al., 2008), and library services (e.g., Burger, 2007; Casey & Savastinuk, 2006), there is little evidence that information and communication technologies are being used for project-based learning or telementoring. Email has been the dominant mode of

telementoring communication since the 1990s. The selected K-12 telementoring programs listed in Appendix B indicate that most of these programs use email or discussion lists. Newer forms of online communication such as web-based synchronous communication (instant messaging, text messaging, online chat, and videoconferencing) and asynchronous communication (e.g., using wikis and blogs) have the potential to expand telementoring and help reshape learning to meet 21st century educational challenges (Dede, 2007). The instructional technology specialist is the member of the PBL team with the best understanding of how to use and manage these technologies for learning, communication, productivity, and creativity.

As noted in the introduction, The Partnership for 21st Century Skills has implicated information, communication, and collaboration technologies in the innovative, entrepreneurial thinking that students will need for future success. Attaining literacy with these technologies is thus essential. The New Media Consortium defines 21st century literacy as "the set of abilities and skills where aural, visual and digital literacy overlap. These include the ability to understand the power of images and sounds, to recognize and use that power, to manipulate and transform digital media, to distribute them pervasively, and to easily adapt them to new forms" (NMC, 2005, p. 2). Technology is implicated in all of the top trends the NMC has identified as likely to affect teaching, learning, and creativity in the next five years: (1) Technology continues to profoundly affect the way we work, collaborate, communicate, and succeed. (2) Technology is increasingly a means for empowering students, a method for communication and socializing, and a ubiquitous, transparent part of their lives. (3) The web is an increasingly personal experience. (4) Learning environments are increasingly virtual rather than physical spaces. (5) The perceived value of innovation and creativity is increasing (Johnson et al., 2009, p. 6).

Among the technologies likely to have a significant impact on schools within the next five years are collaborative environments, online communication tools, mobile devices, and the personal web (Johnson et al., 2009, p. 6). While research on the learning impact of newer technologies is still emerging, a number of guides for classroom use are available (e.g., Pitler, Hubbell, Kuhn, & Malenoski, 2007; Richardson, 2008; Solomon & Schrum, 2007). These technologies have the potential to be powerful tools for inquiry-, problem-, and project-based learning in the hands of technologically fluent telementors and motivated, tech savvy, creative students.

Collaborative environments are virtual workplaces where students, teachers, telementors, and others can communicate, share information, and work together. Collaborative online spaces come in many forms, from online office suites for document sharing (for examples of these and other tools, see Table 1), online document collaboration, personal publishing, social networking tools to connect people and collect resources, flexible learning management systems, personal web portals, to classrooms in virtual environments. As well as enabling collaboration, the online spaces leave persistent conversations that remain for self reflection and peer critique. These spaces can be used synchronously or asynchronously at a distance, or to support and document collaborative work done in class.

Full-featured wikis such as PBworks (http://pbworks.com) and WetPaint (http://www.wetpaint.com) are powerful tools for telementoring. In addition to supporting the collaborative creation of web pages, these wikis also provide productivity and communication plug-ins such as calendars, spreadsheets, Google gadgets, chat rooms, photo and video integration, and page level discussion threads. Students working on problems or projects can gather resources, post plans, exchange ideas, and write drafts of papers and presentations on wiki pages. Telementors can monitor student progress as it evolves and provide feedback on these wiki pages. Studies have shown that wikis promote collaboration, encourage negotiation, and familiarize students with new technology tools (Elgort, Smith, & Toland, 2008; Hazari, North, & Moreland, 2009). They are also an effective tool for collaborative project planning and documentation (Parker & Chao, 2007), information or data gathering and organization, and organizing a personal or team research library (Walsh & Hollister, 2009).

Online communication tools such as instant messaging and online chats via desktop video conferencing are a popular way for students to interact with family and friends online. These familiar tools can also be used to extend learning through telementoring. Desktop videoconferencing, instant messaging services, personal publishing like blogging and micro-blogging, and voice-over-IP enable one-

to-one, one-to-many, or many-to-many synchronous communication. As one example, YackPack (http://www.yackpack.com) utilizes voice, video, and text messaging that can also be recorded. This enables one-to-one or one-to-many communication that allows students and telementors to see and hear each other in real time or via archived messages. Students can use blogging tools to set up multimedia journals to share their opinions, ideas, and research. Telementors, teachers, and peers can provide feedback using the comments feature.

