Project-Based Instruction: Teaching And Learning In An Era 3, 21st Century World*

By

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Introduction

In an Era 3, 21st century world, students must have skills that match the needs of a complex democratic society, and a knowledge and service based economy and social order. While knowledge is important, ideas and skills that help students see the big picture, put knowledge in context, organize information, and communicate results are even more important. Technological innovation has made the ability to do "research" - to find, sort, evaluate, and organize information - even more important than ever before.

These learning goals, along with the ability to communicate with others, think critically and creatively, collaborate effectively, problem solve, and transfer learning to new and novel situations, cannot easily be taught and measured using traditional ways of instruction and assessment that incorporate coverage, discrete skill teaching, and multiple choice, short answer testing. In order to build a high achieving program for all students, to motivate students, to develop challenging programs with high standards, instructional strategies will have to change. One way to create a new type of educational program that incorporates Era 3 goals is through the development of a project-based instructional approach for all students.

Era 3, 21st century educational goals and outcomes suggest the need for frequent use of project-based instruction. Research projects can be used to assure that students are able to use effective research and information processing and literacy skills. Projects can assist in the learning of complex concepts in all subject areas. Science projects can help students learn science concepts and important scientific and mathematical processes, including how to develop and test hypotheses, set up experiments, and explain and predict results. Position papers help learners to examine and evaluate current problems faced by citizens, as well as to develop and defend positions on current issues. Students can create, evaluate and critically respond to visual and performing arts works through projects.

Project-based instruction also has other advantages. It helps teachers break away from traditional textbook teaching. It can lead to a more exciting and interesting curriculum based on student questions and problems. It has the potential of motivating students and creating greater interest in learning. It is a useful instructional strategy in heterogeneous classes with a mix of student levels and abilities. It draws on varied student talents and abilities. And it is already being implemented by many teachers who can share their insights with colleagues as to how to develop an exciting, ongoing, project-based classroom at all grade levels and in all subject areas.

What is Project-Based Instruction?

Project-based instruction means that classroom activities, units classes, even programs often, but not exclusively, center on projects as a key learning activity. The major characteristics of project-based instruction are the following:

Project-based instruction emphasizes purposeful, holistic, complex learning tasks with a product or experience as the end result.

Projects involve students in completing tasks dealing with complex situations, problem solving, and inquiry or research. It usually combines many discrete activities into a whole, fostering greater purpose and meaning for the learner. Teachers provide students with complex tasks that often include such things as interpreting literature and artwork, writing stories and plays, conducting research, drawing conclusions from experiments, writing position papers, creating innovative solutions to problems, planning and implementing new programs, simulating historical events and debating issues and problems. Traditional worksheets, short answer tests, and memorization tasks may be part of project based learning, but they are used to help complete a larger, more meaningful task. The tasks often culminate in a a written paper, a book, an oral presentation, an artwork, a theatrical performance, a video production, a simulation, or a combination of these. Figure 1 illustrates several examples of project tasks.

[Insert Figure One Here]

Projects are often used as culminating activities to a unit, to enrich and deepen learning, or to extend learning. Sometimes a project is the unit, as when a teacher begins a unit with a series of questions or problems, asks students to collect, organize and evaluate information about a topic under study, and then ends the unit by requiring a product or presentation that synthesizes and draws together the entire unit experience. Sometimes projects are used in a subject area to tie together and connect a year-long experience. And sometimes projects are used to tie together and connect information from a variety of subject areas, such as when an interdisciplinary unit is developed at the end of the year for an elementary school classroom.

Many different products and experiences (sometimes called performances) are used to depict the results of student projects. Written documents are very common: letters, diaries, logs and journals, essays, stories, poems, plays, position papers. Graphs and charts are sometimes used as end products to help students organize data and information. Artwork and crafts are often created by students, especially in the elementary school. Murals, illustrations, and models are typical examples. Other examples of end products and experiences include the creation of games, storytelling, creating a videotape or television program, or designing an invention.

