Managing Project Based Learning: Principles from the Field

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Abstract

This investigation describes classroom management techniques used by teachers who were expert in the use of project-based learning instructional strategies. The authors interviewed 12 teachers, and subjected their descriptions of classroom practice to a qualitative analysis. Fifty-three classroom management principles emerged, grouped under seven themes and 18 sub-themes. Themes included: Time Management, Getting Started, Establishing a Culture that Stresses Student Self-Management, Managing Student Groups, Working with Others Outside the Classroom, Getting The Most Out of Technological Resources, and Assessing Students and Evaluating Projects. Researchers are encouraged to include the wisdom of experienced teachers in future research on effective classroom practices.

Managing Project Based Learning:

Principles from the Field

Reviewing several decades of classroom management research, Walter Doyle concluded that the concept of "classroom order" provided the most fruitful way to consider the many factors influencing classroom organization and management (1986, p. 396). Without order, it is difficult for students to be productively involved in classroom learning tasks. Without such involvement, little learning will occur (Fisher, Berliner, Filby, Marliave, Cahen, Dishaw & Moore, 1978).

Drawing attention to the specific contexts of student learning tasks, classroom norms and expectations, the nature of students in the classroom, the history, reputation and style of the teacher, and the physical arrangement of the classroom, Doyle portrayed classroom order as a delicate balance of academic and social demands, co-constructed by teacher and students. Most importantly for the purposes of this paper, Doyle described as most problematic for the maintenance of classroom order those activities that require students to engage in higher order thinking, allow student mobility and choice, include group and out of classroom work, and culminate in procedurally complex tasks (Doyle, 1983; see also Blumenfeld, Mergendoller & Swarthout, 1987). In response to these problematic activities, he argued that teachers will have to assert more control and direct management of classroom transactions (Doyle, 1986, p. 403; Evertson, Neal & Randolph, in press).

In describing the conditions that jeopardize classroom order in traditional classrooms, Doyle could have been describing Project Based Learning (PBL), a teaching and learning model that uses projects to engage students and focus their

learning. Projects are complex tasks that involve students in design, problem-solving, decision-making, and investigative activities. Students work autonomously over extended periods of time, and prepare realistic products or presentations (Arends, 1997; Diehl, Grobe, Lopez & Cabral, 1999; Thomas, 1998). Yet when teachers who are successful in managing project based instruction are asked about their management techniques, they generally speak of exerting less control or "turning management over to the kids" rather than exercising the "overt manage[ment] and control . . . " strategies recommended by Doyle (1986, p. 402). This suggests, as several authors have argued (Evertson et. al., in press; Cohen & Lotan, 1990; Marshall, 1990) that there are other ways to control students and instructional events than are described in the classic classroom management literature, a knowledge base developed from observations of teacher-centered classroom environments emphasizing lecture, discussion, and seatwork .

For teachers who use Project-Based Learning, the task of classroom management is quite different from that faced by teachers employing the traditional instructional methods of lecture, discussion, and seatwork. With PBL, very little time is devoted to teacher-directed seatwork or whole-class discussions. Students spend the majority of their time working on their own or in small groups. Teachers typically do not lead instructional activities, nor do they dispense resources, or present material to be learned. Students find their own sources, conduct their own research, and secure their own feedback. Experienced PBL teachers report that they spend very little time promoting student engagement or handling student misbehavior. Teachers often spend their time participating in projects as peers rather than as classroom managers.

Previous Research on Project Based Learning Management

Although the idea of using projects as the primary means of instruction is at least as old as the writing of John Dewey (e.g., 1918, 1938), there has been little substantive research on classroom management and orchestration as it relates to Project Based Learning. Several studies conducted in traditional classrooms suggest that students oppose teachers' efforts to engage them in more procedurally complex and cognitively difficult academic tasks – as would be encountered in many projects – and prefer procedurally simple tasks requiring routine or algorithmic thought. Atwood (1983) found that the fourth, fifth, and sixth graders he studied were more engaged with procedurally simple academic tasks and less engaged when working on procedurally complex tasks such as reports. Davis and McKnight (1976) report that high school students actively resisted the effort to increase the difficulty and cognitive demand of mathematics tasks. Mayers, Csikszentmihalyi and Larson (1978) report that high school students had more positive attitudes and higher motivation in classes they perceived as cognitively unchallenging compared to classes they perceived as cognitively challenging.

Other relevant research has examined students and teachers experience of pre-specified projects, particularly those emphasizing scientific inquiry. Krajcik, Blumenfeld, Marx, Bass, Fredericks, and Soloway (1998) conducted case studies of two students in two project-based science classrooms. These students were representative of the lower middle range of science achievement. The researchers found that the students were proficient at generating plans and carrying out procedures. However, the students had difficulty (a) generating meaningful scientific questions, (b) managing complexity and time, (c) transforming data, and (d)

developing a logical argument to support claims. Students pursued questions without examining their merits, and pursued questions based on personal preference rather than questions warranted by the scientific content of the project. Students also had difficulty understanding the concept of controlled environments, and created inadequate research designs and data collection plans, and often failed to carry out their plans systematically. When presenting results, students tended to present data and state conclusions without describing the link between the two, or drew conclusions based on incomplete data.

Edelson, Gordon, and Pea (1999) found that secondary students have difficulty carrying out systematic scientific inquiry, were disengaged from the activities, and lacked the background knowledge necessary to plan activities and make sense of data collected. Moreover, students had difficulty accessing the technology necessary to conduct their investigations.

