

APPLIED LEARNING IN MIDDLE SCHOOLS

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What is Applied Learning? Applied Learning, over the past 20 years, has become a code word meaning different things to different people. To many educators “Applied Learning” refers to *learning to apply thinking skills* and *learning to learn* as in Rogoff’s (1990) Apprenticeship in Thinking and Situated Cognition (Kirshner, 1997). To some specialty teachers it refers to laboratory or shop learning, internships, cooperative or work-based learning experiences. To post secondary and technical/vocational faculty, “applied learning” commonly refers to applied academics courses such as Principles of Technology, Applied Math, Applied Communication, and Applied Biology/Chemistry; and similar programs or curricula designed to prepare the learners for direct entry into the technical workforce (Vocational Education Journal, March 1996). For purposes of this paper, “Applied Learning” will be used as a term to represent *experiential, hands-on, active learning which integrates deep academic and rigorous technical content in problems and projects which connect school to life and work.*

Barriers to this type of learning mirror other barriers to reform in middle schools. They include: overwhelming demands on educational institutions and teachers (time constraints, accountability for new standards and learning requirements), lack of applied/contextual textbooks and curriculum resources, pressure to meet standards, teachers fear they will loose control over the classroom, lack of consensus over the definition of excellence in education (Parnell, 1996). In spite of barriers, excellent examples of applied learning can be found at the national, regional and local levels, in academic and technical settings. These examples illustrate both the variety of ways applied learning appear in schools and the ways they are nestled in both academic and technical settings.

Broad reform initiatives include the New Standards Project, a voluntary association of states and school districts committed to school restructuring through establishing high standards for all students. Applied Learning Standards have been developed for high schools and include: Problem Solving, and Tools and Techniques for Communication, Information Technology, Learning and Self-management and Working with Others. The Secretary’s Commission on Achieving Necessary Skills (SCANS, 1991) presents a three part foundation and five competencies which form the core of knowledge and skill needed to enter American workplaces; and form the structure for many state and local certificates of mastery.

In addition to this national effort, individual schools or academies such as the Lewis Middle School (www.lewis.edu), in San Diego, have developed and adopted their own Applied Learning Standards for middle school students.

Academies such as the *Bluebonnet Applied Learning Academy* in Fort Worth, Texas (Miller, 1995) technical education projects such as *The Foxfire Experiment* (Phillips, 1991) as well as large,

multidisciplinary projects such as the San Diego Public Schools Triton Project (<http://edtech.sandi.net/triton>) help students develop deeper learning of academic content and make connections between the content and important life issues and potential career interests.

On the technical side, *The World in Motion II: the Design Experience* (The Society of Automotive Engineers and EDC) applied learning is a series of three specifically adapted engineering design challenges for grades 6, 7, 8 that helps students learn about engineering processes, physics concepts, and mathematical applications through problem solving and design (WWW.SAE.org). Similarly, Lego DACTA has considerable materials and excellent problem-based curriculum to help students in middle school learn basic technology and physics skills through projects in which they build motorized and computerized machines for construction, manufacturing, communication and transportation (DACTA, 1991).

Several excellent examples from the mathematics community include The Middle School Mathematics Through Applications Project (WWW.IRL.org) which has produced multidisciplinary units emphasizing mathematics as students engage in activities such as designing living spaces, role playing cryptographers creating privacy codes. Connected Geometry and Mathematical Ways of Thinking (both at WWW.EDC.org) not only help students link mathematics concepts and applications but help them to develop mathematical ways of thinking and interpreting the world around them.

Other excellent examples of applied learning include innovative approaches such as electronic field trips in which students can visit sites formerly inaccessible and interact with scientists and technicians found in *Live from Antarctica* Unit of (MMAF, 1995) and the Glacier Project (WWW.EDC.org) in which students participate in hands-on, inquiry-based, thematic curriculum which integrates into traditional middle school earth, ocean and space science curriculum. The currently funded NSF project “Integrating Academic and Technical Education for Advanced Technological Careers” is perhaps the most intentional attempt in applied learning which meets our stated definition. This project is charged with developing a single, high school science unit which integrates innovative academic science curriculum with technical curriculum drawn from industry skill standards (EDC, 1997).

