

Professional Partnerships: Using a Web-enhanced Biology Program in a Team-Taught-Inclusion Biology Classroom

**Patricia Waller and Darlene Kale, East Penn School District
Alec M. Bodzin and Lana Edwards, Lehigh University**

Paper presented at the National Science Teachers Association 2003 Annual Meeting in Philadelphia, PA. March 27-30.

As professional educators continue to work toward improvement in student learning, partnerships within the school and the larger community are becoming the means to facilitate reformed-based changes in our schools. In this article, we describe a partnership between a local university and a suburban school district that worked together to implement technology-integrated classroom practices to promote student learning within a diverse student environment. The “key partners” in this collaboration are two university faculty members, a science educator/researcher and a special education educator/researcher, with a classroom biology teacher and a special education teacher who co-instructed in an inclusive ninth grade biology classroom. This collaborative endeavor followed a modified-partnership model presented in the Center for Education of the National Research Council report, *Educating Teachers of Science, Mathematics, and Technology* (2001). In this partnership model (see Figure 1), science and special education educator/researchers, and classroom teachers work as essential partners to enhance inclusive science teacher education and to promote more effective learning strategies for the implementation of curricular materials. The members of the partnership also work together to facilitate professional growth and development for each other. This interaction between the classroom teachers and university faculty increases the level of knowledge and understanding of content, pedagogy, and learning for all participants in the partnership. The instructional practice of the partnership activities are informed by (1) educational research, (2) recommendations from national organizations involved with enhancing teaching and learning, and (3) data gathered from curricular implementations by the partnership itself.

Need for the Partnership

The classroom instructional partners co-teach a mix of lower-level learners and students identified with learning disabilities in an inclusive applied biology classroom setting. Both teachers have high expectations for success for all students. The instructional delivery of curriculum materials is often modified to accommodate the diversity of student learning styles found within this class. For example, to assist learners in understanding biological processes, a series of sequential drawings are often presented to students using a whiteboard or overhead projector in concert with direct instruction.

Prior to the partnership, computer use by the biology teacher was very limited and mainly consisted of information-seeking activities on the Internet. On occasion, a particular Website was assigned as homework for practice or as a review of the material addressed in class. The special education teacher had used interactive educational software with her students and found them to enhance student learning. In addition, the special education teacher had prior experiences using Power Point presentations that contained links to available Web resources.

Both teachers were aware that the World Wide Web provides various instructional resource types to enhance student science learning. These resources include:

- Scientific visualizations - These are rich representations that present scientific relationships as visual patterns and provide data-intensive descriptions of phenomena.
- Simulations - Interactivities used to simulate and explore complex phenomena.
- Animations or Video clips - Animations or video clips to illustrate science content, concepts, or processes.
- Still images - Still images to illustrate science content, concepts, or processes.

The teachers believed that incorporating such instructional resource types combined with effective instruction would assist student learning. However, the school team was frustrated in their attempts to incorporate technology. Locating and finding suitable instructional materials was a very time coming

endeavor. In addition, they often experienced technical problems with their computers and network connections in the school computer lab.

Despite this frustration, or because of it, the classroom teacher accepted an invitation to participate in an evaluation workshop of a new Web-integrated biology curriculum at a local university. This new curriculum was designed to promote biology literacy that is consistent with the *National Science Education Standards* (National Research Council, 1996), i.e. to improve students' understanding of fundamental biological concepts, develop their skills in scientific reasoning and inquiry, and enhance their attitudes towards science and technology using student-centered instruction. The curricular materials consisted of a short concepts-oriented textbook, an extensive Website, and inquiry-based laboratory activities and experiments. The learning environment was designed to be user-centered and to promote the active learning of biology using a 4 E's learning cycle model, a modification of the 5 E's instructional model (Biological Sciences Curriculum Study, 1993). The "E's" represent various phases of the constructivist learning cycle (*engage, explore, explain, evaluate*).