The development of oral presentations gives students a chance to share the results with others in the class and practice speechmaking. Sometimes a simulation or role-play is used to depict the results of the students' work, such as simulating a situation in history (e.g., a group of Presidential advisors deciding on whether to advise the President to drop the atomic bomb on Japan during World War II).

Project-based instruction combines both content and process learning.

Effective project-based instruction emphasizes reflection, thinking and problem solving along with in-depth learning and understanding of concepts and ideas. For example, students often draw conclusions from a variety of information sources, thus deepening their understanding of a subject under study. Projects enable students to reflect on a question, think about how to solve a problem, and develop a plan for completing the project. Students are able to collect, organize, comprehend and evaluate information,

Figure 1
Sample Project Tasks (Abbreviated Format)

1. Select one of the following topics on the Inuits and Their Environment: Inuit Transportation, Inuit Homes, Inuit Food, Inuit Family Life, a topic of your choice approved by the teacher. Use a variety of sources (texts, picture sets, books, visual materials) to locate and record all information you need to complete your project. Decide on the best way to present the information you have collected.

    a. Your project could be a written report, a collage, or a model. A written report could include some pictures, drawings, charts, or maps. A collage or model should have a written explanation with it *(History Course, grade 7)*.

2. Design the largest possible container from the smallest possible amount of stiff colored paper. Determine the amount of paper required for each container. Determine how large the capacity of the container will be when completed. Construct the actual container. Justify your answer in a report, detailing your activities and sources. All mathematical formulas used must be clearly stated and their source acknowledged. Keep a log of your progress *(high school mathematics unit)*

3. Estimate the number of kernels of popcorn in a large container. Use as many different strategies as you can, and keep a record of your strategies and the results *(grades* 3-5 *mathematics task)*.

4. Design and carry out an experiment to determine the best salinity for brine shrimp survivability *(high school biology)*.

5. 5. How many invertebrates can you find in a supermarket? Go to the supermarket to find a variety of invertebrates. Classify the invertebrates that you find. Determine if someone could obtain a balanced diet on a meal of nothing but invertebrates *(biology, any level)*.

6. Select a story from your reader to adapt into a play. Working together in a group, re-write the story and agree on the part each person in the group shall play. Select one prop to signify each character. After a few days of practice, read the play to the class as a readers theater production. *(English, fourth grade)*.

7. Students are given information on both sides of an issue with societal impact. Each student gives a demonstration, using any format (oral, written media presentation) which forecasts the consequences for society of a particular position *(high school current events/social studies)*.

8. Develop a personal fitness plan using the range of available programs in the school *(physical, health education, grades 7and/or 8)*.

9. Create an exhibition that illustrates information about a specific career or career area. Use information from interviews, books and articles, photos and slides, videos, available software and other media. Your exhibition will be part of a career fair that will help share your information with other students *(middle level/high school level)*.

10. Through a media presentation, or in book format, document 30 hours of volunteer community service. Use logs, journals, photos, videotapes, art illustrations, and any other sources to put together your presentation or your book to share with others *(high school)*.

analyze charts, interpret readings, and synthesize data. The application of mathematical processes helps students understand math concepts and their usefulness. Students often share the wealth of information learned from a variety of projects, thus enriching learning.

Project based instruction supports the development of five key 21st century skill sets

Project-based learning also supports the development of some key skills that help students adapt to this new 21st century world and be prepared for lifelong learning:

1. *Ask questions, formulate problems and challenges*
2. *Search for and Process information and data*
3. *Think deeply and flexibly*
4. *Draw conclusions, apply learning*
5. *Communicate effectively*.