Research Questions: Four broad questions help to frame future research on applied learning and middle schools: 1) What do we mean by “applied learning”? 2) What is the impact of applied learning on the achievement and development of students in middle schools? 3) What school structures and support systems are needed to facilitate applied learning in middle schools? 4) What are the long-term effects of successful applied learning experiences in middle schools?

1) What do we mean by applied learning? In many ways, there is a convergence of thinking among academic and technical communities suggesting a movement towards a set of shared end goals. In general, *applied learning* is interpreted by both academic and technical educators as an active, experiential process where students learn abstract concepts within practical, applied contexts; make connections between school and life beyond the classroom walls. Both communities associate the concept of “applied learning” with project learning, problem-based learning, contextual, constructivist learning, or authentic learning as defined by Newmann et al. (Newmann, Secada, and Whelage, 1995) as disciplined inquiry that has

meaning beyond school. Both groups believe there are significant learning benefits associated with this type of learning. (Collins et al., 1989; Newmann & Wehlage, 1995; Forman and Steen; 1996, Boaler, 1997). Applied Learning, under this broad interpretation, has become part of the fabric of our nation's standards movement. The New Standards Project contains standards for Applied Learning. The focus on processes in mathematics (Matthews, 1995) and in the new National Science Education Standards (National Research Council, 1996) supports applied learning as students are asked to extend and apply academic content to new situations. Applied Learning is also seen by post secondary faculty as a way to help students to prepare for the new AMATYC (American Mathematics Association Two Year College) Standards which propose a rich, hand's-on, technology-based, applications-driven curriculum for post secondary technical programs (Wood, 1995). However, the term "applied learning" has been viewed by some as anti-intellectual and relating to a narrow bank of isolated activities associated with preparation for work, and has been all but abandoned in favor of more current terms suggesting broader, deeper and more rigorous intellectual activity (contextual or constructivist learning).

The importance of language we use to describe applied learning cannot be minimized. It has the potential of perpetuating the great cultural "divide" between academic elitists and practical technical/vocational educators and raises questions which can impact the ways we organize schools and provide programmatic options to students. This is of particular importance at the middle school level where students make education and career decisions relating to their choice of high school programs. Researchers need to ask: *Can we arrive at a consensus to define "applied learning" in a way that is accepted and championed by both academic and technical educators? What are the elements of applied learning that are truly shared by educators (academic and technical)? What does the best of applied learning in middle schools look like?*

2) What is the impact of applied learning on the achievement and development of students in middle schools? In addition to promoting deep learning of academic concepts (Collins et al., 1989; Newmann & Wehlage, 1995), applied learning encourages new ways of thinking and behaving. In Experiencing School Mathematics (1997), Jo Boaler followed 300 middle school students over three years finding that both applied and traditional groups did well. However, the applied learning group was able to stretch out their learning to more situations and was able to see how their learning is applied in the world around them. Where students in the traditional school were submissive and rule bound, not likely to think mathematically, students who participated in project-based learning were confident, flexible and enjoyed using initiative. Similarly, research on applied academics at the technical college levels, indicates that students participating in the applied academics programs do as well as their traditional counterparts. In addition, low achieving students tend to demonstrate the greatest gain from the applied academic courses. Applied Learning students also gain confidence about their ability to learn math and physics (Wang, 1995). We need to expand this bank of research focusing on the critical middle school experience by asking: *What impact does "applied learning" experienced in middle school - have on achievement as measured in traditional and nontraditional ways? What impact does "applied learning" experienced in middle school have on*

student's ability to think and process information?on students' cumulative capacity to learn, to solve complex problems in which they need to integrate rigorous technical information and deep academic content? When is learning so "applied" that the deep academic content and technical rigor become lost in the application?

