Solomon R. Guggenheim Museum
The Art of Problem Solving

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NEED

A fifth-grade student is given a basket of recycled materials, and asked to build a model of her ideal classroom. What will the classroom look like, and how can she best use the materials to achieve her vision?

A high school student is given an assignment for a 20th century United States History class, in which he is asked to write a letter to President Roosevelt arguing for or against United States involvement in World War II. Where will he get information on this topic, and how can he use it to construct a powerful argument?

A family is traveling home on the subway, and the line they are on goes out of service. What is the best way to get home?

Problems are a part of school, and a part of life. According to the New Expanded Webster's Dictionary, a problem is: A question proposed for solution; a knotty point to be cleared up. To solve means: To explain; to make clear; to unravel; to work out. The ability to define a problem, propose solutions, take action, and reflect are essential to success in almost every endeavor. Problem-solving skills also help combat frustration that can lead to behavior problems: "Developing the perseverance and tolerance for frustration that is necessary to solve difficult problems is a primary objective of good problem-solving instruction."[1] A recent publication by the Arts Education Partnership notes: "One of the concerns expressed by commentators on public education is that schools may not be doing enough to help students develop capacities for problem solving, critical thinking, and decision making – capacities that will allow them to be lifelong learners and to tackle the challenges they will face in life, school, and work. Arts learning experiences help students develop these capacities."[2]

The Art of Problem Solving (APS) addresses two needs: first and foremost, the needs of at-risk students, and, as an additional benefit, the needs of the art education field as a whole. It does this by emphasizing the ways in which art teaches problem-solving skills, which are needed in all areas of school and life, as well as in making art. For at-risk students, APS will result in

[1] From Math Problem Solving Model, NW Regional Educational Laboratory, at http://www.nwrel.org/msec/mpm/faq.html

engaging ways to learn these essential skills. For the arts education field, APS will result in clear suggestions for how art should be taught to engender these skills, and research indicating the impact of quality art teaching on students' abilities to solve problems and think for themselves. Ultimately, clear guidelines for good art teaching help students, who benefit from better teaching and more engaging and educational art problems and projects.

Serving At-Risk Students

Learning Through Art (LTA), the Guggenheim's artist-in-residence program that provides the programmatic framework for the project proposed here, addresses specific needs of students at risk of educational failure by building partnerships with public schools, primarily receiving Title I funding, in all five boroughs of New York City. LTA serves a large number of students from low-income families, including many new immigrant communities from African, Latin American, Caribbean, Asian, and Middle Eastern countries. Through LTA, professional teaching artists collaborate with classroom teachers and Guggenheim staff to create 10- or 20-week in-school residencies that use the discussion and creation of art to address planned curricula, such as social studies, science and language arts. Classroom teachers are encouraged to actively participate and are offered professional development in how to use art as a teaching tool. LTA addresses New York State Arts Standards One through Four in all programming.

At-risk students are currently in a teaching and learning environment highly focused on developing specific skills related to reading, writing, and math. This reflects a national shift; according to a recent *New York Times* article, "schools [around the country] are increasing – in some cases tripling – the class time that low-proficiency students spend on reading and math."[3] These skills are essential for many reasons: to pass state and national tests; to proceed into the

[2] Lauren M. Stevenson and Richard J. Deasy, *Third Space: When Learning Matters*. (Washington, DC: Arts Education Partnership, 2005.)

next grade; and to address a range of other tasks students will face throughout their lives. However, an equally important set of cognitive skills is being neglected in this educational climate: analysis, problem solving, and creative thinking.

This need is recognized in the New York State Career Development and Occupational Studies (CDOS) Standards, which includes "Thinking Skills" as a Universal Foundation Skill essential for success in the workplace. The standards state that, "Thinking skills lead to problem solving, experimenting, and focused observation and allow application of knowledge to new and unfamiliar situations." The State of New York recognizes that these problem-solving skills are, for almost all students, essential for success in life.

Although these skills are not directly tested in annual elementary school math and language arts exams, the State of New York provides charts showing that they are related to the scoring of High School State Regents exams in history,[4] English language arts,[5] and living environment.[6] As these charts demonstrate, thinking skills are important for writing essays, interpreting documents and images, comparing and responding to literature, and conducting scientific inquiry. In order to do well in school and on exams, at-risk students need support in learning these thinking skills, often categorized as problem solving.