Mobiles devices such as the iPhone and the BlackBerry are increasingly being used by young people (Johnson et al., 2009, p. 16). These provide a range of communication options: mobile telephone, email, text messaging, internet faxing, and web browsing. They support multimedia, with a camera and the ability to play music and video. They also incorporate productivity tools such as an address book, calendar, and calculator. Mobile devices have strong potential for educational uses because of the ability to run third-party applications such as GPS and collaborative document software. As of early June 2009, there were approximately 50,000 third-party applications of all types available for the iPhone. It is easy to imagine a wide range of applications being developed for fieldwork, data capture, information organization and analysis, visualization, data sharing, and other research and productivity aids that could support inquiry learning and result in products shared with telementors.

The personal web refers to how we manage the way we view and use the internet, based on "a growing set of free and simple tools and applications that let us create customized, personal web-based environments that explicitly support our social, professional, learning, and other activities" (Johnson et al., 2009, p. 25). The internet has been a major contributor to information overload. Finding, organizing, and evaluating online content are critical for research and learning. Just as researchers and librarians are doing, students can tag and organize web links by subject. Another valuable personal web tool is the feed aggregator, a web application that gathers syndicated web content in one place for easy viewing. News sites, blogs, podcasts, wikis, social networking sites, library websites, and many others provide RSS feeds that automatically appear in personal aggregator content. With the tools of the personal web, teachers, students, and telementors can tag, categorize, annotate, publish, and review work online and build resource collections using web feeds and resources tagged by others. Teachers, students, and mentors can keep track of student work using RSS feeds to import updates of student publishing on the web.

One example of a free, very easy to use personal web tool that can serve a variety of communication and learning functions in telementoring is Posterous (http://www.posterous.com). By simply sending email with attachments to Posterous or grabbing content from the web, one can create a blog with text, video, photos, and music. Posterous provides for privacy, group sites, and email subscriptions to inform each group member of new postings. Posterous could be an effortless way to conduct one-to-one or one-to-many telementoring communication via email, with text enhanced by multimedia in a chronological, open record of the exchanges.

Specialized software may be needed for those who wish to launch their own large-scale telementoring projects and services. One of the best developed is the Telementoring Orchestrator (TMO) from Simon Fraser University's On-line Learning Relationships Lab (http://www.learningrelationslab.org/). TMO streamlines the tasks of building and describing a mentor pool, matching mentors and mentees, and providing opportunities for just-in-time learning, as well as reducing administrative overhead and preventing mentor overload (O'Neill, Weiler, & Sha, 2005, p. 114-115). TMO supports these roles and functions:

> Telementoring Orchestrator assumes three roles: (1) mentors, who volunteer by filling out a recruiting form; (2) coordinators, who solicit the assistance of one or more mentors from the volunteer pool, assign them to mentees, and provide oversight for the relationships until they are closed; and (3) an administrator, who configures the TMO software for a particular program or initiative, and creates accounts for coordinators. … At a minimum, configuring the installation involves: 1. Setting up an e-mail routing account that can be used by mentors and mentees to exchange messages. 2. Specifying a Knowledge Forum 'database' (workspace) in which mentors

> and their mentees can work together. 3. Defining the varieties of expertise or interests that volunteers might share with their mentees. (O'Neill et al., 2005, p. 115-117)

Freely available, this software currently works only on Mac OS X.

To make effective use of these technologies, schools and classrooms need a reliable technology infrastructure, as well as high-speed internet access. Instructional technology specialists understand how and why technology can be used effectively for learning, communication, and productivity. In collaboration with other experts on the PBL team, they guide students toward achieving better digital media literacy and provide tools for creative expression and the development of innovative, personally meaningful products.

As discussed in this chapter's introduction, schools also face more fundamental and far-reaching challenges as they integrate new information and communication technologies (ICT) and reshape the educational experience. As Dede (2007, p. 35) notes:

> At this point in history, the primary barriers to altering curricular, pedagogical, and assessment practices toward the transformative vision of ICT in education … are not conceptual, technical, or economic, but instead psychological, political, and cultural. We now have all the means necessary to implement alternative models of education that truly prepare all students for a future very different from the immediate past. Whether we have the professional commitment and societal will to actualize such a vision remains to be seen.

