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Project-Based Learning in the Elementary Classroom

by Cathleen Galas & Lisa Rosenthal, with Laura Weishaupt

Project-based learning provides a highly motivating means of teaching basic skills and disciplinary knowledge while also helping children learn how to access and use multiple resources, work collaboratively, and develop planning skills.

Which would you rather do, listen to a lecture on brain development or create a computer program that shows a human brain "developing" before your eyes? Read a book on the life cycle of plants or create your own garden? If you are like the children at Seeds University Elementary School (UES), in both cases you'd choose the latter alternative, what we call "project-based learning." In project-based learning children study neurons in the course of creating computer software; they venture into the garden to learn about plant life. In the process they also learn skills in language, math, art, planning and other areas.

Using project-based learning places students in a real-life, contextualized learning environment. By serving as a bridge between real-life experiences and classroom activities, project-based learning gives value to the questions and answers that arise in the learning process. Working on projects requires students' active engagement for an extended period of time and promotes links among subject matter disciplines. It teaches children how to access and use multiple resources, develop planning skills, and work collaboratively. And project-based learning offers teachers a way to involve parents productively by showing them how real-life activities at home can provide opportunities for learning. With project-based learning, children are more active, engaged and enthusiastic in their learning because their questions are generated by a need and a desire to know rather than an assignment. This creates a more motivating, authentic, and enjoyable learning environment.

What is a Project?

The two core components of project-based learning are: (1) a set of experiences through which children can develop a line of inquiry they want to pursue and generate their own questions, and (2) an investigation that allows children to represent their thinking in a variety of ways and by a variety of means.

Project-based learning builds on children's own interests and questions and involves children in the kinds of activities that scientists and others engage in in the real world. At UES, students work in collaborative teams as well as individually. Teacher-guided instruction and student inquiry run concurrently, with the teacher playing a "facilitator" role to scaffold student learning and children generating and seeking answers to specific questions**.** Children learn about concepts in-depth, but not from a textbook or a lecture**.**

Teachers play an active but non-traditional role in project-based learning. Rather than rigidly deter-

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Also in this issue:

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A Message From the Director

On Preparing Students for the Information Age

When I was a child in the 1950s, doing a report for school was easy. In elementary school I referred to the *Golden Book Encyclopedia* that my parents had bought, one a week, at the grocery store. By sixth grade I had graduated to the *Encyclopedia Britannica*, which I went to the library to use. I never copied; I always paraphrased—although I confess to tracing a map or drawing from time to time.

It was a pretty limited approach to learning then. It makes little sense now. Information is changing at such a rapid pace that parts of encyclopedias can be out of date by the time they are printed. And today's students have access to a breadth of sources of information that didn't even exist when I was young.

The implications for us as educators are enormous. The value of imparting knowledge is diminishing rapidly. To be sure, there are still knowledge and skills that children need to learn; the world is not in such a state of flux that everything is changing on a daily basis. But a lot is changing, and rapidly.

Our role now is primarily to prepare children to be discerning consumers of new "information." In the new millennium students will need to be able to evaluate critically the many sources of information they have access to, make sense of contradictory information, and analyze and integrate different perspectives.

To help children at UES prepare for the information age we are searching for new strategies to develop inquiry skills—to teach children how to formulate questions and then seek, critically evaluate, and summarize what they have learned. The project-based learning described in this issue provides a few examples of approaches we have developed.

In addition, we have developed a curriculum on information management that can help teachers embed information literacy strategies across all areas of the curriculum, from elementary through high school. *Managing Information in a Digital Age* seeks to promote the skills, knowledge, and attitudes that will help students to develop effective lifelong information awareness, seeking, management, and presentation strategies. It also provides a natural vehicle for the integration of technology into instruction. And by utilizing a variety of tools to help students understand the information they gather, the curriculum addresses the needs of students from non-English-speaking families. The UES Information Management Curriculum will be available in February and can be ordered through the UES web site, at **http// www.ues.gseis.ucla.edu.**

— Deborah Stipek

Browse CONNECTIONS on the UESC website, where you can also find a link to the Seeds UES home page:

www.gseis.ucla.edu/research/uesc.html

Teachers and Classroom Climate

by Leslie Ponciano & Carollee Howes

Researchers have found that the social relationships among students and between students and the teacher can influence children's learning, both positively and negatively.