Applied learning projects frequently allow students more control over their own activities (choosing their theme, topic, resources and activities); and provide them with an opportunity to explore their own interests and abilities. Applied learning gives students a reason to learn (Huber, 1995). Thriving in courses where concepts are presented in close proximity to their intended use (McCray 1995), students learn more effectively and are more motivated when engaged in activities that have clear transferability to the real world than when engaged in traditional, decontextualized, academic tasks (Herman et al., 1992). Research questions need to ask: *What is the impact of applied learning on middle school students' motivation to learn and engagement in middle school course work?*

Applied Learning promotes cooperative learning and teaming, allowing students to use their own skills in different ways as they take on different roles within their groups; and to explore new social relationships with peers. Applied learning projects allow students to work to their own strengths as they choose the roles they will play in preparing project materials and reporting on project results, leading the team in some areas, participating as an active team member in others. Discussions with mathematicians, scientists, technicians and other front line workers while carrying our projects and participating in "on-line" field trips, help to fulfill students' need for interactions with adults other than parents and helps them to understand adult work roles. Continued research needs to ask: *What is the impact of applied learning on middle school students' social development?...on their self esteem? ... on their ability to make decisions?... ability to influence others?on the development of their leadership abilities? ...on having meaningful exchanges with adults?*

Research did not show outcomes of applied learning based on race, gender or ethnicity. If we are to build a strong case for applied learning in middle schools, we need to show for whom it works and in what settings. *What are the strategies and models that can be used to all engage students in successful applied learning activities? What kind of training and support is needed for teachers to ensure that the opportunities of applied leaning are equitable for both males and females, and for traditionally underrepresented groups?*

3) What school structures and support systems are needed to facilitate applied learning in middle schools? Applied Learning is active, involving students in physical activities, satisfying their need to move, develop physical skills and use their bodies. "Shop" activities (industrial arts, home economics, business, entrepreneurship, computer labs) allow students to develop physical and fine motor skills as they learn to use hand tools, manipulatives and other implements. Applied learning frequently asks students to use materials, equipment and tools. This implies a structure and set of resources different from the traditional classroom, and skills for which teachers may need additional support.

Teacher control over learning spaces, movable tables for group work or workstations for computers, shop or lab equipment; and accessible, secured storage areas for equipment and supplies help to make applied learning successful and minimally stressful to the teacher. Keeping tools and equipment operational for student use requires teachers to become troubleshooters, taking on a more technical role than they may have been prepared for. Management of time, space, resources and multiple activities requires a set of skills and knowledge teachers may not have practiced. Linking applied learning to the community initiatives requires teachers to be able to work outside of the normal boundaries of the school building and chain of command. Issues related to community-based learning such as transportation costs and in some cases liability coverage for students participating in field trip and shadowing or industry site visit situations are challenging. Applied learning usually implies flexibility in scheduling, with longer periods in which to work on projects, teaming of teachers across content areas. Integrating applied learning into the middle school curriculum requires a rethinking of traditional teacher/student roles and relationships as well as new approaches to assessment. These challenges imply increased investments in teacher enhancement. Our research questions need to ask: *What support systems are necessary to enable “applied learning” to become a viable strategy for middle schools? What is the impact of applied learning on school climate, the organization of schools and curriculum? What costs are associated with applied learning? What is the appropriate balance between applied learning and other learning types of learning in middle schools?* Applied learning is not easy to implement, particularly in traditionally designed schools. We need to consider the effects of applied learning on teachers who choose to carry it out. *What is the impact of applied learning on self esteem and professional self-image of teachers? Does engagement in applied learning influence a teacher’s opinion of the nature of teaching, the role of the teacher? How does this transfer to other non-applied learning situations? What is the process through which teachers move from traditional to applied learning? How do teachers engage in applied learning?*

4) What are the long term effects of successful applied learning experiences in middle schools? Middle school students stand at a great divide, making education and career decisions, sometimes based on inadequate information, inappropriate counseling. Although some questions can be answered through focused middle school projects, others require long term study. *To what extent does applied learning in middle schools influence education and career choice? For example, does middle school applied learning influence types of careers students choose to explore and interests they cultivate? What is the relationship between applied learning experiences and career aspirations and goals? What is the impact of middle school applied learning experiences on career and education decision-making such as selecting a high school program, magnet program, career high school? To what extent does experiencing successful applied learning in middle school impact education and career choice over time?* We know that minimal differences are found between 8th grade males and females on academic expectations and career goals (Post, Williams and Brubaker, 1996), and that these differences become greater in later grades requiring us to ask: *Are successful applied learning experiences in middle school appropriate interventions to engage and retain young women and minorities in technology and higher level mathematics and science courses?*