Table 1. Technologies for Telementoring

	Collaborative Environments	Communication Tools	Mobile Devices	Personal Web	Telementoring Software
Examples	Wikis (PBworks, Wetpaint), blogs (WordPress, Blogger, LiveJournal), office suites (Google Docs, Zoho), flexible learning management systems (Moodle, Sakai), personal web portals (NetVibes, Pageflakes, iGoogle), social networking tools (Flickr, SlideShare, YouTube), virtual environments (Second Life)	Instant messaging (AIM, Meebo, Google Talk), online chat (AIM, Google Talk, Skype), desktop video conferencing (Skype), blogging, micro-blogging (Twitter), voice-over-IP (AIM, Google Talk, Skype), combination voice-video-text messaging (YackPack)	iPhone, BlackBerry	Tagging (Delicious, Diigo), RSS feed aggregators (Bloglines, FeedDemon, Google Reader, Netvibes, Pageflakes), simple, all around personal web tools (Tumblr, Posterous)	Telementoring Orchestrator
Uses	Project planning, document sharing, collaborative writing, personal publishing, social networking, resource collections, portfolios, online classrooms, feedback from teachers, experts, and peers.	One-to-one, one-to-many, and many-to-many communication; archiving messages and conversations; multimedia journals; voice, video, and text communication.	Range of communication options: telephone, email, text messaging, internet faxing, web browsing, multimedia. Third-party applications to support learning and research.	Resource collections, keeping updated on student work, enhanced email communication in a telementoring relationship, portfolios.	Building and describing a mentor pool, matching mentors and mentees, providing opportunities for just-in-time learning, limiting administrative overhead, and preventing mentor overload.

TELEMENTORING MODELS

This chapter began with a brief mention of the types of expert advice being provided online – ask-an-expert services for one-time, discipline-based questions; tutoring for supplementary or remedial study; and telementoring for career guidance, academic advice, or sustained inquiry learning in the classroom. With the exception of the last, these types of advice address three learning needs: the need for disciplinary knowledge, the need for academic advice, and the need for career guidance. Our exploration of inquiry learning, information literacy, and digital media literacy provides a backdrop for assessing the strengths and limitations of these types of online expert advice.

Disciplinary Knowledge

Ask-an-expert services provide answers to one-time, discipline-based questions such as "What are simple, complex, and compound fractions?" or "What is the Pythagorean theorem?" Examples of these services are Drexel University's Ask Dr. Math (http://mathforum.org/dr.math/), U.S. Geological Survey's Ask A Geologist (http://walrus.wr.usgs.gov/ask-a-geologist/), and NASA's Ask an Astrophysicist (http://imagine.gsfc.nasa.gov/docs/ask_astro/ask_an_astronomer.html). Students can ask experts questions that they could not ask of others, and receive answers in a timely manner. However, these services can only provide answers to factual questions that are isolated from the learning context. Factual information does not in itself help students develop critical and creative thinking skills. Moreover, the one-time nature of the process does not help them develop disciplinary knowledge over time.

Online tutoring and homework help services provide supplementary or remedial study that supports well-focused learning needs and guides the student in solving well-structured problems. Often these services are a combination of self-paced tutorials and 24/7 help from live tutors, such as the fee-based services, Tutor.com (http://www.tutor.com/) and Homeworkhelp.com (http://www.homeworkhelp.com/). Free homework help sites are also available, many of them developed or sponsored by school and public libraries. The Internet Public Library's Homework Help page (http://www.ipl.org/kidspace/browse/ref8000) lists a number of free sites. The disadvantage of online tutoring is that the questions and problems are provided mostly by the service, not driven by student inquiry. Online tutoring does not help students develop critical and creative thinking skills by solving authentic, ill-structured problems relevant to their own lives and interests.

Academic Advice and Career Guidance

Academic advice and career guidance are often combined in programs that are aimed at vulnerable and at-risk students. This type of mentoring resembles the traditional mentor model of wise counselor to a young protégé. For example, icouldbe.org (http://www.icouldbe.org/standard/public/lm_index.asp) targets at-risk students from low-income communities. Connecting to Success (http://ici.umn.edu/ementoring/default.html) aims "to promote successful transition of youth with disabilities to adult life." In these types of telementoring programs, mentors encourage students to stay in school and work toward career goals and further education. They provide care and concern, helping with homework and study skills, plans for college, and how to seek and keep jobs. They also help youth improve their communication skills, raise their self-esteem, and change negative and damaging behaviors.

Other telementoring programs are aimed at closing the gender gap in science, technology, engineering, and mathematics (STEM) professions. Programs such as Zoey's Room (http://www.zoeysroom.com/), an online community for middle school girls that fosters interest in STEM subjects, feature chat rooms where girls can interact with professional women with careers in STEM fields.