The classroom teachers were interested in using the curricular materials in their classroom with a goal to improve the incorporation of instructional technology within their inclusive science teaching practices. The university educators/researchers interests included learning about contextual factors pertaining to the successful implementation of these materials in inclusive classroom settings as part of the curriculum evaluation. In addition, the university educators/researchers were updating their knowledge in this area to better prepare the preservice science and special education teachers in their university methods courses. Therefore, a partnership was established to benefit the goals of both groups of educators.

Partnership Implementation

During a period of six weeks, the university educator/researchers observed two inclusion biology classes as participant observers. The educator/researchers provided feedback and recommendations to the classroom teachers as they implemented new technology-based curricular materials with their students. During class and lab activities, the educator/researchers would question students individually and in small groups to determine how they were learning with the classroom activities. After each class, the educator/researchers would recommend pedagogical changes that could be implemented in future lessons and activities.

One major change that occurred was how students accessed the Website content. At the beginning of the implementation period, students traveled to a computer lab and worked on individual computers. The educator/researchers noted that much instructional time was lost when they traveled to a new classroom location. In addition, some students experienced difficulties with logging on to the school network to access a Web browser. Sometimes students were distracted by some of the interactive features on the Website and focused more on media novelties than on understanding content. In addition, the educator/researchers noted that the content teacher's management style was different in the computer lab than in her classroom. She appeared more comfortable handling discipline issues in her own classroom than in the computer lab setting. To facilitate student learning, the educator/researchers recommended that the classroom teacher deliver certain content instruction from the Website in her own classroom using a computer connected to an LCD projector instead of having each learner sitting in front of individual computers. The use of the LCD projector in the classroom resulted in improved attention toward the content. In addition, the questioning strategies used by the teacher provided additional scaffolding for student understanding. The projected images and animations from the LCD projector on to the front of the classroom enabled the teacher to point out the key pieces of information to assist student understanding of concept.

Many of the conversations among the partners included how to customize the curricular materials to better accommodate the learning needs of their students. The teachers would have to review basic laboratory skills such as measuring with rulers prior to implementing laboratory activities. Additional guided prelab questions and activities were developed to provide learners with scaffolds to help guide their thinking about the processes that would be occurring in the laboratory. The discussions of the sequencing of instruction and different methods of implementing curricular materials provided for much reflection on enhancing existing inclusive science classroom practices.

Assessing Inquiry Skills

Prior to the partnership, the teachers did not use inquiry-based laboratories with her inclusive classroom students. Often the laboratories that were used with these students were highly structured, material-centered verification type activities. During the partnership, students participated in a guided research laboratory in groups of four. The inquiry-based activity was a weeklong laboratory, much longer than the usual laboratory implemented for the level of these students. This investigation was a two-part laboratory in which learners are provided with two questions to investigate: *How fast does photosynthesis occur? How can an organism's photosynthesis be measured?* Learners are provided with a detailed procedure for setting up a syringe for data collection. They are then directed to collect specific data with a lab protocol. The “Analysis” section guides learners to analyze a graph to determine the rate of respiration. The “Conclusions” section of the first part of the lab prompts learners to formulate their own questions to be investigated in the second part of the laboratory. In the second part of the laboratory, learners are prompted to review their lab techniques, and are offered suggested topic areas to help formulate their own question to investigate. Learners then design and implement a new experiment. Experimental results are communicated in a laboratory report.

The use of Web-based animations that illustrated how to utilize the syringe measuring tool provided students with additional confidence as they followed the written directions. Through a repetitive process of reviewing an experimental protocol, seeing the use of equipment in a Web-based visualization, and developing experimental protocols for their own investigations, the students became more confident in their use of laboratory equipment and investigative processes.

A laboratory rubric (see Figure 2) was used to assess student understandings of the investigative process. The educator/researchers also conducted small group informal interviews with the students to ascertain their understandings of biology content and concepts learned in the laboratory. The analysis of the laboratory report rubrics indicated that most of the students understood the investigative processes and the fundamentals of the content. In addition, the inclusion students were able to successfully complete an inquiry-based investigation.