Appreciating the intensity of the cognitive, physical, social and motivational changes that take place in young people in middle schools, asks us to think about the potential long term learning benefits that may come from experiencing successful applied learning at this critical time of profound change. *What is the long term effect on students' ability to think, to solve problems, to master technical concepts or academic content when students experience successful and academically challenging applied learning in middle schools?* Furthermore, we need to consider: *Are these effects cumulative if students continue to participate in applied learning throughout high school and in college? Are these effects different for students who experience only traditional learning formats after middle school? Are the effects similar for students who find themselves on an academic track in high school compared to those on a technical track? Do more students enter and succeed in 2 and 4 year colleges when they have participated in applied learning at the middle school level?*

The importance of applied learning to preparation for success in life and work is clear as we consider the new faces of work in the 21st century. Technology and science permeate the world of work from manufacturing to medicine - the distinction between white and blue-collar work is no longer meaningful (Forman and Steen). The increasingly overlapping roles of both scientists and technicians is illustrated in the bifurcated model presented in Foundations for Excellence in the Chemical Process Industries (ACS, 1994.) begging for a reexamination of traditional academic and technical education. The main source of impetus for the School-to-Work movement seems to be a widespread concern that current forms of schooling are not preparing young people well for the emerging economy in which continual learning is an important part work (Urquiola et al, 1997). The tenets of School-to-Work are important for all students (STWOA, 1995). Middle Schools may be a last chance to reach all students equitably with core concepts and skills for career success before traditional tracing into vocational and academic programs takes place.

As computers are used more and more by engineers and scientists, applied maths such as mathematical modeling becomes more important. Engineers are now building prototypes in the computer and testing them in simulation (e.g. Boeing 777), mathematical modeling helps create designs safer and more efficiently. In addition to mathematical modeling, the importance of other applied academics permeates competitive and successful workplaces such as statistics and data analysis in both quality and process control; understanding the nature of systems found underlying concepts of fluid, energy, mechanical systems; bacteria and virus in relation to disease control for health, culinary arts and food processing, national security occupations and homemaking. At what point do we provide all students with a set of applied learning experiences that are focused on becoming aware of and exploring the technical applications of academics as they occur in life and work? To prepare all students for success in the 21st Century, we need to ask ourselves: *How much is too much technical information/skill for our core academic curricula? How much is not enough? What role can applied learning play in deepening students understanding of technical content and preparing them to live and work in a highly technical world?*

These changes in life and work beg larger questions related to the potential role of middle schools in workforce and economic development: *Are concepts, knowledge and skills acquired through applied learning at the middle school level important determinants of a strong and globally competitive workforce? Are students who have participated in rigorous and deep applied learning at the middle school level more successful in professional and technical careers than those who have not? Are they upwardly mobile? Are they more easily cross trained and prepared for the challenges of high performance workplaces where workers take on more responsibility for decision making, for the entire operation or process? Are students who participate in rigorous applied learning in middle schools and follow an academic track into the professions more successful in school and eventually in work than those who have taken a more classical education methodology? Does continuous experiencing of applied learning, beginning in middle school, attract minorities and females into technical careers and help keep them in the pipeline?*

Conclusions: Applied learning holds great promise for middle schools because it supports the cognitive, motivational, social and physical needs of pre-adolescents described by Urdan and Klein (1997). Applied learning helps students construct and extend knowledge through interaction with new types of information, tools and materials; and allows for instruction in a variety of venues through different types of interactions with adult workers and peers. Students learn to use and apply acquired knowledge to a variety of different situations within and outside of school setting. Applied learning helps students to use the knowledge and relates academic learning to the ways these concepts/skills are used in life thereby making important connections between what is learned in school and what is needed to succeed in life and work. Most importantly, the middle school School-to-Work and career exploration activities in which students explore careers, visit worksites and help them to assess their own interests and abilities against those needed of the most successful professional and technical workers. These activities help students to “envision what they will be like in the future”, and to “develop strategic plans for either becoming this kind of person or not” (Urdan and Klein, 1997). This paper raises some of the issues that lie below the surface of “applied learning”. The importance of this transition period and the potential impact of middle school applied learning on future education and careers of all students requires us to answer these questions.

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