These programs provide valuable mentoring to specially targeted sectors of students but are not focused on inquiry learning for the development of critical and creative thinking skills. (For those interested in selected programs of these types, Appendix B provides further information.)

Integrated Telementoring Model for Project-Based Learning

While ask-an-expert services and academic and career telementoring address important student needs such as the need for factual knowledge, general study skills, career information, and guidance for at-risk students, they are each limited with respect to sustained inquiry learning focused on authentic problems. To reach the full potential of project-based learning, I propose an integrated telementoring model that involves a team of specialists – teachers, subject matter experts, school librarians, and instructional technology specialists.

- *Classroom teachers* manage PBL projects and facilitate learning on many levels – the process of project-based learning, the team process, community building, individual learning, and the achievement of the learning outcomes.
- *Subject matter experts as telementors* encourage, guide, instruct, and model disciplinary practices and ways of thinking.
- *School librarians* guide students to become information literate and help them navigate the increasingly complex terrain of information resources.
- *Instructional technology specialists* help students achieve better digital media literacy and provide opportunities for creative expression using a wide array of technological tools.

Table 2 summarizes the complementary sets of skills and expertise the team brings to PBL. The model provides a framework for rich learning experiences for students and supports scaffolding of disciplinary knowledge and ways of thinking, project-based learning, information literacy, and digital media literacy. This model is further discussed in the next section.

Table 2. Integrated Telementoring Model for Project-Based Learning (PBL)

PBL Team	Teacher	Telementor	School Librarian	Instructional Technology Specialist
Primary Role	**Pedagogy, Project Management** • Pedagogical content knowledge • Knowledge of learners • PBL coordination & facilitation • Project design • Project planning • Project management • Fostering community building	**Disciplinary Inquiry** • Exploration & discovery • Testing ideas – Gathering data • Testing ideas – Interpreting data • Community analysis & feedback • Broader perspectives on the benefits of inquiry to society	**Information Literacy** • Accessing information • Evaluating information • Critical thinking to analyze, organize & use information for decision making • Information ethics • Reflecting on the information seeking process	**Digital Media Literacy** • Technology tools • Uses of tools for learning • Uses of tools for communication • Uses of tools for productivity • Uses of tools for creative expression

DESIGN CONSIDERATIONS FOR AN INTEGRATED TELEMENTORING MODEL

For the development of 21st century skills, I have proposed that an integrated model of telementoring implemented by a PBL team has the potential to be more effective than current forms of telementoring. This section discusses how the model could be implemented, based on findings from previous studies of telementoring and/or problem-based learning. The main studies referred to are: (1) an examination of the Portals project, funded by the National Science Foundation to support telementoring relationships in project-based computational sciences classes, involving 40 high school students, five teachers, and 12 mentors (Tsikalas, McMillan-Culp, Friedman, & Honey, 2000); (2) Abbott's (2005) study of eight teachers whose students participated in online learning projects hosted by five established online PBL programs (The Electronic Emissary, iEARN, KidLink, ThinkQuest, and ThinkQuest Jr.); (3) a study by Hmelo-Silver and Barrows (2006) that analyzed the facilitation of a student-centered problem-based learning group in higher education; and (4) Project INSITE, a four-year professional development program to prepare teachers to use problem-centered, inquiry-based science (Lehman, George, Buchanan, & Rush, 2006).

As discussed previously, several components of this model – project-based learning, teacher-librarian collaboration, and the use of information and communications technologies for learning – are in themselves challenging to implement. As an integration of these components, this model is even more challenging, as it involves collaboration among all of the PBL team members and the potential use of a variety of online tools. The model requires careful planning, coordination, ongoing collaboration, and negotiation of roles and responsibilities among members of the PBL team.

The planning is done by the school-based members of the team. During the implementation of the project, the teacher's role is both project manager and learning facilitator. Important factors to consider when designing a project using the integrated telementoring model are commitment to the project, learning goals, roles and functions of participants, the online learning environment, and participant readiness for project-based learning.

Commitment

Project-based learning takes much time to plan and sustained effort to complete (Abbott, 2005). The first and most important factor to consider is the desire and willingness of the school-based team members to tackle project-based learning using this model. Another important factor is the school climate and readiness – whether school administrators and peers welcome innovative uses of technology or not. Access to and funding for new technology may also be key considerations.