These findings point to the importance of the careful management and orchestration of project based instruction, and the provision of multiple scaffolds for students as they conduct their inquiries. It appears that teachers can not simply “turn students loose” on projects, even when the basic outline and stages of the project have been specified in advance. Instead, student activities must be structured to facilitate student success and meaningful learning, and students must be carefully monitored as they progress through project stages (Krajcik, J. S., et al., 1998; Thomas, 2000).

Project based instruction is taxing for teachers . Krajcik, Blumenfeld, Marx, and Soloway (1994) describe a four-year University of Michigan research study designed to gather data from teachers who were in the process of implementing Project-Based Science (Krajcik, 1998) in four middle school and one elementary

school classrooms. All participating teachers attempted to implement the same 6-8 week projects developed by the National Geographic Kids Network. Data sources for the study included audiotapes and videotapes of science lessons, interviews with teachers, and informal conversations. Researchers constructed case reports which focused on the challenges and dilemmas teachers faced as they attempted to enact Project Based Science.

Ladewski, Krajcik, and Harvey (1994) report on one aspect of this University of Michigan study. They describe one middle-school teacher's attempts to understand and enact Project-Based Science. The results from this case study demonstrate how new instructional approaches can conflict with deep-seated beliefs on the part of a teacher, leading to conflicts associated with the relative benefits of student autonomy versus the efficiency that accompanies teacher control. In a companion paper to the papers cited above (Marx, Blumenfeld, Krajcik, Blunk, Crawford, Kelly, & Meyer, 1991), and in a more recent summary of their research (Marx, Blumenfeld, Krajcik, & Soloway, 1997) the University of Michigan research team describes the common problems faced by teachers as they attempt to enact Project Based Science. These problems have to do with time, classroom management, control, support of student learning, technology use, and assessment. For example, teachers report difficulties associated with striking a balance between the need to maintain order in the classroom and the need to allow students to work on their own (Marx et. al., 1997).

The research conducted by the University of Michigan team involved teachers' attempts to learn and implement an established PBL curriculum, complete with project descriptions, directions for activities, and common instructional material. This

implementation situation may be qualitatively different from one in which teachers plan, develop, and implement projects on their own.

The Present Study

In the process of preparing an introduction to Project-Based Learning for teachers and administrators (Thomas, 1998), and a handbook designed to help middle and high school teachers plan successful projects (Thomas, Mergendoller, & Michaelson, 1999), the authors spoke at length with approximately 50 secondary classroom teachers who have designed and implemented one or more PBL units. These interviews were designed to gather information about the PBL design process and the ingredients of successful projects.

The present investigation was a follow up to these interviews, and focused on the conditions associated with successful *implementation* of project work. More specifically, the purpose was to derive principles of PBL project management from the experiences of veteran PBL teachers. Although we maintain the concern with classroom order characterizing earlier classroom management research, we widen this focus to include the management of all aspects of PBL implementation. This includes, for example, communication with parents, the use of outside experts, group management, and assessment. In so doing, we hope to provide a wide-ranging set of contextualized findings to support further research into the complexities of classroom management in situations where teachers initiate and enact Project Based Learning without explicit guidance from curriculum developers

Procedures

Teacher selection

From a list of 50 classroom teachers with whom the authors were previously acquainted, we selected 12 teachers we considered exemplary PBL practitioners.[1] These teachers: (a) were recognized as experts by other teachers within the national PBL community, (b) had experience in training other teachers in the implementation of Project-Based Learning, and (c) had made presentations about their experience with and implementation of Project-Based Learning at practitioner conferences or workshops (e.g., Autodesk Foundation, 1999).

Interview schedule

The second author developed a semi-structured interview schedule that was designed to elicit teachers' strategies for implementing a project, managing the events of that project, and managing students over tasks and time. Forty three questions were developed. These questions covered the following categories:

I. Overall Planning: When do you use PBL and why?

II. Planning the Project

- A. Pre-project Planning
- B. Relationships beyond the Classroom
- C. Classroom Arrangement
- D. Technology
- E. Introduction of the Project

III. Carrying out the Project

- A. Ancillary Instruction or Guidance
- B. Teacher's Role

C. Record-keeping

D. Mid-Project Change

E. Equity, Achievement, and Grading

F. Project Follow-up

IV. The Future of Project Work in your Classroom

Interview Procedure

The first author used the interview schedule to conduct telephone interviews with the 12 teachers. Teachers were told that the purpose of the interview was to gather information on the strategies teachers employed to maximize project success. The interview posed a series of questions for each of the themes outlined above. For each theme, initial, broad questions were followed by more precise questions tailored to the experience and classroom practices of each interviewee. This allowed us to gather information on the same topics from each interviewee while respecting the diversity of their perspectives. Interviews lasted from 45 minutes to one and one-half hours. All interviews were recorded (with the teachers' permission) and transcribed.

Interview Analysis

Following transcription of the interviews, the authors separated teachers responses into narrative segments that expressed a specific idea or described a particular experience. If teachers provided explicit advice (e.g., "Don't use group grades") this was also made into a separate segment. All segments were then examined both within interview questions and across the entire interview to discern recurring and qualitatively distinct themes. These themes represented different aspects of project implementation including Time Management, Getting Started, and Managing Student Groups.

Teachers' responses within each theme were then examined for implicit or explicit classroom management guidance. Using the teachers' words as a guide, a classroom management "principle" was crafted to distill the essence of the teachers' experience (e.g., "Reach agreement with students on grading criteria before the project begins"). At times this was done by excerpting a phase or sentence from the narrative segments. Other times, an implicit principle was made explicit through paraphrase, elaboration, or interpretation.