Taken together, they provide students with powerful tools for learning and living. They form an "Inquiry Based" Instruction model for teaching and learning, and provide the common threads for powerful project development. They suggest the development of project-based units of study that concentrate on working from important, essential questions, providing students with many opportunities to frequently collect and process information and data, encouraging students to extend and deepen their thinking about a topic, providing opportunities for students to draw conclusions and apply learning, and enabling students to frequently and effectively communicate their ideas, explanations, and results. All subjects and content areas, such as literature, history, science, engineering, mathematics, health and physical education, the arts, and foreign languages, become the vehicle through which these skills are continuously taught, learned, and developed over time through complex projects.

Project-based instruction tends* to *be relatively long term.

Projects are usually not completed in one day. They require a series of steps and stages, each of which takes some time. In some cases, the time lines may be less than a week, while in other cases the project may take many years. The size and scope of a project can vary considerably. For example, a research project might be divided into a series of stages, such as creating problems or questions for exploration, finding, organizing and evaluating information, completing a draft of a report, and producing a final product. Each stage may vary in length and complexity, depending on the level of the student. Young children may inquire about simple questions on a topic, and the class as a whole may collect information and together write a report. On the other hand, a high school student, in order to graduate, may be expected to develop a significant problem in science, conduct experiments, draw conclusions and write a report connecting the information to previously learned information in science.

Project-based instruction emphasizes open-ended, creative tasks and products.

Project work in schools sometimes emphasizes tasks that may differ little from traditional schoolwork, as when students copy materials from encyclopedias to answer factual questions. While these types of projects enable students to practice some important skills, good projects enable students to choose from many different types of tasks, to design their

own way of completing the project, to find and evaluate information in many different ways, and to create many different types of products. A good project task allows for multiple ways to design, plan, execute, and implement. Some projects may also have task and product options that enable students to choose one of interest and/or related to their learning styles and talents. Other projects may emerge as a result of student interest in a topic or problem.

Project-based instruction uses complex measures to determine success.

Because of their complexity, good projects are not easily evaluated and graded. Many different aspects of learning are included in the evaluation of projects, such as the quality of the question or problem explored, the processes used, the abilities and skills of the student, the effort and time spent on the project, the sophistication of the project, and the end result. All of these are important contributors to a successful project. The assessment of the product or experience at the end of a project is what is often meant by performance assessment.

Projects are often evaluated using a "rubric," or rating system, to determine success. A rubric includes a number of criteria, on a continuum, designed to measure the level of excellence of student work. Figure 2 is an example of one type of rubric, developed by a school district in. Bucks County, Pennsylvania, used to determine student level of achievement for a senior research project.

[Insert Figure 2 Here]

Project-based instruction provides opportunities for feedback, determination of progress, and revision and improvement.

Unlike traditional tests, projects provide opportunities for students to continually improve their work and work towards higher levels of achievement and sophistication. Each project builds on the previous development of skills and enables students to produce better questions and problems, designs for completing projects, and products. As they complete their projects, students have the opportunity to share drafts of their work with both teachers and other students, to receive feedback, and to make revisions. Each discussion of student work reveals his or her level of understanding, both of knowledge and process. Students are able to take pride in their work and are rewarded for their efforts. They begin to see connections between long-term efforts and results. Projects are important ways to increase discipline, perseverance, and long-term effort.

Project skills and processes can also be improved over time through the development of a curriculum that emphasizes how students arc progressing. Transition times at the primary, upper elementary, middle/ junior high school years can be used to conduct more formal evaluations of student projects, to determine student abilities, and provide opportunities for practice.

Project-based instruction may be completed either individually or in small or large group settings.

Projects can be developed through individual or group efforts. Both types of projects are important, for individual projects increase individual learning and achievement in many areas, while group projects create many more opportunities for shared learning, use of multiple talents, and conflict resolution.

Figure 2
Palisades High School Senior Research Project
Rubric Scoring System

5. EXCELLENT
- Thorough research - use of numerous resources.
- Organization - well thought out.
- Presentation is in logical sequence.
- Reflects mastery of language - varied and mechanically correct.
- Demonstrates or deals with data and information in an insightful and analytical manner.
- Project shows evidence of originality and creative thinking.