Learning Goals

These are some of the typical goals teachers set for project-based learning with telementoring (Abbott, 2005; BIE, n.d.; Hmelo-Silver & Barrows, 2006; Lehman et al., 2006; Tsikalas et al., 2000):

- Students engage in the central concepts and principles of a discipline and develop reasoning skills appropriate to the discipline.
- Students do in-depth exploration of authentic and important topics.
- Students solve complex, multidisciplinary, open-ended problems.
- Students create products that solve problems, explain dilemmas, or present information generated through investigation, research, or reasoning.
- Students engage in self-directed learning.
- Students acquire, evaluate, and use information effectively.
- Students use essential tools and skills, including technology, for learning, self-management, and project management.

- Students effectively communicate and collaborate with each other in teams, and online with adult experts.
- Students reflect on their own work and provide effective feedback to peers.

During planning, the school-based team members align learning goals with various content standards, technology standards, and life skills standards (e.g., McCREL, 2009), as well as information literacy standards (AASL, 2007). These learning goals are also associated with the 21st century student outcomes outlined by Partnership for 21st Century Skills (2008), namely, knowledge in core subjects; learning and innovation skills; information, media and technology skills; and life and career skills.

Roles and Functions

The complex, interdisciplinary, and open-ended nature of project-based learning requires a clear view of general functions and roles, as these maybe taken on flexibly by different members of the team over time. Functions generally fall into four areas: (1) structure, (2) process, (3) facilitation, and (4) community building (Tsikalas et al., 2000). Strategies and functions related to each of these areas may be assumed by any member of the PBL team or by the students themselves, depending on their readiness for PBL.

Structural strategies and functions refer to how activities, communication, and the process of project development are structured. What tasks and activities will be done, when, and by whom? Who will communicate with whom, about what, and when? In their study of the Portals project, Tsikalas et al. (2000) found that structural strategies and functions are generally set by the teachers and mentors. Teachers specify student roles and also set the activity structure in which the telementoring occurs, tied to a set of project deliverables. Mentors often structure the process of project development, advising students on what steps need to be taken to complete the deliverables by the deadline. In the integrated telementoring model, school-based PBL team members would collaborate on these activities and make decisions about how to integrate information literacy and digital media literacy skills in a timely manner.

Process strategies and functions refer to expectations related to the learning conversations over time. Tsikalas et al. (2000) found that these are often set by students, who decide on what role the mentor will take, set expectations, ask good questions, build personal relationships with the mentor, and manage the communication (such as selecting the type of media to use to communicate about certain topics). Mentors also perform process functions – assessing and anticipating student needs, providing information, stimulating students through questioning, directing action, extending students' vision of their projects, and exercising quality control.

Facilitation strategies and functions refer to the means of guiding, supervising, and supporting the learning and communication processes. Facilitation strategies can be considered a form of modeling done by the PBL team. Such strategies include pushing for explanations; restatement; summarizing; encouraging students to generate hypotheses; mediating content by reviewing, digesting, and re-teaching; and redirecting communication from impasses (Hmelo-Silver & Barrows, 2006; Tsikalas et al., 2000). Teachers are critical facilitators in the mentoring groups (Lehman et al., 2006; Tsikalas et al., 2000). They create structures to facilitate mentoring, mediate students' interactions with others, and build community. Some help students rehearse important conversations and provide opportunities for students to teach or mentor. When teachers are involved, student communication with mentors is often richer with ideas, opinions, and emotions (Harris & Jones, 1999). In some cases, teachers take on the role of co-mentor (Tsikalas & McMillan-Culp, 2000).

Community building strategies and functions refer to sharing materials, activities, or messages to promote a shared sense of purpose and benefit from participation in the online community. Tsikalas et al. (2000) found that these are undertaken by students, teachers, and mentors alike. For students, this means primarily collaboration within their team. Teachers help build community by fostering a climate of collaboration in their classrooms. Mentors support community building by helping students to socialize

into particular cultures; treating students as colleagues; providing acceptance and encouragement; and referring students to other people for assistance.

The work of teachers as facilitators and project managers is often unknown to mentors. Making this work visible to telementors can provide them with valuable insights into students' knowledge, skills, learning styles, and communication styles. When relevant PBL team communication and collaborative work are conducted or documented in the online spaces, these four types of strategies and functions can be better coordinated and duplication of efforts avoided.