Teachers who are struggling with classroom management issues might find that working on classroom climate—the social relationships among students and between students and the teacher—will help. This is the implication of new research on children's school success. Many researchers working in preschools, elementary, and middle schools are discovering the importance of social relationships within classrooms. They are finding that when relationships among teachers, students and classmates are negative, time is spent dealing with interpersonal confict and children are less motivated to accommodate to the teacher's agenda. Positive relationships, in contrast, promote harmonious and productive interactions and allow classroom learning to proceed.

The Classroom Social Climate

What is a classroom social climate? We define the social climate of a classroom as including:

- the quality of relationships and nature of interactions between children and the teacher
- the quality of relationships and nature of interactions among classmates
- the level of aggression and conflict

Imagine, for example, a classroom where the children follow classroom rules, work responsibly on assigned tasks, and are cooperative and helpful to each other. Children engage cooperatively in complex ways that enhance their learning; disruptions and behavior problems are rare. When children work in small groups, they talk amicably and learn from each other, focusing on the assigned tasks. Because the teacher is not distracted by the need to get children on task or manage conflicts, he or she can move around the room to help individual children who may be struggling or have questions.

Researchers have found that in classrooms that look like this, the teacher is usually friendly and supportive and has a positive relationship with each child. The teacher knows children well and uses this knowledge to help them learn. Children feel emotionally connected to and supported by their classmates.

Now picture a classroom where the children are aggressive and disruptive. When the children are asked to work together they work in a parallel fashion or acrimoniously. In this classroom, a small group project would run into difficulties. The groups would be unable to get started because of disagreements and lack of cooperation. The teacher's time would be spent with behavior management, rather than in facilitating learning.

Researchers are finding that in classrooms that look like this the teacher is not connected to children at a personal level, and may appear angry, even hostile. The teachers' relationships with some children are based on conflict rather than closeness and a good understanding of

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individual children's learning styles and emotional needs. Children in such classrooms are often organized into cliques, and they do not feel responsible for each other's emotional well being or learning.

Creating Positive Classroom Social Climates

How can teachers create positive classroom climates? The research suggests two pathways:

- The organization of classroom learning opportunities and opportunities for peer collaboration
- Establishing close, personal relationships with children, including those that have histories of conflictual relationships

Classroom Organization and Peer Interaction

Peer interaction is an integral part of the classroom social climate. And research has shown repeatedly that the degree to which teachers encourage and develop positive interactions among students in the earlier years affects children's social competence with peers later on.

Studies suggest that this can be accomplished in part by providing opportunities for and encouraging peer interactions. Classrooms that focus almost exclusively on basic skills, with students working independently, do not promote positive social skills and peer relationships (Howes and Matheson, 1992).

Positive peer interactions can be promoted in part by organizing classroom tasks to require collaboration. One study of exemplary teachers in inner-city elementary schools found that the teachers encouraged collaboration and emotional support among their students. They created tasks and activities in which students were interdependent, and promoted helpfulness and a sense of responsibility for each other's learning. Cultural diversity was celebrated and students were encouraged to take pride in their cultural heritage. These effective teachers were also emotionally and personally involved with their students.

Another study showed that cooperative learning environments promoted healthy relationship-building among students (McCallum and Bracken, 1993). These researchers define healthy relationships as those in which interactions are beneficial for each person involved and that lead to socially desirable outcomes. Other studies have shown that cooperative learning situations have a positive influence on the quality of support, help, and friendship among teachers and peers (Johnson, Johnson, and Anderson, 1983).

Other strategies can also be used to promote a social context in which students are respectful of each other and support each other's learning. Put-downs, name calling and other forms of verbal aggression should not be tolerated. And children can be taught, in addition to being encouraged, to help peers. Teachers can, for example, teach even very young children how to give a classmate hints and suggestions rather simply telling them the answer to a question.

Children can also engage in discussions and in role-playing to learn strategies for dealing with peer conflict situations. "How do you think John felt when you called him __?" "What else might you have said to let him know you were angry?"

Establishing positive relationships

It is the relationship that develops between each individual child and the teacher that has the greatest impact on children's later social and school competence. Several studies have found that when children develop more positive teacher-child relationships as they begin school they are more successful as older elementary children, not only in forming positive relationships with subsequent teachers but in attending to learning goals and activities.