The process of specifying themes and principles and attaching narrative segments was fluid and interactive. In some cases, the themes represented straightforward responses to questions. For example, " grading students" was a theme that emerged from several interview questions regarding grading. Several classroom management principles for the grading theme emerged from explicit practitioner responses about grading (e.g., "Base project grades on a variety of criteria from a variety of sources"). In other cases, themes and principles emerged by looking across interview questions. For example, in asking teachers about planning, arrangements, and the role of the teacher, a new theme emerged: "Establishing a Culture that Stresses Student Self-Management."

As principles were being identified, we "attached" the narrative segments to each principle. This helped ensure that each principle was grounded in a specific classroom context and reflected teacher experience. Sometimes, several different teachers made statements that illustrated the same principle. When this occurred, narrative segments from the different teachers were attached to the same theme. At other times, similar principles were combined to create a slightly different principle. Again, narrative segments from the original principle were attached to the new

principle. Finally, the classroom management principles were organized into sub-themes to make it easier to identify the types of guidance provided by the expert teachers.

At the conclusion of the analysis process, narrative segments provided by the 12 expert PBL practitioners were organized into 7 themes. Each theme was divided into two to five sub-themes. Each sub-theme contained between two and four principles, for a total of 53 principles.

Results

We display below the themes, sub-themes and principles resulting from our analysis. As a guide to the reader, we first present themes, sub-themes, and principles schematically without teacher comments, and then contextualize the project management principles using an exemplary narrative segment from the transcribed interviews.[2]

Insert Table 1 About Here

The same themes, sub-themes, and principles are now illustrated using excerpts from the interviews.

Theme: Time Management

Sub-theme: Scheduling Projects

Principles:

1. Avoid bottlenecks within courses: schedule projects and end-of-quarter assignments at different times.

Projects should not replace end of quarter tests or papers; if that happens, then a lot of things are due at the same time, and it's counterproductive.

2. Avoid bottlenecks between courses: coordinate project schedules with other teachers.

Almost everybody does projects at the same time. Students complain that they have five projects due in the same week. Teachers should talk to one another and space projects out over the course of the year. This would result in higher quality projects.

3. Use block scheduling to increase flexibility.

Block scheduling is extremely important, as is having flexible classroom space and computers. We also have a system of permanent passes so kids can go down to the library and move around the campus.

Sub-theme: Holding to Timelines

Principles

1. Build in a 20% overrun

When planning a project, set a certain number of days and build in a 20% overrun.

2. Be prepared to introduce alternative instruction when the project schedule bogs down

You've got to keep a flexible project schedule. The weather may not cooperate. Students may complete thins faster than

you expected. Sometimes kids think they are done and you don't. We've had to give extensions to get expert interviews or because of technology breakdowns. Ideally the project is the outgrowth of other kinds of learning, so you can always reinforce subject matter learning when you can't work on the project.

3. Learn how to adjudicate scheduling decisions: when to enforce and when to extend a time line

The schedule you lay out is never the schedule you follow. It takes experience to know how much flexibility to give students and when to bring down the hammer. If projects take forever, kids lose interest and focus. You have to know when to tighten up and maintain deadlines and when to loosen up and say, let's take another week.

Theme: Getting Started

Sub-theme: Orienting Students

Principles:

1. Get students thinking about the project well before they begin

Before starting a project, we get students thinking about it so they'll be ready to plunge in when it's time. Last year, we did a project in April on the physics of music but we started talking about it in January when the semester began. I suggested a number of questions they might want to pursue, and we discussed how they might form their work groups.

The earlier students start thinking about it, the more prepared they are.

When we start a new school-wide project, we have a kick-off event that gets the students excited about the project and marks it as something different from typical schoolwork.

2. Give students a rubric that communicates what they are responsible for

The best way to grade project work is to have a rubric. The rubric should be known in advance by the kids. Then, when working on project, they know what they are searching for and trying to accomplish. They have a standard they can apply tot heir own work and to the final evaluation. Students should be involved in developing/refining the rubric. Students should be able to restate a rubric in their own words.

3. Reach agreement with students on grading criteria before the project begins

The more teachers and students agree on grading criteria before the project begins, and the more transparent the grading criteria is to students – so they really understand what the characteristics of an excellent project are – the better.

Sub-theme: Promoting Thoughtful Work in the Early Stages of a Project

Principles:

1. Build in the use of a research plan for recording what, why, where, when, how decisions

   The first day of the project is a warmup. I have kids brainstorm questions, and complete a research plan. I don't send them tot he library until I'm sure they know why they are going there. Before they go anywhere outside the classroom, I have their time organized for them. "Here's your research topic for today. I'm going to check your notes at the end of the period."

2. Use negotiation, as needed, to start students on productive tracks

   I have a private meeting with each group to get them started while the rest of the class is involved with a reading assignment. I discuss each group's research questions with them. Students often don't know what a good research question is. You have to tell them if they have written a questions that is really hard to research. I say, "Try it if you want, but here are my suggestions."

3. Require frequent checkpoints and products to facilitate a sense of mission

   At the beginning of a project, we require a product to be completed out of each work session. If it's a research period of one and one-half hours, we'll require them to make an oral group report about what they've learned. Or we ask

them to write an action plan. After they get used to our expectations, we will let them go for a couple of periods before asking for a report.

Theme: Establishing a Culture that Stresses Student Self-Management

Sub-theme: Shifting Responsibility from the Teacher to Students

Principles:

1. Involve students in project design

Re-engineering the learning environment means moving from the sage on the stage to the guide on the side. It means creating a more collaborative environment with students where projects are a mutual responsibility. You have to rethink your whole relationship with students and become more of a facilitator and coach. Bring the problems to the students to decide rather than solving the problems yourself and bring the solutions to the students. Make the design of the project itself part of the curriculum. It looks like you are giving up control, but you aren't. You still have ultimate control of things, but you've decided what decisions students are able to make, and you are hold them accountable for making them

2. Avoid making decisions for students

I had to unlearn the idea that teaching was about my content; I had to learn it was about their thinking. Most of the content students get is dismissed as soon as they

graduate (or pass the test). I had to learn how to help students think through the project work and decide what it is going to look like, and not make all the decisions myself.

