New Teacher and Student Roles in the Technology-Supported Classroom

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Abstract

This paper examines how a range of technologies support teacher and student practices and contribute to a transformation in their traditional roles. Three new roles for students were identified: self-learner, team member, and knowledge manager. The new teacher roles found were: instructional designer; trainer; collaborator; team coordinator; advisor; and monitoring and assessment specialist. The new roles of both students and teachers are often associated with project-based or inquiry learning. The relationship of technology innovations in instruction to these new roles is discussed.

New Teacher and Student Roles in the Technology-Supported Classroom

The focus of this paper is a preliminary analysis of how the roles of teachers and students in different classroom settings are altered as a result of computer-based technologies. We are particularly interested in how the capabilities of computer-based technologies can enable and constrain innovative pedagogical practices.

Powerful new capabilities of computers make it possible to access, represent, process, and communicate information in new ways (Kozma, 1991, 1994). These capabilities make it possible to search and organize information, analyze data, represent ideas, simulate complex systems, and communicate with others in ways that were not practical or even possible previously. They also enable new ways of teaching and learning—new activities, new products, and new types of learning (Kozma & Schank, 1998). The research literature (Means & Olson, 1997) documents a strong association between these new technology-based practices and changes in curriculum and pedagogy. For example in many countries, the use of educational technology is part of an instructional shift toward project-based, constructivist approaches to teaching and learning within a context of school improvement or reform. Instead of focusing solely on increasing the acquisition of facts related to specific subject areas, teams of students are engaged in solving complex, authentic problems that cross discipline boundaries. Instead of dispensing knowledge, teachers set up projects, arrange for access to appropriate resources, and create the organizational structure and support that can help students succeed. This approach moves conceptions of learning beyond rote memorization of facts and procedures to learning as a process of knowledge creation. It moves education beyond the notion of a place where knowledge is imparted to one of classrooms, organizations, and societies as knowledge building communities (Bereiter, 1999; Scardamalia & Bereiter, 1994; Brown & Campione, 1994). These are more appropriate constructs for the information society and knowledge economy of the future. Technology plays a role in this approach of providing students with tools and information that support their problem solving, communication, collaboration, and knowledge creation. It also provides teachers with new tools that can transform instructional roles, curricula, and practices. Plomp, Brummelhuis, and Rapmund (1996) define learning as a process in which four components interact: (1) the teacher, (2) the student, (3) curriculum content and goals, and (4) instructional materials and infrastructure—more specifically in our paper, the role of information and communications technology (ICT). In this paper, will synthesize findings about changing teachers' and students' roles and classroom practices from twelve case studies in technology-enhanced classrooms across the U.S. This paper, we will provide descriptive details of individual cases as well as analyze similarities and differences across cases.

As in other studies (Means & Olson, 1997), many of the innovative schools in this study used technology to support project-based or inquiry-based learning. Project-based learning was a predominant feature of the innovations in two of the schools: Newsome Park Elementary School and New Tech High School. In two of the schools, Mantua and Jennings, project-based learning was part of a larger reform effort. In Mantua Elementary, the reform is part of a larger, "Basic School" philosophy in which technology was used to create a learning community with a coherent curriculum. At Jennings Junior High, the reform package is more eclectic and atheoretical and project-based learning is employed along with other approaches that include reduced class size, renovation of facilities, and retention of school staff. In the remaining two schools, Mountain Middle School and Lemon Grove Middle School, project-based learning

(inquiry-based learning, in the case of Lemon Grove) are instructional approaches that are employed along with others with the primary goal of increasing student achievement. In the case of Mountain Middle School, student achievement is explicitly standards-based.

Beyond this finding, what implications do these new instructional approaches have for the roles of students? What new teacher roles complement those of students? How does technology support these roles? In the following sections, these questions will be addressed by analyzing interview and observational data from the six case study sites [1] collected in the 2000-2001 academic year.

Student Roles

New student roles.

Looking across the six schools in our study, we identified three new roles for students that were often associated with project-based or inquiry learning: self-learner, team member, and knowledge manager. Each of these roles is, in turn, associated with typical activities.