4. VERY GOOD
- Project meets stated requirements.
- Thorough research - uses several resources.
- Organization - planned and in logical sequence.
- Research is accurate, thorough, and supported by detail.
- Use of language is mechanically correct and competent.
- Data and information are descriptive and reflect analytical thinking.

3. ACCEPTABLE/SATISFACTORY
- Project has minimally met all requirements.
- Research is accurate, but lacks detail and explanation.
- There is basic organization, but reasoning is not always clear or logical.
- The structure and mechanics are generally correct, with some errors.
- Final project demonstrates an adequate understanding of data gathered and /or materials used.

2. UNACCEPTABLE/NOT YET SATISFACTORY
- Project has not yet met all requirements.
- Research is scant and lacks detail.
- Final product is poorly organized and is difficult to understand.
- Written materials have many errors in sentence structure and mechanics.

1. UNACCEPTABLE/UNSATISFACTORY
- Student has not completed project requirements.
- Student has shown little or no evidence of completing project.
- Student fails to turn in completed project by deadline date.

Types of Projects

A project-based system of instruction should provide students with opportunities to learn in new ways and build on the five skills that students will need for 21st century living. One way to meet new era 3 challenges is to focus on seven different types of projectsand incorporate them into the K-12 curriculum. These seven types of projects, along with more traditional testing procedures, provide a unique opportunity to help students demonstrate that they have learned and can apply important content and skills for college, career, and life.

Reading/Writing Projects.

Students read and comprehend books, novels, plays, poems, etc., often through themes. Students show their comprehension and understanding by writing general reactions, interpretive essays, poems, stories and plays based on the material read. For example, students in one third grade class developed a "project of the month" around a different type of literature: biography, fiction, mystery, etc. Students select a book or an author and write a general reaction, develop a drawing depicting their favorite part of the book, develop a new ending, etc. Other types of projects focus on reading and writing biographies of famous people, short stories during a particular period in history, plays of one author, etc. An extension of this type of project is through the analysis and interpretation of artwork and music, which includes writing tasks.

Information/Data Organizing (Information Literacy) Projects.

Students collect information and data from books, articles and other readings, surveys, interviews, the Internet, etc., and put that information into many formats, including graphs and charts. Sometimes information is represented in other formats, such as artwork, crafts and music. Typical information organizing projects include classifying information from textbooks or other resources, summarizing survey data through charts and graphs and developing decision making trees from data to help make decisions.

Research Projects.

These enable students to design research problems, find questions, collect, organize, and evaluate information, draw conclusions and share results – usually by completing a research paper. Students may show the results of their research through different types of products and experiences, including artwork, illustrated books, oral presentations, audio and videotape productions, photographic essays, simulations, plays, and the like.

Design Projects.

Students design experiments, invent products and objects, design technology, or design artwork or models For example, in a science design project, students develop an hypothesis for investigation, design an experiment to test the hypothesis, draw conclusions from collected data, and present the results of the experiment in written and/or oral format.

Other design tasks include using scientific principles to design an object that will descend from a specific height at the slowest speed, to design artwork using artistic principles, or to design house using the latest technological software.

Problem Solving/Decision Making Projects.

Students solve problems and make decisions through situations and complex problems. Problem situations around current and future issues, such as pollution, world events, health care, poverty, and economic issues are interesting and exciting areas of study, and provide students with opportunities to learn about current and future complex issues and problems and to use creative problem solving processes. Complex mathematical problems are another source of problem solving projects. Decision making projects through simulations of both historical and present-day decisions are worthwhile projects.

Position Papers

A special format for decision making projects is through the development of a position paper. After considerable research and discussion about an issue or dilemma, students write a persuasive essay, or position paper, giving their point of view and their reasons, and evidence to support this point of view.

Real World, Authentic Projects.