Sub-theme: Establishing a Culture that Stresses Student Self-Management

Principles:

1. Take advantage of opportunities to foster time management skills

   I had to learn to be patient as students develop adult time management and organization skills. We don't generally teach students how to manage time. In fact, traditional teachers and classrooms set up structures so that students don't need to know how to manage their time – it's managed by the teacher and the bell schedule.

2. Take advantage of opportunities to teach students how to learn

   Part of your new role is not just to teach content, but to teach kids how to learn content. The high achieving kids already know this. They know when they go to the library they have to get more than one book. They know not to choose topics like John F. Kennedy because there is too much information available. Your role now is to work with kids who have never tackled a difficult question and teach them the research and study skills.

Sub-theme: Establishing Standards for Student Work

Principles

1. Use examples of professional work to establish standards

   Kids won't know what high standards are unless they see it. I try to figure out how to derive models of excellence. You can use the work of previous students. Or, you can use professional work: blueprints done by real architects or poetry written by a local poet. You have to have models or kids don't know what they are working toward.

2. Use examples of previous students work to define what high quality work looks like

   I show them examples of what was done the year before. It boosts the quality of projects – kids want to do better than the kids did last year. I was worried that students would just copy what last year's students did, but seeing previous students' work actually sparked more ideas.

3. Combine standards with scaffolding to help students reach milestones.

   Projects often fall apart because teachers don't pay enough attention to scaffolding students. A great deal of thought needs to be given to how to support students through coaching and mentoring. Students need to have milestones and benchmarks, perhaps even templates. It's best if they see examples of quality work before the project starts. Then they will try to equal or surpass what's already been done.

Theme: Managing Student Groups

Sub-theme: Establishing the Appropriate Grouping Pattern

Principles:

1. Heterogeneous grouping is a compatible pattern for project-based learning

When it is time to work in groups on a project, I think about why I'm grouping and what the group needs to accomplish. My experience is that if you allow students to choose their own groups there will be some strong, mature groups and some wacky, immature groups. The strong groups wind up running the show. I don't want this to happen; I want leadership to rotate and be shared. When it was time to do water testing in a nearby stream, I put together field teams that had kids who were leaders, kids who needed leadership, conceptually strong students and weak students. Another part of the project required students working together over several weeks putting data in spreadsheets, thinking about things, sharing ideas. I decided it would be okay for them to be with their friends but I didn't want to have them simply choose their friends because some kids wouldn't get chosen. So I had them apply to work with one another. Then I looked at their choices and made up the groups. This way I was able to place the unpopular or behaviorally challenged kids in appropriate groups.

2. Match the grouping pattern to the context and need for expertise associated with the task

   One type of grouping strategy – say, kids who are friends and want to work with each other – works well on a task that requires a great deal of time out of school. A different type of group is necessary if the task is complex and requires a diverse set of skills – say the researching of a complex topic and the creation of multimedia and written reports. Think about the skills necessary to accomplish the task at hand when forming a group.

3. Consider forming groups so that novice students can learn from experienced students

   You first have to think about the purpose of forming groups. We always controlled group characteristics. We had both juniors and seniors. We wanted seniors (who were experienced with projects) mixed in with juniors so they could teach them the ropes. Other teachers have each student pick another student to form a pair, and the teachers put different pairs together into four-person groups. This way both teachers and kids have control over how the groups are formed. My general experience is that three- or four-person groups work best.

4. Use the "jigsaw" technique to disseminate expertise within groups

We formed students into expert teams who investigated different areas and thus became experts. Then we formed new teams which had one member from each of the expert teams. That way each new team had an expert in each of the areas originally investigated.

Sub-theme: Handling Problems Within Groups

Principles:

1. Incorporate realistic consequences for non-participation

I sometimes allow groups to fire individual members. That's like a business – the project takes precedence over everything. Once they are off the team they have to do more traditional learning activities. If a student is not working in a group, take them out of the group. This can help the current project you're working on, but the same problem may arise with the next project.

2. Tighten up time and tasks to get a group back on track

You can't just tell a kid, "You have to start working." They'll feign work while you're there and then stop. "If you ask them why they aren't working, they may tell you. They may not. It's a fine art of working with and motivating an individual. You just have to use all the tools you can. You can get everybody to sit down and ask the group. "How are we going to get you guys going again. I've been watching you for two periods and I haven't seen anything happening.

What are we going to do about this?" Once you identify the issues you can work with the student using conversation and encouragement. No kid wants to be a failure unless they are having extreme emotional problems. If you can't get a group restarted, then ask them: "Is there an alternative, individual way of working on this project that will show me you've learned that material? " Students often don't want to work by themselves because it's not as much fun as working in a group.

3. Use group process techniques to promote full participation

It's inevitable that not everyone in the group will carry their own weight. I deal with it by having individual and group reflection and critiques about process and product. I don't want to find out two months later that someone isn't working. I try to use peer pressure: Groups have to get up and talk about where they are and what they're finding out. If someone isn't pulling their own weight, then it emerges. There are lots of checkpoints, so I can make sure people are on track.

Sub-theme: Keeping Track of Each Group's Progress

Principles

1. Establish frequent but short conferences to discuss progress

I manage groups by setting clear benchmarks and due dates, and holding "touch-ins" (short conferences) with groups on

a regular basis. Some teachers set aside one day a week for a student-run discussion of group progress, problems, and opportunities.