The "self-learner" role is not only a major feature of New Tech High School but also at the elementary school, Newsome Park. In the schools, students must select their own real-world projects and identify possible solutions. In this way, students help determine the content of the curriculum. Students in these schools must also organize their projects and manage progress made on them. This management task extends to managing student time. Time management was most pronounced at New Tech, where students moved from class to class within the open campus at their own discretion, unprompted by bells that marked class periods. At Jennings Junior High School the role of self-learner extended to that of helping others learn. As one teacher put it, "They definitely rely on each other instead of me. The focal point is on them and not on me."

While students have always been divided into groups, the role of collaborator or "team member" is a relatively new one for students. The difference here is that the team in some way owns the project or investigation, and the team member is actively involved in advancing the project. There is both shared and individual responsibility for the success of the project. Students work collaboratively to move it forward. This team work was most obvious in the projects observed in Mountain Middle School, where students collaborated in science class to publish a newspaper on the Alaskan ecosystem, called *Tundra Times*, or the cross-disciplinary "light rail" project in the 3rd grade of Newsome Park. Sometimes the role of team member was a specialized one. For example in the "light rail" project, students rotated between different tasks given to a map committee, a research committee, and a field trip committee. For the 5th grade "flowers and plants" project at Newsome Park, students performed specialized tasks such as collecting survey data on the preferences of potential customers, cultivating the plants, developing and implementing an advertising campaign for the plant sale, or conducting research on how to care for the different plant varieties. Sometimes, students share their expertise with other students, as at Jennings Junior High School.

The third role that we observed was that of "knowledge manager". This was, perhaps, the most prevalent role and the one most often associated with the use of technology to support project-based learning. The focus of the role is on the development of knowledge products. These are often reports, research studies, newspapers, or multimedia presentations that solve a

[1] Pseudonyms are used for all the six case study sites identified in this paper.

real world problem, address a scientific question, or express personal feelings. Examples of these products include a daily, student-produced, in-house news TV program at Mantua, a presentation on biomes at Lemon Grove, student-published poetry on a website at Mountain, and a study of flowers and plants at Newsome Park. Activities demanded of this role include formulating questions, searching for information, collecting and analyzing data, and designing reports and presentations. Perhaps the school that took this role most seriously was New Tech High School, which has as its mission "to prepare students to excel in an information-based, technologically-advanced society". Run as a high-tech start-up company, New Tech views students as knowledge-workers. At New Tech, students are engaged in extended projects consisting of complex tasks and long-term deadlines. The intent is to create technology-savvy citizens who are prepared for college and the world of work.

Technology supports for new student roles.

A range of hardware and software applications support these new student roles. The most supported role is that of "knowledge manager". In this role, students have access to vast stores of information, either on the Internet or CD-ROM. In addition, they have a variety of tools that they can use to transform this information into knowledge, tools such as search engines, data analysis packages, word processors, spreadsheets, graphing and graphics packages, and presentation and web development software.

The role of "team member" is supported through the use of communications hardware and software. Two schools—Newsome Park and Mantua—are using wireless computers that support teamwork. With wireless laptops, students could assemble whenever and wherever needed (within the range of the network). Students were observed using their computers in classrooms, hallways, and libraries. Thus, groupings are based on what made the most sense for learning rather than on hardware constraints. Several schools provide students with email accounts that they used to exchange information with team members and teachers. Additionally, several schools used intranet applications such as *Lotus Notes* or *Blackboard* that support the exchange of documents. However, there was no use of software that was specifically designed for collaboration or shared construction of documents.

The least-supported role was that of "self-learner". This role is marked by the need for students to set their own goals, organize their own work, and manage their time. There were no student-equivalents to professional applications such as project management and time management software. This kind of software design for students engaged in project-based learning remains an open-market niche for educational software companies.

Teacher Roles

New teacher roles.

In terms of new teacher roles, the picture across the six cases we studied is much more complicated. Although teachers retained many of their traditional roles (e.g. class leader or director, lecturer, discussion leader), they negotiated multiple new roles in classrooms that utilized innovative technology-supported practices. The new teacher roles we identified were: instructional designer; trainer; collaborator; team coordinator; advisor; and monitoring and assessment specialist. Each role is associated specific activities and is made possible by the use of technology in support of project-based learning and inquiry-based instructional methods.

