

determine what they will study and how. Students are presented with a situation to which they "react and discover basic conflicts among their attitudes, ideas, and modes of perception. On the basis of this information, they identify the problem to be investigated, analyze the roles required to solve it, organize themselves to take these roles, act, report, and evaluate these results" (Thelen, 1960, p. 82).

The teacher's role in group investigation is multifaceted; he or she is an organizer, guide, resource person, counselor, and evaluator. The method is very effective in increasing student achievement (Sharan & Sharan, 1989/1990), positive attitudes toward learning, and the cohesiveness of the classroom group. The model also allows students to inquire into problems that interest them and enables each student to make a meaningful, authentic contribution to the group's effort based on his or her experiences, interests, knowledge, and skills.

Another model of teaching based on social interactions is project-based learning (PBL). In PBL classrooms, students work in teams to explore real-world problems and create presentations to share what they have learned. Compared with learning solely from textbooks, this approach has many benefits for students, including deeper knowledge of subject matter, increased self-direction and motivation, and improved research and problem-solving skills.

Students find PBL very engaging, as George Lucas, founder of the George Lucas Educational Foundation and director of *Star Wars*, explains: "Project learning, student teams working cooperatively, children connecting with passionate experts, and broader forms of assessment can dramatically improve student learning. New digital multimedia and telecommunications can support these practices and engage our students" (George Lucas Educational Foundation, 2008).

A three-year 1997 study of two British secondary schools—one that used open-ended projects and one that used more traditional, direct instruction—found striking differences between the two schools in measures of student understanding as well as standardized achievement data in mathematics. Students at the project-based school did better than those at the more traditional school both on math problems requiring analytical or conceptual thought and on those requiring memory of a rule or formula. Three times as many students at the project-based school received the top grade achievable on the national examination in math (George Lucas Educational Foundation, 2001).

Project-based learning, which transforms teaching from *teachers telling to students doing*, includes five key elements:

1. Engaging learning experiences that involve students in complex, real-world projects through which they develop and apply skills and knowledge
2. Recognizing that significant learning taps students' inherent drive to learn, their capability to do important work, and need to be taken seriously
3. Learning for which general curricular outcomes can be identified up front, while specific outcomes of the students' learning are neither predetermined nor fully predictable
4. Learning that requires students to draw from many information sources and disciplines in order to solve problems
5. Experiences through which students learn to manage and allocate resources such as time and materials (Oaks, Grantman, & Pedras, 2001, p. 443)