These provide students with the opportunity of conducting projects with direct payoffs and results in the outside world. One of the best examples of such projects is the Foxfire project in Georgia, which has led to the writing of countless books about the culture and history of rural Georgia. Projects which lead to community involvement and service, multicultural explorations in real world settings, an understanding of careers and career options, cooperative work experience, internships, and a focus on health issues produce direct payoffs for students in a changing world.

An important set of skills developed through these seven types of projects is the ability to work cooperatively with others. Both individual and cooperative group projects are important, but group projects enable students to demonstrate that they can work effectively with others, one of the Pennsylvania learning outcomes in the citizenship section. Part of the general assessment of group project work should be an analysis of student ability to work together, and the group project provides teachers with an opportunity to teach group process skills.

Projects are also a natural vehicle for teaching students technological skills. Computers are an invaluable aid for projects, for they can provide students with ways to obtain information and to write reports and produce other written products using word processing. Challenging simulations and tasks can be found in some of the latest software.

Computers can also be used in very sophisticated ways to collect, store and organize information and create end products that include charts, graphs, and graphics. Internet and other media can be major sources of information. They can help students find expertise and resources from around the globe. Other technologies, such as DVD's, video equipment, and so on, can also become an integral part of project-based instruction.

Building a K-12 Project-Based Instructional Program

A project-based instructional program, centered on the seven types of projects described above, has the potential for creating an exciting, inviting, and challenging curriculum that supports era 3 21st century learning. Ideally, students are involved in a variety of interesting projects at every grade level, some through subject area units of study, some through interdisciplinary projects and units of study. Even students in kindergarten classes can learn project skills and become involved in projects through questions that are explored and

examined independently and in small groups.

As students practice and learn project skills, they become more able to design complex, long-term projects by conducting research, writing position papers, organizing information, answering difficult questions, solving difficult problems, conducting experiments, making powerful presentations. Authentic, real life projects can help students learn about careers, current issues and events, service learning and the like. Questions and problems that are developed by students from emerging interests can be part of the mix of project-based instruction. Students can learn to develop their own projects that are of interest to them. Culminating individual and group projects during the high school years, based on these seven types, developed as part of student coursework or as interdisciplinary learning experiences, can be used to show that students have mastered processes and content at high levels of achievement. A collection of student projects and their evaluations, over time, can become the central focus of a portfolio assessment system.

However, moving towards a project-based instructional program has its potential problems. First, there is a danger that many projects will not be interesting or challenging to students, but will provide students with the same type of learning in which they were previously engaged, but in a different format. Copying words from an encyclopedia to answer a predetermined set of factual questions does not provide students with opportunities for open-ended, creative, challenging projects.

Second, there is a danger that projects will not be developed that combine challenge with ability to complete the project. Projects that are too difficult for students will frustrate them, and turn them off, rather than on, to learning. A judicious mix of choices and options, along with an understanding of student current skill levels, can help to avoid this problem.

Third, a corollary to the above problem is that a project-based curriculum will not build in enough opportunities to learn the skills necessary to do good work in projects. Teachers must work with students, especially in their younger years, to teach skills such as how to develop focused problems, use multiple sources, compare and contrast information, focus on important information, organize data, draw conclusions, and the like. One of the most important ways to help students learn many of these skills is to model learning and to show them successful products from previous projects. As teachers work with students on projects, they will come to know what skills are necessary to teach in order for students to be successful.

Fourth, projects cannot be rigidly developed as if every student will do the same project at the same level. The advantages of a project-based approach will not be gained unless there are opportunities for student choice and diversity, and for students to use varied talents and skills as they do projects. While all students need to learn basic project processes and skills, the use of varied talents, such as artwork and illustrations, handwriting, music, and so on can be encouraged to produce exciting products and experiences. Also, students should have many opportunities to practice their skills, reflect on their work, receive feedback, and revise and improve their work. Growth in learning should be encouraged through this process.