Positive relationships can be achieved by showing interest in students as human beings—greeting them warmly when they enter the classroom; asking about their birthday party or their new baby brother or their trip to Nebraska; and being attentive and responsive to emotional distress. It also means holding them to high academic standards and investing in their learning in a way that shows them you care whether they master the material.

It is difficult to avoid negative, conflictual interactions with disruptive students, and the attendant negative effect on the tone or social climate of the classroom. Some teachers, however, are able to work with students who have severe behavior problems and construct positive relationships with the students by disconfirming past negative teacher-child relationships. One study, for example, found that when disruptive students, who expected to face hostility and anger from the teacher, instead found warmth, understanding, and firm limits, they eventually altered their behavior (Howes and Ritchie, 1998). This finding demonstrates that although children affect the social climate of the classroom, teachers can sometimes turn negative into more positive relationships.

Classroom Climates Affect Individual Children

Research has also shown that the classroom environment affects the behavior of individual children.

In a recent study, a group of boys were rated as highly aggressive. Some of these boys were enrolled in

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Not Making the Grade: Reporting on Student Progress

by Laura Weishaupt, Deborah Stipek & Margaret Heritage

Evaluation practices that enable students to participate with teachers in evaluating their own learning are more effective, provide more information, and are more motivating than traditional letter grades.

Grading is one of the most common means by which teachers give feedback to students and parents regarding children's work. Most schools use some version of letter grades, such as A,B,C, D, and F; or E (excellent), S (satisfactory), and N (needs improvement).

At Seeds UES we want student evaluations to be consistent with our philosophy of encouraging children to be independent learners who can participate with teachers in evaluating their own learning. To do this, we believe evaluations should be child-centered and focus on children's specific skills and needs.

Traditional letter grades fail on all counts. What information is contained in a B? With grade inflation, it no longer necessarily means "above average." Even if it did, "above average" provides no information at all on what a child knows and understands and what she needs to learn next. Moreover, the meaning of any grade can change, even in the same school, as children move from one teacher to another.

Indeed, grades often promote "gaming"—children jockying to get the teacher who is known as the easy grader. And research has shown that many children become more focused on getting good grades than on

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first grade classrooms with other highly aggressive children (Group 1) while the rest of the boys were enrolled in classrooms with lower levels of aggression among classmates (Group 2). The boys in Group 1 were more likely to be rated by their teachers as highly aggressive five years later, in the sixth grade. The boys in Group 2 were seen as less aggressive in the sixth grade. The findings suggest that the level of aggression they were exposed to in the classroom environment during first grade influenced their behavior, as perceived by teachers in the sixth grade.

It's Worth the Investment

Investing time in relationships with each student and creating a positive social climate in the classroom require considerable time and effort, but both can have immediate and long-term benefits for children. A positive social climate will pave the way for children to have positive relationships in future learning contexts. In the short-term, it will also help create an environment in which children can focus on learning the academic curriculum.

For Further Information

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actually learning or mastering the material. Ironically, getting a good grade often leads to strategies—such as taking shortcuts and even cheating—that do not necessarily promote learning.

As a motivational tool, grades are effective for a small subset of children—those who care about grades, see good grades as within their grasp, and need to work hard to get them. Children who learn more slowly than their peers soon find that no matter how hard they try, they will not do as well as most of their classmates. Good grades, therefore, are not perceived as accessible, regardless of how hard children work. For children who learn more quickly and easily than their classmates, good grades are achieved without much effort. If grades are their primary source of motivation, they have no reason to exert a lot of effort and really push themselves to the next steps.

Many studies have shown that the most motivating evaluative feedback: (1) conveys a sense of developing competence by drawing children's attention to their new skills and understandings; (2) provides guidance for future efforts; and (3) is genuinely accessible to all children, regardless of how their skills compare to those of their peers.[1] An alternative to letter grades is clearly needed to achieve these goals.