2. Use planning sheets, group folders, and other concrete devices to record evidence of progress

   I keep a folder for each group that tells what's going on. It tells what the group did each day, what the group will do tomorrow. Groups also have folders recording what they have to do, what they accomplish. When I meet with groups, we go over the work in their folders, check off what they accomplished against what they said they were going to do, and assess the quality of the work they completed.

3. Make group progress a public matter

   I keep records public so students have ownership of them. I use checklists that describe each component in a project. (A student will have to complete eight to ten components to complete the project.) When they complete each component satisfactorily, it is checked off. I put a student in charge of the progress chart. I'll have a class meeting and ask the student in charge of the progress chart to give an update of where everyone is. By making it public, there's no getting away from the accountability, and kids push each other. It's not just me nagging them.

Theme: Working with Others Outside the Classroom

Sub-theme: Coordinating with Other Teachers

Principles:

1. Coordinating with a partner requires daily contact

   In our academy, we all work in the same physical area and are constantly talking about projects and educational reform. We have formal planning sessions on Wednesday (30 minutes) and Friday (1-1/2 hours). We make adjustments daily.

2. Find ways to have faculty planning meetings

   I had to learn how to share early with other faculty at the school what we are doing. We showed them student work as a way to get into a conversation about teaching and learning. Most teachers don't talk much about teaching and learning. We had to allow dissenters to ask fair questions and had to give them honest answers. We were all used to doing things the way we wanted to as teachers, so we had to learn to work with each other.

Sub-theme: Communicating with Parents

Principles:

1. Communicate to parents early

   We inform parents using a newsletter, we put it on the homework hotline and on the web site. We send a letter home with the project calendar, a list of checkpoints that

tells when different parts of the project are due, a list of standards by which the project will be graded, and a phone number to call if they have questions. We ask parents to sign the letter and return it so we know they were aware of what will be happening. We send a second letter home with an invitation to parent presentation right near the end of the project.

2. Be honest and forthright with parents

When talking to parents about projects be honest about the tradeoffs you made about the breadth and depth of content covered. All teaching (and projects) require tradeoffs. Kids don't cover as much content if they learn the content in depth. Parents want some kind of a mix between breadth and depth. They don't want their kids learning to be restricted to a bunch of facts. They want their kids to think and reason. Come clean with parents: Tell them how you structured the unit to provide both breadth and depth and what you were willing to leave out.

3. Establish procedures and events to promote parent involvement

Parents are involved in summer and school-year course and project planning. We have a Fall parent meeting (in addition to the regular back-to school night) to discuss standards for student work and projects. We want the family to understand and buy into the standards we have set for

student work. We send material home and stay in close touch with parents. There is a mentor dinner at the end of the third quarter internship that all parents attend.

4. Find ways to involve parents in projects or to enlist their help

At the beginning of the year, I send out a description of the project we're going to do and a parent volunteer slip. Although the students are doing physics projects, you don't have to know about physics to volunteer – parents could tutor kids in PowerPoint, for example. I always have parents view and critique the practice exhibition that takes place about a week before the final exhibition. Parents also show up for open house, and I talk about the projects and display those from previous years.

Sub-theme: Working with People from the Community

Principles:

1. Take sufficient time to work out the feasibility and nature of external partnerships before rushing in.

If at all possible, meet with the people in person that you want to help you with our project. Figure out who is an expert, who can come into your classroom and engage students, and who is an expert better suited to simply answering questions – say via email. When experts do come in, prepare students for them.

2. Students need to figure out how they will work with external resource people

Train students to interact with community members. Students need to know how to get funding and support for future projects.

3. Experts have the greatest impact at the point when their expertise is needed by students

Let the kids get frustrated trying to answer a question that is beyond them and then bring the expert in. The expert will be treated like a hero.

Theme: Getting The Most Out of Technological Resources

Sub-theme: Using the Internet

Principles:

1. Find ways to help students make informed choices about web sites to explore

The Internet is going to be a wonderful resource; it's not there yet, it's only a starting point. School library/media center often has better information than the Internet. The librarian/media teacher has to be a project partner, brought in from the beginning and told what their role will be and how they can help.

2. Take advantage of opportunities to teach critical thinking skills for Internet use

Often kids look at web sites, but they don't have the prerequisite knowledge and vocabulary to understand what they are seeing. You have to coach them. Kids aren't aware that the quality of information available on the Internet varies tremendously. You have to work with students so that they evaluate the quality of information available and consider multiple sources to see if they are in agreement. In general, kids are too prone to use the Internet and ignore print resources.

Sub-theme: Using Technology

Principles:

1. Make certain that technology is crucial to the goals of the project before making it a central feature

It is important to not let the bells and whistles be the central focus of the project. Content slips away if there is too much emphasis on technology. The important question to ask is what can be accomplished using a technological (or any other) tool? For example, we had kids use an authoring program to create a computer-based interactive presentation focusing on a twentieth century American poet. Viewers could select academic background, the biography of the poet, students' analysis of his/her poems, a video about the poet, and then enter their own comments about the presentation.

This was an example where technology let us create a product that could not be created without it.

2. Try out the technology before using it with students

   You have to try out the technology yourself before asking students to use it. We learned PowerPoint before we taught the students to use it. You can easily waste a whole period when the technology doesn't work as you had expected it to.

3. Have students master complex technology before including it in projects

   In our middle school, kids are just learning to use technology in the seventh grade. If you are going to include technology you have to have lab time planned for them to master it. Give limited, specific amounts of time in the lab. Have an assignment for each lab period – don't just turn them loose. Make them turn in a design brief before they can use the computer.