Fifth, projects need to be coordinated so that students are not overwhelmed with too many projects at one time. This is especially true in the middle and high school years, when students have many teachers who are used to giving out their assignments without consideration of other teachers' assignments. It is helpful if teachers work together to coordinate project assignments, perhaps even creating interdisciplinary projects when it is possible to do so. Giver the fact that seven types of projects are listed here, it may be

tempting to mandate that each teacher conduct all seven projects each year. This would be an overwhelming job and not the point of this article. It is better to study the curriculum and insert different types of projects that best fit with the curriculum where appropriate. Some grade levels may concentrate on only one or two types of projects, such as science experiments and research projects. A carefully thought· out approach to the implementation of projects is crucial to its success.

Sixth, it is extremely important to develop an evaluation system based on key criteria for successful projects, such as those outlined in Figure 2. The criteria and samples of student work and presentations should be made public and shared with students. Students can be taught the criteria for success, shown models, and given time to analyze models with varying degrees of success, and practice scoring sample projects. *The development of a rubric for each type of project, used* by *teachers over many grade levels, and the focus on sample models and evaluation systems, are critical for students if they are* to *learn how* to *judge their work and to improve their skills over time*.

Some Final Thoughts

Project-based learning and instruction moves schools closer to purposeful, authentic, real life activity as it also helps students meet the challenges of an Era 3, 21st century world education. Projects provide students with opportunities to master 21st century content and process learning outcomes using a meaningful instructional approach.

The potential richness and variety of projects enable students to learn concepts in depth; to improve reading and writing skills; to conduct research and experiments; to solve problems and make decisions; to make connections to the outside world; to motivate, interest and challenge students. Cooperative projects help students learn to work together effectively. Projects integrate technology and help students master technology skills in meaningful settings. Interdisciplinary projects help students see connections between the subjects and enable teachers to work collaboratively. Self developed projects, emerging from the interests of students, build self-confidence and mastery. A coordinated, project-based instructional program, as part of a K-12 curriculum, can encourage success and mastery for all students. The time for building a comprehensive, project- based instructional program is now!

REFERENCES

The following books provide information about developing projects and models and examples of projects:

Books and resources from the Buck Institute (www.bie.org)

Arnold, John. *Visions of Teaching and Learning: 80 Exemplary Middle Level Projects*. Columbus, OH: National Middle School Association, 1990.

Bochinski, Julianne. *The Complete Handbook of Science Fair Projects*. New York: John Wiley and Sons, Inc., 1991.

Bonnet, Robert and Keen, G. Daniel. *Computers: 49 Science Fair Projects*. Blue Ridge Summit, PA: TAB Books, 1990.

Cordero, Wilma and Kintisch, Shelly. *Breaking Away from the Textbook: A Creative Approach* to *Teaching in American History*. Lancaster, PA: Technomic Publishing Co., 1990.

Gutnik, Martin. *How to* Do *a Science Project and Report*. New York: Franklin Watts, 1980.

Trowell, Judith (Editor). *Projects* to *Enrich School Mathematics*. Reston, VA: National Council of Teachers of Mathematics (NCTM), 1990.

The following books provide information regarding how to evaluate projects:

Hill, Bonnie Campbell and Ruptic, Cynthia. *Practical Aspects ofAuthentic Assessment: Putting the Pieces Together*. Norwood, MA: Christopher-Gordon Publishers, Inc., 1994.

Making the Grade: Evaluating Student Progress. Scarborough, Ontario: Prentice Hall Canada, Inc., 1987.

The following competitions emphasize a project approach:

The Future Problem Solving Program enables students to develop creative solutions to future oriented problems. For further information, contact the International Future Problem Solving Program office on line.

Odyssey of the Mind promotes divergent thinking through performance based problem solving. For further information, contact Odyssey of the Mind, PO Box 547, Glassboro, NJ 08028, or go online.
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