Student Evaluation at Seeds UES

At Seeds UES we have developed evaluation practices that avoid the ambiguities and shortcomings of a traditional letter grading system. The system helps children and parents play a more active role in children's learning. It is designed to help students become independent learners who are able to judge the quality of their own work and are more likely to be motivated in their learning. Teachers benefit from having assessment information that is clearly linked to their goals and suggests next steps for their instruction, and parents gain a clearer, more complete picture of what their child has gained in school and areas in which they might want to provide further assistance.

What Does A Non-Grade Look Like?

At UES, evaluative feedback on student learning comes in two major "categories": ongoing, *formative* feedback usually given to students as they work in the classroom, and *summative* feedback in the form of a final report card (called a "report form"). In both cases, information is linked to performance objectives, which are necessary for teachers to know what to give feedback on. Teachers and administrators have identified key concepts and skills within each content area; both daily observations and informal assessments are used to determine student progress in acquiring and mastering these concepts and skills. To aid in the evaluation process, each student keeps a portfolio of his or her work. Student portfolios allow teachers to point to specific work samples as representative of where children are at a given time and also help illustrate and create a time frame for children's progress and pace of learning.

Formative Assessment

Day-to-day student evaluation gives information about specific skills or understandings and makes the next step clear. For example, teachers point out patterns in errors on math assignments rather than simply indicating which problems are wrong. They give written comments on students' writing, noting strengths and making suggestions for areas needing further attention. Giving individual, narrative comments helps students to develop criteria for critiquing their own work as well as guidance for making adjustments on specific assignments.

Teachers make sure that every student knows what is expected and the criteria by which children will be evaluated. For example, rubrics are used for assessing writing in the upper elementary grades. Teachers explain to students the criteria for each score on a 5-point scale. The rubric serves as criteria children can use to assess their own writing, even before it is turned in to the teacher. It is also used by the teacher to provide substantive feedback. The teacher and student might discuss, for example, why the student's writing fell short of a "4," thus providing a deeper understanding of the work and the teacher's expectations for next time.

Teachers of younger students use more narrative feedback and one-on-one conferencing to review work and give information on ways to improve. To simplify the task for young children they often focus on particular aspects of writing (e.g., a coherent paragraph, staying on topic, correct spelling and grammar) at any given time. In math they may give a child a few problems or ask questions about a problem a child is working on to assess his conceptual understanding and provide feedback on what he needs to work on.

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[1] *For details and practical suggestions related to student evaluation, see D. Stipek (1998), Motivation to Learn: From Theory to Practice. Boston: Allyn and Bacon.*

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Summative Assessment: Report Forms

UES report forms, completed once each year, provide detailed summative information rather than letter grades. Based on the formative assessments teachers conduct throughout the year (such as daily observations, the TIMSS achievement tests, and the Woods and Moe Analytical Reading Inventory[2]), the summative assessment gives a clear picture of a child's skills or understandings across the curricular strands. It rates particular skills at a point in time, and provides evidence to explain or support the rating.

Items on the report form under literacy skills for 4- to 5-year-olds include, for example: Listens and comments appropriately; listens to peers; listens to adults. Items under mathematics skills for children ages 5-7 include: Collects, organizes and interprets data in a variety of ways; translates patterns from one medium to another; understands grouping by tens. Arts skills for 7- to 9-year-olds include: Sustains interest and involvement in activity; uses principles and elements of music (rhythm, dynamic, pitch); uses principles and elements of drama. Health Education for 9- to 11-year-olds includes: Aware of physical, emotional and social changes occurring during puberty; aware of how to deal with change; aware of life pressures and knows how to exit from problem situations. And Information Management Skills for 12-year-olds include: Makes careful observations; poses questions; evaluates and verifies information.

In creating the report form, UES teachers and administrators looked carefully at ways to give parents information about children's performance in relation to the school's curricular objectives. The form lists summary criteria related to these objectives and gives parents information about children's performance in relation to them. Categories listed on the form take into account the nature of learning, with the 4-point scale reflecting the development of children's understanding:

1. not in evidence (skills absent from child's performance)
2. with assistance (child can accomplish task with assistance from an adult or peer)
3. independently (demonstrates competence)
4. excels (is able to generalize to new areas of learning)

There is also space on the report form for teachers to include a narrative, provide documentation, highlight specific strengths and areas where improvement is needed, and make specific recommendations. Children's work is often shown to illustrate the skill levels indicated on the form.