Online Learning Environment

The use of online tools should be carefully planned to meet learning goals, ensure ease of use, and accommodate potentially differing levels of technological fluency among the participants. Factors to consider in structuring the online learning environment include whether online communication will be synchronous, asynchronous, or a combination of both (and which tools to use); whether communication between participants will be private or open to other project teams and mentors; and how to organize resources and individual and group spaces.

Choices about modes of communication and technology tools should be integrated into the regular project planning process – determination of the learning goals, how the learning will be assessed, the skills and understandings expected as outcomes, and the activities that will enable students to achieve those outcomes. For example, if a learning goal is that students understand the structure of a subject, students can organize information in databases (Jonassen, Carr, & Yueh, 1998) or online repositories in wikis and tag each item. Students can then discuss and develop their understanding of conceptual relationships among the tags using a concept map and receive feedback from the PBL team.

In general, the use of separate online tools can be confusing for new users of technology, so the use of a single comprehensive tool (e.g., a full-featured wiki or flexible learning management system) as the main communication center is advisable. The advantage of a wiki over a learning management system is that it can be edited and new pages can be added by any member of a private wiki. At the start of a project, it is important to post goals, project criteria, selected resources, and templates that are accessible to all members of the PBL team, students, and telementors. During the project, wikis are an effective tool for collaborative project planning and documentation (Parker & Chao, 2007). They are also effective for information or data gathering and organization, as well as organizing a personal or team research library that tracks the research process and showcases final products (Walsh & Hollister, 2009). Here, the school librarian plays the major role.

Wiki pages are designed primarily for collaborative writing. Asynchronous discussion and feedback about wiki pages can be done through the page comments or page discussion features available on most wikis. Synchronous discussions may be preferable for brainstorming and other activities that require immediate response. For these, chat plug-ins are available on most wikis. The recorded communication can be used for further collaborative writing, self-assessment, and critique by peers and the PBL team. At the completion of the project, wiki pages and other online spaces can be used for presentations and portfolios.

Telementor-student communication can be done privately and asynchronously via email or synchronously via instant messaging. For group mentoring, O'Neill (2004, p. 182) argues for the importance of "mentoring in the open," where telementoring conversations are visible to other groups and experiences are shared. This provides an opportunity for students to see exemplary telementoring relationships at work and learn from such vicarious, peripheral participation (Lave & Wenger, 1991). Public mentoring discussions can take place asynchronously via discussion forums and synchronously via chat plug-ins in the wiki. These open conversations allow telementors to use the experiences of other groups to guide and scaffold learning, as well as to initiate peer support. When members of the school-based team also participate online or post summaries of face-to-face work in the online spaces, collaboration is strengthened.

Issues and challenges related to mentoring in an online environment are: (1) miscommunication, due in part to the lack of nonverbal cues; (2) slower development of relationships online than face-to-face; (3) the need for competency in written communication and technical skills; (4) a reliable technology infrastructure; and (5) protection of privacy (McLoughlin, Brady, Lee, & Russell, 2007, p. 4).

Participant Readiness

The importance of student readiness cannot be overemphasized. Do students have sufficient content knowledge and skills to handle the project successfully? Do they have the necessary skills with technology and access to the required technology both within school and without? Can they take independent initiative and work collaboratively? Tsikalas et al. (2000) found that students who could communicate and collaborate well with each other tended to do this more effectively with telementors. They also found that mentoring relationships were more successful when students were aware of their needs and proactive about seeking specific assistance. The PBL team can prepare students for the telementoring experience by: (1) encouraging them to be open and honest with their mentors about what they do not understand; (2) providing opportunities to practice describing what they do and do not understand; (3) providing peer and teacher feedback about their communication; and (4) educating them about the various roles and functions mentors may take (Tsikalas et al., 2000, p. 10).

The school-based members of the PBL team need a common understanding of the philosophy, principles, and practice of PBL and preferably some experience either as facilitators or learners. Because implementing PBL online adds complexity, experience with implementing it first face-to-face is beneficial (Savin-Baden, 2007, p. 39). Collaboration requires significant time and effort but also brings rewards in personal learning, professional development, and student achievement. In a study of a yearlong professional development course involving teacher-librarian partners who collaborated on curriculum, Yukawa and Harada (2009, p. 13-14) found that:

> Participants characterized the relationship as a partnership of equals, with teachers providing subject expertise and intimate knowledge of their students and librarians providing information literacy expertise, knowledge of resources, technology expertise, and guidance to students through the conceptual and emotional challenges of the research process. Participants appreciated using each other as sounding boards in deepening conversations about unit and lesson planning, standards, essential questions, assessment tools, and information literacy instruction. A key change in roles was the degree to which librarians were integral to the entire process of planning, implementation, and assessment, with joint responsibility and accountability. A valuable theme was the way the partnerships extended to other faculty at the school.