"Instructional designer" is one of the more common new roles taken on by teachers. Much like the "self-learner" role adopted by students, teachers in this role must design, plan, and organize themselves in order to effectively use and integrate technology in their classrooms. The instructional designer takes into account of all the resources available to meet the variety of needs his/her students have and implements well designed activities to address those needs. Teachers from New Tech High School are exemplars of this role. Since all the curricula is based on students creating interdisciplinary projects, teachers design and create instructional materials constantly. A teacher, describing a software tool (*Tegrity*) that allows a teacher to record and store digital web video on demand for students to view, explained, "I think is it meets a variety of learning styles and I couldn't do that in the traditional classroom, but it's wonderful. I have kids, you know, begging me, hey Smith, you know, we need you to put that *Tegrity* lesson up because they go home and they can access these materials from home. It helps them access the material to decode their textbook to get through the lessons and it's a wonderful, wonderful tool…". Support for this new teacher role can be found in those cases where remedial instruction occurred. At Mountain Middle School, for example, remedial instruction in mathematics using a drill and practice software tools is in an overall approach using technology to provide remediation and develop skills so that students may catch up and eventually achieve at high standards. Lemon Grove Junior High School, with its use of "thin client" terminals, are able to differentiate remediation for each child using a skill-based software program that helps to diagnose and remediate students according to their individual deficiencies in mathematics and reading. Each child can receive additional help in an area of weakness, receive guidance from a computer-based tutorial, and work independently so that teachers have the flexibility to work with students individually or in small groups.

The role of "trainer" is one that was reflected in 3 of the 6 cases. "Trainers" give individual instruction to enable skill development. This training is accomplished through modeling the use of technology and helping students see how they might use software tools that can help them accomplish unique tasks. The teachers in Newsome Park regularly model how ICT could be used in completing projects. Because all teachers own an Apple PowerBook laptop computer, many use a variety of software applications and multimedia programs in class to present material or to model an activity that students will undertake. In a 4th grade classroom that was observed, the teacher began the class by giving a multimedia presentation about fractions (1/2, 1/4, etc.) that showed squares being divided into halves and into fourths. The next day, the students worked at laptop computers around the classroom, using the same multimedia software the teacher used the day before to create slides of whole squares representing fractions. Teachers at Newsome Park have received support from a job-embedded form of professional development in the use of a variety of software packages and computer-based learning activities. During the training, the teachers are encouraged to take what they are learning about spreadsheets, databases, and multimedia presentations and share it with their students. As one teacher put it, "I know I've learned a lot. It has improved my teaching, I think, especially taking the *FutureKids* (professional development) class. I'm creating things; it gives me the opportunity to create things along with my students so we're kind of learning together..." This role of "trainer" was also supported by observations and interview data from New Tech High School and Jennings Junior High School.

The collaborator role was evident in all six of the cases we analyzed. Collaborator refers to a variety of activities teachers undertake to work with their colleagues to improve their instruction. These activities include informal sharing with colleagues, team teaching, and grade

level or interdisciplinary instructional activities conducted in conjunction with other colleagues. Team teaching is common in instructional approaches that utilize project-based learning and allow for additional time for students to explore some natural phenomenon in depth. For example, team teaching is an institutionalized feature of core content instruction at New Tech High school. It is less so at Jennings Junior High, although teachers in the English department collaborate with one another on lesson plans and content. Teachers at Mantua, Lemon Grove, Mountain, and Newsome Park report that sharing of ideas among their grade-level colleagues is common as was team teaching.