In accordance with UES's holistic view of the child, a large section of the form is devoted to social and work skills. Items in this section include, for example: follows directions, displays consistency of effort, initiates play, expresses feelings in appropriate ways (ages 4-5); prepares well for class, uses time productively, cooperates in group work (ages 5-7); accepts expectations in class, shows respect for the rights, opinions and feelings of others (ages 7-9); uses age-appropriate friendship-making strategies, uses conflict resolution skills, collaborates with a variety of peers, and demonstrates citizenship (ages 9-11 and 11-12).

In addition, UES students ages 9-12 fill out and discuss with their teachers extensive mid-year and final self-evaluations. And throughout the year teachers for this age group sometimes meet individually with a student and parent to talk about a specific issue such as writing, math, or social issues.

Is it Worth the Time and Effort?

Although abandoning letter grades to use more detailed strategies for evaluating student competencies requires more time, it is worth the effort. This kind of evaluation provides substantive information that can be used to guide students' future efforts and help them gain self-evaluative skills, and clear evidence of developing competencies, which is motivating. All children can, if they try, see progress. Parents are well informed of what their children are learning, and particular areas in which they might support their children's efforts or offer assistance.

The process of completing the student assessment forms is invaluable for teachers. It focuses their attention on specific skills and helps them design instruction that is truly child centered—appropriate to meet the instructional needs of the individual children in their classrooms.

[2] *The Third International Mathematics and Science Study (TIMSS) is a collaborative research project conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA). It is the largest and most ambitious international study of student achievement ever conducted. In 1994-'95 it included five grade levels in more than 40 countries. For more information, visit the TIMSS web site at* **www.timss.bc.edu**.

The Analytical Reading Inventory, 6th edition, is published by Prentice-Hall, Inc., Upper Saddle River, New Jersey.

Project-Based Learning

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mining the structure of activities or investigations, they create pathways to learning goals by supporting children's own inquiry. To accomplish this, teachers:

- create an environment and provide experiences and resources conducive to inquiry
- scaffold instruction
- model and guide students to make tasks more manageable
- provide access to information
- manage the classroom to ensure that work is accomplished
- sustain motivation and thoughtful participation over time
- observe and continually assess student responses
- assess progress, diagnose problems, and evaluate results
- listen to children (their thoughts, questions and ideas)

Although project-based learning does not have a teacher-directed focus, it is guided and prompted by teachers and there are times when teacher directed-learning occurs. Directed teaching of a lesson may be embedded in a project, as the need to teach a particular skill arises. Project work also illuminates for the teacher what students need know and aids in planning lessons accordingly. For example, the teacher may teach a lesson on a concept that children are confused about, or for which developmentally appropriate resources are not available. Because lessons emerge out of children's own questions and need to know, project-based learning optimizes learning opportunities.

In this article, we will describe two projects we implemented in our classrooms at UES: (1) The Simulation Project, for children ages 9 to 11, and (2) The Garden Design Project, for children ages 5 to 7.

The Logo™ Project

For the Logo™ project, the students' task was to use MicroWorlds Logo software to design educational computer simulations to teach 3rd graders about the brain. A simulation or animation might show, for example, the development of the brain in a fetus through an animation of the changes over a three-month period. During the 10-week project (4 hours per week), children worked in teams of four or five students. Each team had one computer station.

The lessons began with an introduction to the science theme (the brain) and an overview of scientific concepts involved. Then, to incite curiosity and stimulate a need and a desire to know, the teacher had the class brainstorm wonder questions. She used such prompts as: What do you know (or think you know) about the brain? What do you want to know?

The next step was to discuss with students the process of "doing science," including discussion of science process skills such as: observing, communicating, comparing, ordering, categorizing, and relating (inferring, applying). Teachers defined the terms, discussed examples of each and engaged students in conversation about situations, real and hypothetical, in which these skills might be used.

The teacher then introduced students to science resources they could use for their research, including print, technology, people and places. Some of these included books she had made available as a classroom science library and Internet sites she had listed on the class web site. (If the class does not have a web site, Internet resources can be put into a bookmark file for easy student access. UES students also benefit from an Information Management curriculum that teaches them how to gather, evaluate and make sense of information sources).

Teacher preparation included creating a timeline of lessons covering basic concepts, class discussions, and planned experiments; defining mandatory and optional activities and experiments; and identifying and collecting resources for on-demand learning.