Telementors who join the PBL team from private and public sector organizations outside of the education sector often find it a challenge to understand how telementoring works in the school culture, which may be quite different from their organizational cultures (O'Neill et al., 2005, p. 111). The role of the telementors can be diverse and encompassing. They encourage, offer advice, coach, help students clarify their values or goals, provide information, act as role models, help students socialize into particular cultures, and stimulate students to acquire new knowledge (Tsikalas et al., 2000, p. 10-11). The most likely mentor group configuration for PBL is one telementor to a small group of students, although a telementor may work with a single student or an entire class. At the start of a project, telementors may need an orientation to inquiry learning, project goals and expectations, student learning needs, their role as consultants, the roles of the other members of the team, the school context, technology and software to be used, and tips on how to communicate with the students online (Bennett, Heinze, Hupert, & Meade, n.d.). Advice to telementors should continue as needed throughout the telementoring relationship.

Using the integrated telementoring model, the PBL team serves as a model for students of the interdisciplinary teamwork that is increasingly valued in today's workplaces and communities. As the PBL team members plan, implement, manage, and facilitate project-based learning for students, they

model the skills in collaborative problem solving, information literacy, technological fluency, innovation, and leadership that they expect students to demonstrate as a result of their PBL experiences.

BENEFITS AND CHALLENGES OF PROJECT-BASED TELEMENTORING

Although PBL with telementoring is time consuming, many teachers feel it is worthwhile because of the benefits to their students. Student benefits include: (1) increased student engagement and motivation, (2) improved writing and speaking skills, (3) improved information gathering skills, (4), improved reasoning and problem-solving skills, (5) learning science and scientific processes, (6) learning about technology, (7) the transfer of learning into student performance, (8) self-directed learning skills, (9) improved collaboration and cooperative learning skills, (10) opportunities to teach their peers, and (11), self-evaluation techniques (Abbott, 2005; Lehman et al., 2006; Ravitz, 2009).

Interviews with volunteer telementors indicate the self-perceived benefits of telementoring: (1) doing outreach for their employers, (2) cultivating interest in their field, (3) increasing the representation of women and minorities in their field, (4) engaging in the pursuit of challenging inquiry, (5) learning more about teaching and about themselves, (6) giving back, and (7) realizing the potential of the internet (O'Neill, 2000, p. 11-15).

PBL with telementoring also brings benefits to teachers, who value: (1) learning new teaching methods and strategies to increase student motivation, (2) learning more about a discipline, (3) learning new technologies and gaining increased technological competence, (4) becoming less directive and more facilitative to promote student-centered learning, (5) seeing students' success, (6) collaboration with others, (7) increased satisfaction from teaching, and (8) improved personal confidence (Abbott, 2005; Friedman, Zibit, & Coote, 2005; Lehman et al., 2006).

The disadvantages of PBL with telementoring include: (1) heavy demands of time and effort, (2) problems with technology and access to technology, (3) disparity in student technology access or skills, (4) classroom management problems, (5) lack of sufficient materials and supplies, (6) difficulties with group dynamics, (7) problems covering content when PBL interferes with the regular curriculum, and (8) poor collaboration and lack of support from team members (Garcia & Rose, 2007; Lehman et al., 2006).

Another significant challenge is effective facilitation. Although facilitation is generally seen as one of the most important dimensions of PBL, Savin-Baden (2007) points out that "there has still been relatively little discussion about what is being facilitated – whether it is students' understanding and enactment of problem-based learning, the team process, the process of learning, individual learning, or the achievement of the learning outcomes, and to what extent the tutor's ability to facilitate affects all these" (p. 41).

While the process of planning, implementation, and assessment of a telementoring project is an important type of professional development in itself, more structured educational opportunities for learning about PBL may also be necessary. One of the best ways to understand PBL and telementoring is for educators to experience these processes for themselves (Gareis & Nussbaum-Beach, 2007; Hitchcock & Mylona, 2000; Weizman et al. 2008). Experience with telementoring, project-based and problem-based learning, and technology integration should begin with pre-service teacher education (Garcia & Rose, 2007; McLoughlin et al., 2007; Price & Chen, 2003) and be extended with in-service professional development (Dede, 2006; Yukawa & Harada, 2009; Weizman et al., 2008).