4. Contract or partner with an expert

   You'd better have somebody who can troubleshoot the technology. If the lab or the computer goes down, and you can't trouble shoot the problem yourself, you'll lose student work. Technology is dicey stuff. If you don't really know it, you'd better have a partner who does. It doesn't matter how fabulous technology can be if it results in utter frustration and no learning.

Theme: Assessing Students And Evaluating Projects

Sub-theme: Grading Students

Principles:

1. Use a variety of assessment methods

   You don't give up testing, essays, or quizzes when you do projects. The important question is what kind of information will they give you? I use quizzes, for example, to find out if kids understand things so I can push on. Kids will always need to write essays. Use multiple measures to look for both content and process outcomes. When you give students a description of the project, explain what will be an individual assignment (and graded individually), and what will be a group assignment (with each person in the group receiving the same grade.)

2. Include both individual and group grades

   I use a variety of grading strategies. Everyone gets an individual grade as well as a group grade. Every student grades every other student in the group. Written and other "academic" work is graded individually along the way using rubrics – it's not considered part of the project grade. The project grade focuses on SCANS skills, self- and group-management, organization, promptness, as well as the final presentation. The grade encourages students to look at the

process of how they have worked together and what has been accomplished.

3. Emphasize individual over group performance

We favor individual over group grades. Kids want to know how they are doing; they want their own performance rewarded.

Sub-theme: Troubleshooting Projects

Principles:

1. Monitor project progress with an eye toward glitches and misdirection

There is no "cookie cutter" way to do projects. Don't be afraid to make mistakes. Initially I thought I was doing a disservice to students if I had something that didn't work. Now I realize it's better to make a mistake and discuss with students what needs to be changed to make it work. This has also improved my relationship with students – it's more collegial now.

2. Look for opportunities to intervene with mid-course instruction

If key things are not understood, stop the ship and say, "Time for a mid-course correction." You might want to give a lecture; you might want to have a class discussion about an important book. If you have an ongoing assessment model in place so you are periodically checking in with students and they are checking in with themselves, you will

know whether the project is going accounting to plan. If students aren't getting something, address it.

3. Be prepared to intervene with mid-course corrections and

When a problem arises, I have a class meeting to debrief the incident and reassess the project. This opens up the student/teacher relationship and enables you to start with a new beginning. Sometimes it's hard to face the fact your project isn't working as you had planned, but you have to bite the bullet, recognize a failure, and turn the failure into success. Focus on why the failure occurred and help students overcome whatever was blocking them (e.g., time management, organization, diligence, writing skills, etc.).

Sub-theme: Debriefing Projects

Principles:

1. Put procedures in place to collect formative evaluation information from students

I typically ask two questions when the project is complete: 1) What do you see of lasting value as a result of this project for yourself as a learner? and 2) What do you see of lasting value as a result of this project for the community? I also have a comment box and solicit suggestions from audience/students/observers about how we could do things better.

2. Use models to demonstrate reflection strategies

Kids generally dislike and complain about reflecting on their own project work. I show them good models of reflection that other kids have done. Once they know what quality reflection looks like I ask them to reflect on their own work. The last part of the reflection asks them to select five projects done by other students in the class and describe what it was about those projects that impressed them. I emphasize the fact that if they are always choosing projects done by their friends, they're not being honest. Kids don't always want to write about what they've done, but they love to write about other projects they liked and tell why.

3. Prompt students to give you information about how the project might be improved

Students always ask what is this going to be worth? Post-project reflection is a way to move the focus of discussion to "Here's an end product. Are you proud of it? Did it do what you set out to do? How could it be made better? How could project activities have supported your work better?" Class reflection also provides feedback for the teacher. Maybe we should have talked about something earlier instead of waiting until the last week. Kids are going to do projects their whole life. They need a chance to think about what they've done and how they can do better.

Discussion

The purpose of this study was to identify the principles that exemplary teachers use for implementing and managing Project Based Learning. What we found were a set of concerns ("Themes") and strategies ("Principles") that reflect the context-setting and coordination tasks necessary to sustain student-directed Project Based Learning. In several ways, these themes and strategies are unique in comparison to those typically found in the teacher-directed, traditional classroom where the emphasis is largely on maintaining uniform and attentive student behavior during lecture, discussion, and seatwork.

In a traditional instructional approach, classroom management is nearly synonymous with student discipline and pacing; "with-it" teachers (Kounin, 1970) settle down and silence rowdy students, and move through the curriculum at a rate that neither bores the brighter students, nor overwhelms the weaker ones (Gump, 1982). While classroom disruption and pacing are important to the teachers we interviewed, these do not appear to be their primary management concerns. Instead, PBL teachers are concerned with making it possible for students to manage classroom tasks, time, resources, group work, as well as learning and assessment, on their own.