Introduction to the Software Design Project

To provide a basis for the technical skills students would need to create their simulations related to brain functioning, the teacher provided an introduction to Logo programming in which students learned about the program's basic drawing, text, and animation functions. They spent approximately three hours of class time learning these basic computer skills.

After the teacher explained to students what their task would be, she had them brainstorm answers to the question: "What is a simulation?". Next, each team was provided with planning tools, including a planning board, self-stick notes, colored stickers, blank storyboard sheets and calendars. Then each group held a team-planning meeting to discuss ideas and allocate work. Teams were heterogeneous in terms of students' ages and experience in project-based learning.

Ongoing Science Learning and Research

Since project-based learning is not a linear process, students learned science content concurrently with

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developing their project designs. The teacher presented lessons in a variety of ways: (1) Students performed experiments and dissections; (2) experts visited the classroom to talk about their work; (3) students took field trips to scientific laboratories; (4) the teacher held class discussions and taught lessons; (5) students did on-line experiments and used e-mail and cyber chats to contact experts; (6) students read a variety of resource materials for their research; and (7) students presented and listened to student "talks."

These experiences helped students to learn science content they could use to develop and refine their projects. In each case, the teacher guided students to relate the experience back to their questions and projects by asking: How does this experience make you ask more questions about what you are trying find out? Thus, students could use the new knowledge to help them refine their wonder questions into individual driving research questions, create new facets of their designs, or solve problems they were having, and the teacher was able to see how the experiences affected the design process, thus giving her insight into children's learning and the effectiveness of different activities for presenting information. Class discussions, a showcase of projects, sharing of questions, student talks, and student commitment "roasts" also helped students refine and develop substantive and interesting research questions and to revise their projects accordingly.

Students' questions in Weeks 2 and 6 illustrate the evolution of their thinking. For example, one student asked in Week 2: What are the parts of the brain? In Week 6 he asked: What are white matter and gray matter responsible for in the brain? What is their function?

Another student asked in Week 2: How does your brain control your dreams? In Week 6 she asked: Do people who are blind dream? How do they get information for their dreams? Are their dreams in color, and if so, how do they know about color?

Formative Evaluation of Software by Third-Grade Users

Throughout the design process, students evaluated their software simulations with 3rd-graders, the potential audience for their product. They prepared questions to ask the 3rd graders and in a post evaluation session did a "quick write" to assess the feedback they received. *Figure 1* shows a sample exchange from one of these sessions.

Figure 1

Evaluation of Software by 3rd-Grade Users

Ken:	Tell me what you learned.
3rd grader:	I'm not totally sure what this does. (Points to graphic depicting a developing brain.)
Clay:	It tells you how the brain develops. Look see. It goes from 3 weeks to 4 weeks to 5 weeks. It's the spinal cord developing in the brain.
Ken:	I can show them [3rd graders] –- do something that will help show them. (He slows down the animation.)
3rd grader:	Oh, so you put it smaller.
Ken:	See. That's the brain. Small, bigger and bigger. And so it develops.
3rd grader:	So you're going to put 6, 7, 8 and 9 weeks? You have to do 1 and 2 weeks.
Ken:	Well, no. We're skipping some of them because if you go week by week, it's going to go a very long time before it's 3 months old.

Evidence of Science Learning

The teacher looked for evidence of students' science learning in their discussions, the content of their projects, and the sources they chose for research. High-level class discussions and formal assessments showed that the students did learn the content. Through both their projects and discussions they demonstrated in-depth understandings of the topic areas in which they had chosen to be "expert". Students also were able to explain science concepts to different ages and types of learners. And they demonstrated the ability to critically evaluate the validity of different sources of information, to generate hypotheses, and interpret and summarize experimental results.

The Garden Design Project

As in the Logo Project, the task for 5- to 7-year-olds was to learn science (as well as other skills) by creating something—this time a garden. With the natural environment surrounding the school serving as inspiration, the activities and lessons created for the project were intended to achieve learning objectives outlined in the California Science Framework for kindergarten through first grade. These include helping children understand: that plants need water and light; that roots are associated with the intake of water and soil nutrients; that green leaves are associated with making food from sunlight; and how to observe and describe similarities and differ-

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ences in the appearance and behavior of plants (e.g., seed-bearing plants); how to identify major structures of common plants (e.g., stems, leaves, roots); and how to make scientific progress by asking meaningful questions and conducting careful investigations.