Advantages of the Partnership

From the classroom teachers' perspective, having additional sets of eyes during the learning activities provided an increased comfort level for the classroom teacher. An inclusion biology classroom consists of diverse learners both motivated and unmotivated. In addition, ninth graders, as a group, have difficulty adjusting to the curricular content that is demanded of high school age learners. The university educator/researchers, both clinical supervisors of instruction, focused their observations on the learners' engagement. The feedback that was provided assisted the classroom teachers with thinking about applying new pedagogical practices and implementing additional curricular customizations designed to assist student learning.

From the perspective of the university educator/researchers, new insights were gained to help train preservice science educators and special education teachers for future work in inclusive science classroom settings. These insights included: provisions for collaborative planning between special education

teachers and science teachers; the importance of curricular customizations to existing materials; additional supports to access content for science instruction; use of inquiry supports to assist student learning; and diverse instructional delivery systems to meet the needs of inclusive science classroom learners.

Technology Implementation.

The university educator/researchers provided specific technology implementation suggestions to the classroom teachers. They provided the teachers with vocabulary necessary to communicate properly with the school's technology office. They informed the teachers of different techniques that would assist them in the use of the computer to promote student learning. One of the most important recommendations was to use a LCD projector in the teacher's own classroom instead of the students using individual computers in a computer lab setting. The regular education teacher who had limited experience with computers as a tool in the classroom was encouraged by the educator/researchers to borrow the science department's LCD projector and use a one-computer classroom model for delivering direct instruction. Upon implementation of this recommendation student attention and participation increased during the class. The educator/researchers noted an increase in the students' time on-task from 42% with working on individual computers in a computer lab to 88% when the teacher used the LCD in her own classroom. With the more frequent use of the one-computer model, the teacher's confidence increased; thus, obtaining one of the goals of the partnership.

During the partnership implementation, student content knowledge increase significantly on biology content assessment. This improvement in test scores provided credible evidence for the classroom instructional team to petition their school district administration to purchase an LCD projector and interactive whiteboard for classroom use in the forthcoming school year. This research supported evidence assisted administrators in making technology-purchasing decisions assisted them when they requested technology funds from their school board.

Inclusive Science Practice.

The educator/researchers provided validation for many of the techniques the teachers had developed during their careers (Kame'enui & Simmons, 1990, 1998). They noted the importance of assessing student background knowledge and prerequisite skills. Successful acquisition of new information depends largely on the knowledge the student brings to the task, the accuracy of that information, and the degree to which the student accesses and uses that information (e.g, mastery of previous information) (Kame'enui & Simmons, 1998). Students in the inclusive biology classroom struggled with content and activities when they did not have sufficient background knowledge to complete a particular task. For example, students inaccurately calculated results for their chromatography lab because they did not have proficiency with prerequisite measurement skills.

The educator/researchers also noted that the use of teacher questioning helped structure students' understanding. This strategic use of prompts and questions provided a “scaffolding” of temporary instructional support as students learned new content. Guided questions targeted specific concepts and helped teachers limit the amount of information that would be required for students to process at a given time. The educator/researchers also observed that teachers focused instruction on the “big ideas in science.” In other words, teachers emphasized the essential biology concepts and principles that would facilitate efficient and broad acquisition of knowledge. Presenting “big ideas” reduced unnecessary terminology and helped inclusive students better understand science concepts. The use of conspicuous strategies was also observed. When introducing new laboratory procedures or biological processes (i.e., photosynthesis), teachers would make the steps of the process or aspects of the content explicit. “Thinking aloud” during direct presentation of content made steps more observable and helped make complex tasks more manageable for students with learning disabilities.

Strategic integration was also documented during classroom instruction. Teachers helped students strategically integrate or link target concepts across lessons. The educator/researchers observed that

teachers carefully combined new information with content information that students already knew. Teachers also embedded a systematic review of newly introduced skills and content during the biology unit. Repetition of information and laboratory directions, for example, helped reinforce skills needed to complete laboratory activities successfully. Finally, classroom observations revealed active classroom engagement. Students were consistently involved in a variety of academic tasks that required responses through a range of modalities. For example, students took notes, completed guided-note sheets, engaged in direct, dialogic communication about biology content during small group activities with peers, used Web-enhanced curriculum, and participated in laboratory experiments.