"Team coordinator" is another teacher role supported by data collected at three of the six case study sites. The focus of this role is on the active assignment of individual students to project or study teams. In addition to opening up opportunities for collaborative learning activities, teachers who assume the "team coordinator" create opportunities for peer tutoring and support between students with mixed achievement levels. This role was evident at Newsome Park, New Tech High, and Jennings Junior High. At New Tech High, students receive a grade for their level of collaboration from their project team members. Additionally, to graduate, all students must demonstrate and document their collaboration skills through the completion of an electronic portfolio that is evaluated by teachers and a review panel from the community. A teacher at Jennings Junior described how the use of technology enhances collaborative learning: "…when we went to technology, it was the highest form of collaborative learning. We didn't have all those obstacles in working with teams where one person was trying to force another person to work. The technology just lends itself to them working very much as a team…". Teachers at Jennings Junior and Newsome Park employ heterogeneous grouping (i.e.. placing students with different levels of ability together in the same group). Heterogeneous grouping is used to incorporate all students in small group collaboration. Provision is made to ensure that low performing students play a significant part in the group's work, especially true when using ICT.

The role of "enabling advisor" refers to the teacher who gives assistance, advice, suggestions or poses questions in a way that enable students to make sound decisions and find the information they need to complete a particular task. The teacher adopting this role is apt to give students a great deal of autonomy so that they take greater responsibility for their own learning activities. A common term used sometimes to describe this role is the term "facilitator". This new teacher role was found in four of the six cases analyzed. At Jennings Junior High, one teacher described this role in this fashion:

> I'm the facilitator! You know, I'll come back and say, oh, OK, here you might want to look at this, this, this, and this. Here you go. Here are three sites that I hope address the question. Go ahead and read them and see if that's what you were looking for. Almost like a research person for them. But they don't even know it. Which is, I mean, just absolutely fantastic. And they're just, you know, that's how I see myself. It's just there to assist them in their learning process…

Newsome Park teachers link constructivist learning principles and project-based learning to this new teacher role. Here's how the technology coordinator described it:

> As far as the role of the teacher, I think with the project-based learning, the traditional role of the teachers has definitely changed. I know when I entered into teaching it was kind of a more traditional role where the teacher stood up and taught the class. They taught the information and the child was responsible for regurgitating the information.

> It's more of a, I don't want to say, drill and practice, but it's more of memorization and exposure to information. Where now with the constructivist approach and project-based learning, the teacher pretty much takes a facilitating role and the child basically takes control and directs their own learning process…

Teachers expressed adopting this new role in Mantua Elementary, Jennings Junior, and New Tech High, but less so at Mountain Middle School.

The "monitoring and assessment specialist" refers to the new role where teachers monitor student performance and attempt to assess and improve student performance. This role is reflected in a variety of ways among 4 of the 6 cases analyzed. In Mountain Middle School, a school where standards-based achievement was a vital priority, this role was reflected in teacher tracking of individual student test scores. Teachers and administrators monitor test scores and provide written feedback and encouragement to students about how they might improve their scores on future examinations. At Lemon Grove, the skills-based software for mathematics and reading provides "just-in-time" data to teachers about student performance. This enables the teacher to have a regular point of assessment. At New Tech High, teachers use rubrics that lay out the various components of the work being completed as well as assign a score or level of competence based on clearly articulated criteria. Students are regularly involved in a range of self-assessment and peer assessment activities using rubrics.

These various teacher roles align and exist in tandem with the new student roles seen in our analysis of these cases. Additionally, the new teacher roles appear to overlap the different student roles in the cases we analyzed. The student role of "self learner" is complemented and supported by the roles that teachers play as "trainer", "instructional designer", and "monitoring and assessment specialist". This connection is nicely illustrated by the interaction of teachers and students in learning together and collaborating at Jennings Junior High School. The student role of "team member" appears to be linked to the teacher role of instructional designer, collaborator, and team coordinator. Newsome Park, with its focus on teams working together on project-based learning activities, is an exemplar of how the new teacher and student roles operate. The knowledge manager, a creator of knowledge products, is related to and supported by the advisor, instructional designer, team coordinator, and the collaborator roles that teachers adopt. New Tech High, with its teachers adopting multiple roles, provides a setting where both the new student and teacher roles are present to support project-based, interdisciplinary learning with technology.

Technology supports for new teacher roles.