The project began with children looking at a 3-D model of artist Claude Monet's garden at Giverny, France. This sparked a teacher-led discussion about how people create their environment. The class then looked at their own gardens at home and the environment at UES and decided to plant a garden outside their classroom.

During the planning stage, students visited Descanso Gardens and the gardens at the Getty Museum in Southern California to view models and get ideas. As they looked at the area available for their garden, the teacher guided them in discussing problems of light, water and space. They noted which things were permanent and could not be changed. Then they brainstormed ideas for the garden they would create. Some of the items they voted on and agreed to include were: a bridge, a wishing well, a bog pond and an art deck for painting.

With the help of a landscape architecture student, children created sketches to see how their ideas would work. Embedded in the sketching process were teacher-directed lessons on measurement and angles. They also visited the library, used the Internet, and read books in their classroom to learn more about plants and decide on which plants would grow best in their garden. In the course of children's research, the teacher helped them find answers to the questions they generated, such as, "How do flowers get their smell? How do they get their color and their pigments?"

Over the course of about five months and with a great deal of help from parent volunteers, the children and their teacher constructed the garden. During this time, investigations that taught science, math, and language arts helped children to understand what was happening in their garden and also became clearer because of the garden project.

In the beginning of the project, for example, the teacher led an investigation on the parts of a seed and the process of germination. To illustrate and to help children understand what conditions are necessary for plant growth, she had the children conduct experiments in which they planted seeds in various pots and then put some of the pots near the windows and others in a closet. After children had observed and recorded what happened, the teacher helped them apply their findings as they decided where to place the plants in the garden. Then, in an overview of the project, the teacher helped children to see how the phases of growth and development they had observed—in their experiments, in their garden, and in the changes in trees outside their classroom—constitute the life cycle of plants.

The teacher also used the garden project to illustrate how food goes from "seed to table" as children toured a restaurant kitchen to learn about food preparation, and harvested the fruits and vegetables in their garden to serve at a "restaurant night" in their classroom.

In addition to the science lessons, the teacher wove in lessons on numbers, measurement and scale as children built models for the art deck and bridge. She taught literacy skills as children recorded in science journals what was happening in the garden. In art lessons she had them create decorative items, such as colorful clay tiles, to go into the garden. And painting outside, as Monet did, helped children learn both art and science as the teacher guided them in observing the reflection of light on the water and the detailed differences among the plants and trees.

Throughout the project, children's emergent ideas were key. They became the catalyst for activities and inspiration for lessons that the teacher used to achieve

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Project-Based Learning

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her curriculum objectives. In the five months of the Garden Design Project the children worked on the garden almost every day. The garden design theme became a thread that helped to structure lessons in a number of different areas and created a natural starting point for children's questions. Rather than the teacher asking children what the parts of a flower are, or how plants take in water, children asked these questions—either of the teacher, an encyclopedia or a web site—because the garden gave them a practical need to know the answers.

The questions—along with class discussions, children's science journal writings, and formal and informal assessments—helped the teacher assess what children were learning and to make decisions about how to guide the development of the project.

Planning Is Key

Project-based learning offers a variety of learning benefits to teachers and students. In addition to basic skills (such as reading, math, and writing) and disciplinary knowledge (e.g., science), through their work on projects such as those described above, children learn how to access and use multiple resources, work collaboratively, and develop planning skills. And this method of teaching has the advantage of being more motivating; children enjoy activity more than repetitive listening and paper-and-pencil tasks, and they are more likely to see the value of school learning when it is directly connected to real life. Project based learning also offers teachers a way to involve parents productively by showing them how real-life activities at home can provide opportunities for learning.

One caveat to project-based learning is that teachers must be careful not to organize activity for the sake of activity rather than activity in the service of learning. It is essential that teachers have clear learning goals and conduct constant evaluation during the process to assess whether the activities are really promoting achievement of those goals.

With careful planning and attention to detail, project based learning can provide a dynamic and effective atmosphere where children not only learn a great deal, but enjoy doing so.

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