Overall, instruction in the inclusive biology classroom included the use of explicit instruction to facilitate inquiry learning. Teachers directly modeled and demonstrated how to think about biology content and how to think through steps in laboratory experiments. Teacher-directed instruction included the face-to-face telling, sharing, modeling, demonstrating, and direct leading of academic learning (Baumann, 1984). Teachers communicated information to students explicitly and in ways that used instructional time deliberately and efficiently (Kame'enui, Jitendra, & Darch, 1995). When students demonstrated increased understanding of the content through the use of explicit instructional supports, students became progressively more independent with inquiry-based applications as learning shifted from teacher-directed to student-directed.

New Pedagogy-Roadblocks

Successful experienced, classroom teachers frequently do not have the time nor inclination to explore new tested pedagogical techniques. Three major factors contribute to this lack of interest in new learning new pedagogical approaches: time, energy, and risk. Time is needed to find, explore, learn and practice new techniques. When attempting to incorporate new techniques into an existing teaching style, a teacher uses more energy compared to using the style with which they are comfortable. The extra

attention needed when using a new methodology is added to the usual teacher concerns about student involvement and content delivery during the class. Another factor is the risk to a teacher's professional reputation. To successful teachers, the risk of failing in an attempt at new pedagogy is a threat to their self-confidence.

New Pedagogy-Reducing the Roadblocks

Becoming part of a partnership reduces some of the anxieties caused by the factors listed above. Our partnership presented the opportunity to implement well-designed Web-based instructional material without requiring the classroom teacher to expend time to locate animations and interactivities to be used to assist learners in understanding biology content and concepts. Time was needed to customize the existing materials to accommodate the needs of an inclusive classroom. The energy utilized to incorporate the curricular materials into the classroom was reduced since the educator/researchers shared their knowledge of pedagogical approaches. The fear of failure was buffered by the educator/researchers' support of good pedagogical practices that were implemented. This encouragement provided positive feedback to assist teachers in overcoming difficulties they experienced. Finally, the school administration was supportive of the partnership. They knew the teachers were exploring new curricular materials and practices to would benefit the students.

Conclusion

Partnerships, as described in this article, can provide a way for the classroom teacher to be provided with ongoing informal professional development as they explore new pedagogical approaches in a supportive climate. Classroom teachers experience enhanced professionalism as new content, new pedagogies, and new resources are shared in a collaborative endeavor. The real benefit accrues to the students. The classroom students in this partnership were provided with the opportunity to participate in

an inquiry-based scientific investigation. In addition, they had the opportunity to use Web-based materials that helped motivate them to learn.

The National Research Council and National Institute for Science Education are encouraging partnerships as the most effective way to bring about improvement in science education in K-12 institutions. With opportunities for partnerships available, the most important recommendation to a science teacher is get involved as soon as possible.

Notes

1. The preparation of this article was funded by a grant from the National Science Foundation (NSF), Grant IMD-9986610. The opinions expressed are those of the authors and do not necessarily reflect the position of NSF.

References

Baumann, J. F. (1984, December). *The systematic, intensive instruction of reading comprehension skills*. Paper presented at the annual meeting of the National Reading Conference, St. Petersburg, FL.

Biological Sciences Curriculum Study. (1993). *Developing Biological Literacy: A Guide to Developing Secondary and Post-secondary Biology Curricula*. Colorado Springs, CO: Biological Sciences Curriculum Study.

Committee on Science and Mathematics Preparation (2001). *Educating Teachers of Science, Mathematics, and Technology-New practices for the Millennium*. Washington, D.C.: National Academy Press.

Kame'enui, E. J., Jitendra, A. K., & Darch, C. B. (1995). Direct instruction reading as contronym and eonomie. *Reading and Writing Quarterly: Overcoming Learning Difficulties, 11*, 3-17.

Kame'enui, E. J., & Simmons, D. C. (1998). *Effective teaching strategies that accommodate diverse learners*. Upper Saddle River, NJ: Prentice Hall.