CONCLUSION

The purpose of this chapter has been two-fold: (1) to explore the rich potential of telementoring for project-based learning in the context of the urgent need to help students develop new skills and literacies, and (2) to provide the framework for an integrated telementoring model to be tested by new telementoring projects. Using this model, an interdisciplinary PBL team of experts – the subject matter expert serving as telementor, the classroom teacher, the school librarian, and the instructional technology

specialist – can provide students with new opportunities for holistic, authentic, personally meaningful learning using emerging technology.

Subject matter experts as telementors encourage, guide, instruct, and model disciplinary practices and ways of thinking. Teachers manage PBL projects and facilitate learning on many levels – the process of project-based learning, the team process, community building, individual learning, and the achievement of the learning outcomes. School librarians guide students to become information literate and help them navigate the increasingly complex terrain of information resources. Instructional technology specialists help students achieve better digital media literacy and provide opportunities for creative expression using a wide array of technological tools. As a team, these experts model the skills in collaborative problem solving, information literacy, technological fluency, innovation, and leadership that are needed in the workplaces and communities of today and tomorrow.

This model requires careful planning, coordination, ongoing collaboration, and a clear view of general roles and functions with flexibility in assuming them. Important factors to consider when designing a project using the integrated telementoring model are commitment to the project, learning goals, roles and functions of participants, the online learning environment, and participant readiness for project-based learning. While collaboration requires significant time and effort, the rewards in personal learning, professional development, and student achievement can be great.

Implementation of the model cannot be divorced from broader educational issues and challenges – the need for formal instruction in new literacy skills for students and educators, professional development on learner-centered approaches like PBL, developing and sustaining school-wide and community-based communities of practice, learning environments that incorporate new technologies, and fundamental changes in the structure of the educational environment. These challenges are also opportunities for project-based telementoring to contribute to needed changes in educational structure, transformations of teaching practice, and more relevant learning experiences for students.

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Appendix A. Selected Project-Based Learning Websites and Resources

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Appendix B. Selected K-12 Telementoring Programs

Programs are free unless otherwise indicated.

Learning Goal	Program	Target Groups	Duration	Mode of communication	Facili-tation	Mentor Training
Project based learning One mentor per class	The Electronic Emissary http://emissary.wm.edu/	K-12 students	6 weeks to school year	Email, forum, chat, teleconferencing	Yes	Yes
Project based learning One-to-one mentoring	International Telementor Program http://www.telementor.org/index.cfm	K-12 students	Flexible	Secure, online messaging system	Yes	
Academic & career mentoring One-to-one mentoring	IBM's MentorPlace http://ibm.mentorplace.epals.org/WhatIs.htm	Grades 3-12	School year	Face-to-face at beginning and end of school year; online messaging	Yes	Yes
Academic & career mentoring (fee-based) Many-to-many	Zoey's Room http://www.zoeysroom.com/	Girls age 10-14; math, science, technology	Indefinite	Online only via discussion list	Yes	
Career mentoring One-to-one mentoring	Connecting to Success (Minnesota) http://ici.umn.edu/ementoring/default.html	High school students at-risk & with disabilities	School year	Only email and school-sponsored activities	Yes	Yes
Career mentoring 3 mentors for each student	icouldbe http://www.icouldbe.org/standard/public/lm_index.asp	Middle & high school students at-risk, inner city	School year	Email, discussion board (anonymous)	Yes	Yes
Online tutoring (fee-based) One-to-one tutoring	Tutor.com http://www.tutor.com/	Grades 4-12 homework help	24/7 live homework help	Instant messaging		
Online tutoring (fee-based) One-to-one tutoring	Homeworkhelp.com http://www.homeworkhelp.com/	Grades 4-12 homework help	Tutorials, live homework help	Audio dialogue, text messaging		
Ask an expert Career advice in science, engineering, technology	GEM-SET http://www.uic.edu/orgs/gem-set/index.htm	Girls aged 13-18	Short term	Discussion list (students known by first name only)	Yes	
Ask an expert Astrophysics	NASA Ask an Astrophysicist http://imagine.gsfc.nasa.gov/docs/ask_astro/ask_an_astronomer.html	General	One-time question-and-answer	Email		
Ask an expert Math	Drexel University, Math Forum, Ask Dr. Math http://mathforum.org/dr.math/	K-12 students	One-time question-and-answer	Email		