A variety of technology supports these new teacher roles as they are adopted by teachers in all the school sites we visited. The instructional designer and trainer role are supported by a range of software tools that enable the differentiated instruction at Lemon Grove and project-based learning occurring at Newsome Park and New Tech High. The use of the *Tegrity* video software system at New Tech High, the utilization of application software tools, and the use of the CCC mathematics and reading software at Lemon Grove are examples of how teacher can design an instructional program that can be used to develop skills and meet the needs of students of different learning styles and achievement levels. The collaborator and team coordinator roles are supported by the use of Internet browsing software and electronic mail software programs. *Lotus Notes*, used at New Tech High, enables teachers to plan appointments, communicate via email, compile agendas for weekly meetings, and obtain student information, add Internet

hyperlinks to existing course documents, and store other digital learning resources. Telecommunications software permits efficient communication between team members (student teams or team teaching teams) or between teachers, their students, and their parents. Electronic mail has been particularly supportive of these roles at Mountain Middle School, where teachers exchange email communication with students and parents. Additional support can also be found for the enabling advisor and monitoring and assessment roles in the skill development software and application tool software supporting projects in a number of the school sites analyzed.

Conclusions

The findings from this preliminary analysis of six cases reveal that technology is being used in a variety of ways to improve classroom instruction. Each of the six cases provides an example of how technology is enhancing instruction in variety of school types in different regions of the U.S. Additionally, teacher and student roles are being altered in ways that are reflective not only of the presence of technology, but also the efforts at systemic school reform. These findings highlight different roles that students and teacher adopt in the course of their interaction with technology-supported pedagogical practices that inquiry-based learning. These practices:

- Promote active and autonomous learning in students;
- Provide students with competencies and technological skills that allow them to search for, organize, and analyze information, and communicate and express their ideas in a variety of media forms;
- Enable teachers, students, and their parents to communicate and share information on-line;
- Engage students in collaborative, project-based learning in which students work with other classmates on complex, extended, real-world-like problems or projects;
- Provide students with individualized or differentiated instruction, customized to meet the needs of students with different achievement levels, interests, or learning styles;
- Allow teachers and students to assess student and peer academic performance.

What is the significance of these role transformations? Although these changes in roles and technology-enhanced pedagogical practices can be linked with a number of factors, one stands out as noteworthy. The standards movement, which has resulted in schools throughout the U.S. adopting high performance standards, has had a significant impact on schools to prepare them to use technology. Coupled with the move toward challenging standards are the high expectations that schools have adopted, believing all children can achieve at high levels if given the necessary support. This environment has provided new opportunities for teachers and students to break out of old roles and patterns through the use of technology. Furthermore, technology has allowed teachers and students to adopt new behaviors and responsibilities consistent with the realities of a rapid technological society. Future analyses of all the data from the U.S. case studies will examine additional cases that will help to explain, identify, and describe additional role changes and derive implications for policy and improved practice.

References

Bereiter, C. (1999). *Education and mind in the knowledge age*. (http://csile.oise.utoronto.ca/edmind/edmind.html)

Brown, A. & Campione, J. (1994). Guided discovery in a community of learners. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 229-270).

Kozma, R. (1991). Learning with media. *Review of Educational Research, 61*(2), 179-212.

Kozma, R. (1994). Will media influence learning? Reframing the debate. *Educational Technology Research and Development*, *42*(2), 7-19.

Kozma, R., & Schank, P. (1998). Connecting with the twenty-first century: Technology in support of educational reform. In C. Dede (Ed.), *Technology and learning*. Washington, DC: American Society for Curriculum Development.

Means, B., & Olson, K. (1997). *Technology's role in education reform: Findings from a national study of innovating schools*. Washington, D.C. U.S. Department of Education, Office of Educational Research and Improvement.

Plomp, T., Ten Brummelhuis, A. & Rapmund, R. (1996). *Teaching and learning for the future* (Report of the Committee on Multimedia in Teacher Training (COMMITT)) to the Netherlands Minister of Education). The Hague: Sdu

Scardimalia, M. & Bereiter, C. (1994). Computer support for knowledge-building communities. *Journal of the Learning Sciences, 3*(3), 265-384.