Kame'enui, E. J., & Simmons, D. C. (1990). *Designing instructional strategies: The prevention of academic learning problems*. Englewood Cliffs, NJ: Merrill.

National Research Council. (1996). *National Science Education Standards*. Washington, DC: National Academy Press.

Figure 1. Partnership model.

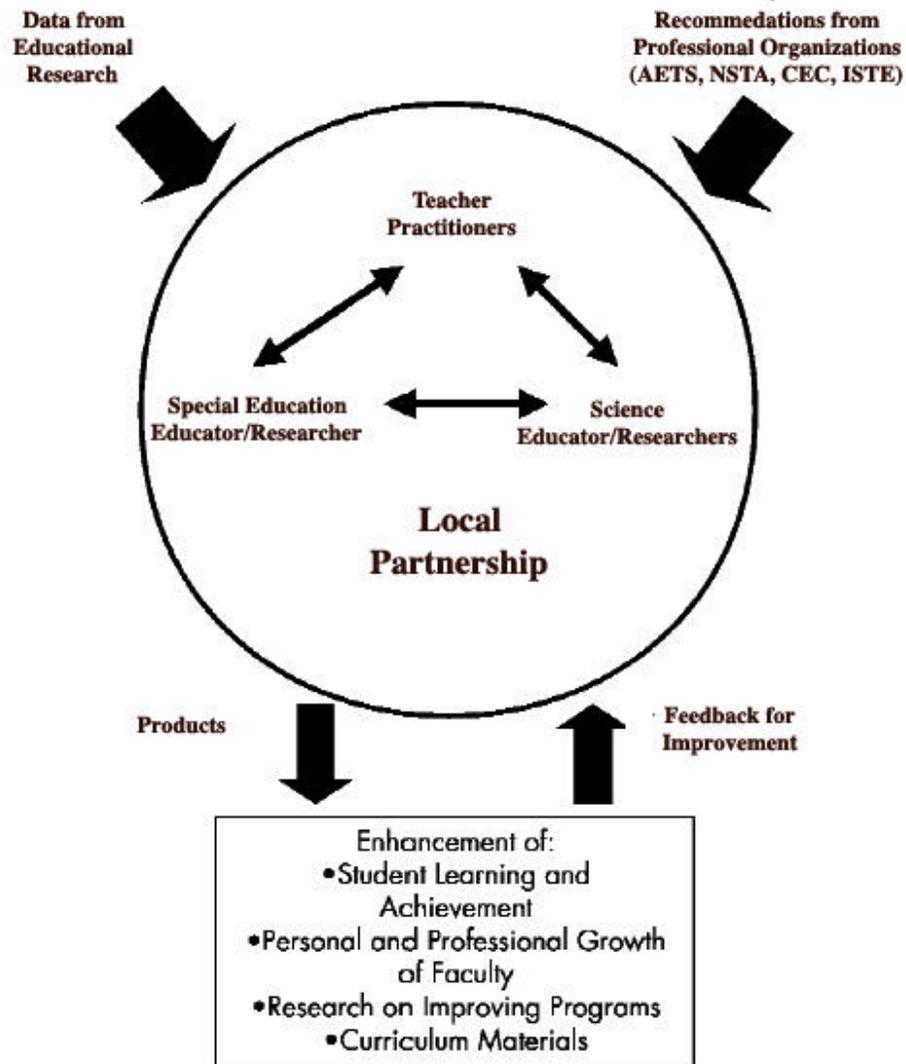


Figure 2. Laboratory Rubric

(modified from a rubric used by the Olathe East High School Science Department, Olathe, KS)