The result is that teachers in the learner-centered classrooms tend to have a broader set of management responsibilities than do teachers in more traditional classrooms (Everston, et al., in press). First, Project Based Learning appears to require management tasks that are not typically associated with traditional instructional formats, e.g., managing students' interaction with outside experts, managing the use of technological resources, explaining to parents why students do not bring home traditional worksheets. Second, classroom management is more complex for Project

Based Learning teachers than it is for teachers whose instructional practices revolve around lecture, discussion, and seatwork. In traditional classrooms, teachers are primarily concerned with maintaining order so that they may deliver content; classroom management is thus seen as prerequisite to effective instruction. With Project Based Learning, classroom instruction and management are more likely to overlap and to be shared by teachers and students. The teacher still has an essential managerial role, but as suggested by the themes emerging from our analysis (e.g., holding to timelines, establishing a culture, promoting thoughtful work, troubleshooting projects), Project Based Learning teachers' management concerns go beyond setting the stage so that students can listen to the teacher or engage silently with prescribed content. PBL teachers are responsible for putting together varieties of resources, information sources, learning contexts and participants, then orchestrating time, tasks, and arrangements throughout the course of instruction. As a consequence the PBL teachers in our study reported a large number of planning, monitoring, scaffolding, adjusting, and troubleshooting strategies. Although all teachers must deal spontaneously with unexpected student questions and behaviors (Doyle, 1980; Jackson, 1968), effective Project Based Instruction requires teachers to work jointly with students to invent solutions to these problems. The overlapping, wide-ranging, and changing demands of PBL management and instruction are difficult to master, and novice PBL teachers frequently experience dilemmas and difficulties in implementing projects (Evertson, et. al, in press; Marx, et. al, 1997).

The responsibility to orchestrate events, resources, and procedures seems, according to the teachers' comments, to be more or less demanding depending upon certain project characteristics. One such characteristic, that has the potential to

increase managerial problems, is the extent to which technology is central to the project. For example, many projects involve the use of Internet resources and computer-mediated communications between students and outside experts. As the interviews excerpted in this paper suggest, the use of technology places additional managerial demands on teachers. In addition to issues associated with finding relevant content and making sure that Internet resources can be integrated in a time-efficient manner, there are also problems associated with network failures and access to sources. In a recent paper considering the systemic factors that impede the implementation of Project Based Science (Krajcik, 1998), Blumenfeld, Fishman, Krajcik, Marx, and Soloway (2000) observe that:

> *The Internet represents a new class of technologies for classroom use that is even more difficult to integrate into schools than previous technologies. Unlike computer technologies that are self-contained and controlled entirely from within the school or classroom, the classroom use of the Internet requires coordination with the outside world. There is potential for difficulty at all levels: the teacher and students using the Internet as a learning tool; school-level administration arranging for access to the Internet-connected computers during instructional periods; maintenance and support both at the school and district level; and the provisioning of the Internet at the district level (p. 7).*

School networks may crash, needed sites may be down or overloaded, Internet traffic may slow to a crawl. From a management perspective, PBL teachers not only have to prepare for the effective integration of Internet resources, they have to prepare a back-up plan in case these resources are unavailable.

Project characteristics that seem to facilitate management of Project Based Learning include the extent to which the project is "authentic" (Steinberg, 1997) and not "school-like," and the degree to which instructional responsibility is shifted from the teacher to the student. These latter characteristics include making students aware of precisely what they are responsible for doing and producing, establishing professional standards for student products, providing examples of high quality work, introducing external resource people as mentors or partners, building in realistic consequences for failure and non-participation, holding frequent conferences and peer reviews, and assessing student learning on the basis of some realistic performance event.

Finally, we wish to comment on the significance of the methodology employed in this investigation. First, the present study can be seen as a complement to other investigations of PBL-like paradigms (e.g., intentional learning [Bereiter & Scardamalia, 1987], unguided discovery [Polman & Pea, 1997], generative learning [Cognitive & Technology Group, 1991], problem-based learning [Maxwell, Bellisimo, & Mergendoller, 1999; Stepien & Gallagher, 1993]). In these investigations, difficulties observed during the course of a project-like activity become the source of subsequent intervention research. For example, Scardamalia and Bereiter (1991) describe a "computer-supported intentional learning environment (CSILE)" that was designed, in part, to provide temporary support for young learners who were observed to have difficulty asking questions and directing their own inquiry. Other intervention studies, conducted using PBL-like tasks, focus on providing scaffolds to support collaborative group work (Hmelo, Guzdial, & Toms, 1998) and student self-assessment (Barron et al., 1998).

The connection between the present research and these intervention studies is that teachers represent an experienced group of observers with stories to tell not only about the difficulties they observed with project management or with their students' performance on a learning task, but about the scaffolding ideas they have developed to ameliorate their difficulties or to facilitate students' performance. Stated in another way, the principles and strategies listed in the present case study can be viewed as candidate interventions for future experimental research.

There is considerable interest among the teacher education and professional development communities in helping new and established teachers find their own unique "voice" (e.g., Jensen, Foster, & Eddy, 1997; Llorens, 1994). The current study should be seen as a response to those concerns. We highlight the voices of teachers and their pedagogical knowledge. Although we have worked to sort and crystalize their experience, the lived reality and conclusions are their own. We believe this study, which brings together the analytic perspective of researchers with the results-oriented perspective of teachers, is a good example of how the professional cultures and strengths of research and teaching can be brought together in a productive manner. We hope this research will encourage others within the professional research community to take seriously the hard won knowledge of teachers, and package this understanding in a way that is beneficial to teachers and researchers alike.

NOTES

1. We are grateful for the educators who spoke with us about the PBL management strategies they found successful in their classrooms. They did not seek anonymity, and we wish to acknowledge the contributions of the following individuals whose wisdom and experience are at the heart of this analysis. They are: Clarence Bakken, Ron Berger, Bill Bigelow, Will Fowler, Stephan Knobloch, Thomas Markham, Dave Moore, Kate McDougall, Adria Steinberg, Michelle Swanson, Leslie Texas, Melissa Wrinkle.
2. Often, narrative segments suggesting the same principle were found in interviews from multiple teachers. To keep this article as short as possible, we have selected a single excerpt to contextualize the principle.

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Caption Table 1: Schematic View of Project-Based Learning Classroom Management Themes, Sub-Themes, and Principles

Mergendoller & Thomas, Managing Project Based Learning:
Principles from the Field

Table 1

Theme: Time Management

Sub-theme: Scheduling Projects

Principles:

3. Avoid bottlenecks within courses: schedule projects and end-of quarter assignments at different times.
4. Avoid bottlenecks between courses: coordinate project schedules with other teachers.
3. Use block scheduling to increase flexibility.

Sub-theme: Holding to Timelines

Principles:

1. Build in a 20% overrun
2. Be prepared to introduce alternative instruction when the project schedule bogs down
3. Learn how to adjudicate scheduling decisions: when to enforce and when to extend a time line

Theme: Getting Started

Sub-theme: Orienting Students

Principles:

1. Get students thinking about the project well before they begin
2. Give students a rubric that communicates what they are responsible for
3. Reach agreement with students on grading criteria before the project begins

Table 1 (continued)

Sub-theme: Promoting Thoughtful Work in the Early Stages of a Project

Principles:

1. Build in the use of a research plan for recording what, why, how decisions
2. Use negotiation, as needed, to start students on productive tracks
3. Require frequent checkpoints and products to facilitate a sense of mission

Theme: Establishing a Culture that Stresses Student Self-Management

Sub-theme: Shifting Responsibility from the Teacher to Students

Principles

1. Involve students in project design
2. Avoid making decisions for students

Sub-theme: Establishing a Culture that Stresses Student Self-Management

Principles

1. Take advantage of opportunities to foster time management skills
2. Take advantage of opportunities to teach students how to learn

Sub-theme: Establishing Standards for Student Work

Principles:

1. Use examples of professional work to establish standards
2. Use examples of previous students work to define what high quality work looks like
3. Combine standards with scaffolding to help students reach milestones.

Table 1 (continued)

Theme: Managing Student Groups

Sub-theme: Establishing the Appropriate Grouping Pattern

Principles:

1. Heterogeneous grouping is a compatible pattern for project-based learning
2. Match the grouping pattern to the context and need for expertise associated with the task
3. Consider forming groups so that novice students can learn from experienced students
4. Use the "jigsaw" technique to disseminate expertise within groups

Sub-theme: Handling Problems Within Groups

Principles:

1. Incorporate realistic consequences for non-participation
2. Tighten up time and tasks to get a group back on track
3. Use group process techniques to promote full participation

Sub-theme: Keeping Track of Each Group's Progress

Principles:

1. Establish frequent but short conferences to discuss progress
2. Use planning sheets, group folders, and other concrete devices to record evidence of progress
3. Make group progress a public matter

Table 1 (continued)

Theme: Working with Others Outside the Classroom

Sub-theme: Coordinating with Other Teachers

Principles:

1. Coordinating with a partner requires daily contact
2. Find ways to have faculty planning meetings

Sub-theme: Communicating with Parents

Principles:

1. Communicate to parents early
2. Be honest and forthright with parents
3. Establish procedures and events to promote parent involvement
4. Find ways to involve parents in projects or to enlist their help

Sub-theme: Working with People from the Community

Principles

1. Take sufficient time to work out the feasibility and nature of external partnerships before rushing in.
2. Students need to figure out how they will work with external resource people
3. Experts have the greatest impact at the point when their expertise is needed by students

Theme: Getting The Most Out of Technological Resources

Sub-theme: Using the Internet

Principles:

1. Find ways to help students make informed choices about web sites to explore
2. Take advantage of opportunities to teach critical thinking skills for Internet use

Table 1 (continued)

Sub-theme: Using Technology

Principles:

1. Make certain that technology is crucial to the goals of the project before making it a central feature
2. Try out the technology before using it with students
3. Have students master complex technology before including it in projects
4. Contract or partner with an expert

Theme: Assessing Students And Evaluating Projects

Sub-theme: Grading Students

Principles:

1. Use a variety of assessment methods
2. Include both individual and group grades
3. Emphasize individual over group performance

Sub-theme: Troubleshooting Projects

Principles:

1. Monitor project progress with an eye toward glitches and misdirection
2. Look for opportunities to intervene with mid-course instruction
3. Be prepared to intervene with mid-course corrections and renegotiated work plans

Sub-theme: Debriefing Projects

Principles:

1. Put procedures in place to collect formative evaluation information from students

Table 1 (continued)

2. Use models to demonstrate reflection strategies 3. Prompt students to give you information about how the project might be improved

Project-based learning. Literature review. Nichola Harmer - School of Geography, Earth and Environmental Sciences.Â Online literature searches were conducted using the key word â€˜project-basedâ€™ and relevant publications were also sourced from the reference lists of articles accessed. Roughly half were research articles in which the methodology was clearly described and results presented and discussed. Of these, the majority used mixed quantitative and qualitative methods or qualitative methods alone, only four studies used quantitative methods. Project-based learning is an instructional approach designed to give students the opportunity to develop knowledge and skills through engaging projects set around challenges and problems they may face in the real world. Project-based learning, or PBL, is more than just projects.Â You can also flip your understanding of how to get started with project-based learning by approaching it from the students' perspective and providing them with the resources they need to make sense of PBL as a concept and the practical steps once they are engaged in the process. Tom Vander Ark, writing for Getting Smart, shares a helpful introductory framework for high-quality PBL. Project-based learning (PBL) is a student-centred instructional approach used to promote active and deep learning by involving students in investigating real-world issues in a collaborative environment. In Property programs, PBL is particularly appropriate as is exposes students to experiential learning in which they experience a â€˜feelâ€™ for the activities involved in the property profession.Â With real-life applications of principles. learnt from the course, PBL improves studentsâ€™ motivation and gives students a sense of satisfaction (Blumenfeld et al. 1991; Green 1998; Hadim & Esche 2002). Krajcik et al.