Standards: The levels at which students are expected to perform the task

Score	Advanced (5)	Proficient (3)	Needs Improvement (1)
_____	<ul style="list-style-type: none"> Question is narrowly focused and suggests how an answer might be investigated. It is answerable. 	<ul style="list-style-type: none"> Question is answerable but not narrowly focused. 	<ul style="list-style-type: none"> Question is too broad and not practically investigated.
_____	<ul style="list-style-type: none"> Correctly identifies specific, measurable independent and dependent variables. 	<ul style="list-style-type: none"> Identifies variable being tested & variable being measured. 	<ul style="list-style-type: none"> Variables and constants significantly incomplete &/or inaccurate.
_____	<ul style="list-style-type: none"> Hypothesis is testable and clearly stated in "If... then..." format. Specifically predicts relationship between dependent and independent variables. 	<ul style="list-style-type: none"> Hypothesis is clearly stated. It predicts the influence of one variable on another. 	<ul style="list-style-type: none"> Hypothesis is poorly stated and doesn't directly mention the variables.
_____	<ul style="list-style-type: none"> Complete, detailed list of materials (size, conc., quantity) presented in vertical list format. 	<ul style="list-style-type: none"> Most materials are listed and appropriate. 	<ul style="list-style-type: none"> Materials quite incomplete or inappropriate for experiment.
_____	<ul style="list-style-type: none"> Accurately tests the hypothesis 	<ul style="list-style-type: none"> Attempts to test hypothesis 	<ul style="list-style-type: none"> Does not address hypothesis.
_____	<ul style="list-style-type: none"> Conducts or analyzes at least 3 trials. 	<ul style="list-style-type: none"> Multiple trials attempted or need is recognized. 	<ul style="list-style-type: none"> Single trial, poor understanding of use of multiple trials.
_____	<ul style="list-style-type: none"> Procedure is in vertical list format, accurate, complete, easy-to-follow, and reproducible by another person. Includes diagrams to clarify procedures. 	<ul style="list-style-type: none"> Step-by-step procedure, generally complete. Minor errors/ omissions make it difficult to follow or not always repeatable. 	<ul style="list-style-type: none"> Procedure difficult to follow. Major omissions or errors.
_____	<ul style="list-style-type: none"> Includes all appropriate safety concerns. 	<ul style="list-style-type: none"> Includes critical safety concerns. 	<ul style="list-style-type: none"> Safety concerns trivial or inadequately addressed.
_____	<ul style="list-style-type: none"> Data table contains accurate, precise raw data & summary data reported in correct SI units with descriptive title. 	<ul style="list-style-type: none"> Data table with accurate data, most units labeled or implied. Minor errors. Title absent or trivial. 	<ul style="list-style-type: none"> Data table inaccurate, confusing, and/or incomplete. Missing units.
_____	<ul style="list-style-type: none"> Data summarized in well-organized, easy-to-read graph &/or figures. Descriptive title, appropriate labeling, keys, etc. 	<ul style="list-style-type: none"> Data displayed in well organized easy to read graph &/or figures. Descriptive title, minor errors in use of units and labeling. 	<ul style="list-style-type: none"> Graph/figures presented in a confusing and/or sloppy fashion.
_____	<ul style="list-style-type: none"> Data summarized in a clear, concise, logical manner. Patterns identified & described, but no conclusions drawn. 	<ul style="list-style-type: none"> Reasonable, but somewhat unclear summary of data. Patterns in data not clearly identified. 	<ul style="list-style-type: none"> Summary is unclear and illogical. Patterns in data not identified.
_____	<ul style="list-style-type: none"> Scientifically valid, logical conclusion, well supported by the data collected. Clearly addresses problem and stated hypothesis. 	<ul style="list-style-type: none"> Scientifically valid, logical conclusion, supported by data collected. Attempts to address problem and stated hypothesis. 	<ul style="list-style-type: none"> Conclusion is incomplete or illogical. Does not address the problem and hypothesis.
_____	<ul style="list-style-type: none"> Sources of error identified and explained. Appropriate recommendations made to eliminate errors. 	<ul style="list-style-type: none"> Sources of error identified. 	<ul style="list-style-type: none"> Weak/trivial attempt to identify sources of error.
_____	<ul style="list-style-type: none"> Student generates specific questions for future study. 	<ul style="list-style-type: none"> Student makes attempt to generate questions for future study. 	<ul style="list-style-type: none"> Student makes incomplete or inappropriate attempt to extend or apply knowledge.