New York City has published Applied Learning Standards, which are currently being revived in the creation of social studies and science assessments for sixth-, seventh-, and eighth-grade students; "problem solving is the centerpiece of the standards," claims the Applied Learning Standards website. These standards state that students will be able to: "Apply problem-solving strategies in purposeful ways, both in situations where the problem and desirable solutions are clearly evident and in situations requiring a creative approach to achieve an

[3] Sam Dillon, "Schools Cut Back Subjects To Push Reading and Math," *New York Times* 3/26/06, A1.
[4] See http://www.emsc.nysed.gov/workforce/cdos/crosssocialstu.htm

outcome."[7]

Problem solving also is referenced in various standards suggested by national organizations. Although New York State elementary school math tests do not directly reference problem solving, the National Council of Teachers of Mathematics (NCTM) emphasizes the importance of these skills in the introduction to their Problem Solving Standards:

> "Problem solving is an integral part of all mathematics learning. In everyday life and in the workplace, being able to solve problems can lead to great advantages. However, solving problems is not only a goal of learning mathematics but also a major means of doing so. Problem solving should not be an isolated part of the curriculum but should involve all Content Standards."[8]

The National Council of Teachers of English (NCTE) also refers to problem-solving skills within their K-12 English Language Arts standards: "Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources … to communicate their discoveries in ways that suit their purpose and audience."[9] These national standards recognize that students should be challenged to be curious, and to pose, explore, and propose answers to problems.

Gifted and Talented (G&T) curricula often provide students with the opportunity to build problem-solving skills. Elementary level G&T programs regularly serve students who score higher on academic tests. According to a NYC G&T Regional Coordinator, the development of problem-solving skills is embedded in the G&T curriculum through open-ended questions that challenge students to go beyond surface understanding. However, such practices are not emphasized with at-risk students in general education. Although students not tracked into G&T

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[5] See http://www.emsc.nysed.gov/workforce/cdos/crossela.html
[6] See http://www.emsc.nysed.gov/workforce/cdos/crosslivenvir.html
[7] New York City Department of Education Applied Learning Performance Standards are at http://www.nycenet.edu/offices/teachlearn/documents/standards/applied/preface/9aplearnps.html
[8] See Problem Solving standards listed on National Council of Teachers of Mathematics website at http://standards.nctm.org/document/chapter3/prob.htm
[9] See #7 on the National Council of Teachers of English website at http://www.ncte.org/about/over/standards/110846.htm

programs often struggle with skills that G&T populations have already mastered, it is equally important for them to learn these skills.

Serving the Art Education Community

The arts education community benefits from clear standards in all art forms. Nationally, this includes both content and achievement standards. The New York City Department of Education has recently produced a *Blueprint for Teaching and Learning in the Arts*, which offers suggested projects and themes at various levels, and includes performance indicators for these projects. The Wallace Foundation has cited the Blueprint as "the first citywide, comprehensive arts curriculum in the nation – which provides the school system and partner organizations with a coherent approach to teaching the arts at all levels in all schools."[10] However, standards generally provide more information about what children should accomplish than how teachers should teach. Also, visual art remains a product-focused discipline; notably, the *Blueprint's* benchmarks in art making all begin with the word "create," never the process-related words "explore" or "manipulate." The benchmarks for music, however, begin with a variety of process words such as "explore" and "improvise."[11]

Art educators know that art can teach students many things. Renowned art educator Elliot Eisner has written a list of "Ten Lessons the Arts Teach," which is prominent on the website of the National Art Education Association, and includes such statements as, "The arts teach children that problems can have more than one solution," and "The arts teach students to think through and within a material."[12] These statements, however, are only true when art is taught as an exploratory activity: when students are posed problems and encouraged to find

[10] See http://www.wallacefoundation.org/WF/NewsRoom/NewsRoom/PressRelease/ArtsForYoungPeople.htm
[11] New York City Department of Education, *Blueprint for Teaching and Learning in the Arts, Grades K-12: Visual Arts & Music*, 2004.

[12] See http://www.naea-reston.org/tenlessons.html

unique solutions, or when students are given materials and taught to manipulate and express with them, rather than told what to make. For example, the impact of a project in which students are taught to copy Van Gogh's style is very different than a workshop in which students are challenged to find ways to create their own landscape which conveys mood through color and brushstroke.

The Guggenheim proposes that the arts education field would benefit greatly from carefully considered process-based hallmarks of good teaching, including implementation objectives (what teachers will do) as well as outcome objectives (what students will do).

SIGNIFICANCE

In Fall 2006, the Guggenheim's Learning Through Art staff led a professional development workshop for teachers in which they were given three materials-based art challenges – making as many different marks as possible using their hand as a printing tool; using white and primary colors of paint to mix a color that matched their skin tone; and transforming a piece of clay into an animal without detaching or reattaching any pieces. Teachers were then asked to reflect on the ways in which they solved these problems. They listed a number of problem-solving skills they drew upon to complete these activities, including: experimentation, building on prior experience, comparing and contrasting, brainstorming, collaboration, breaking down a problem into sub-problems, redefining the problem, and decision-making. It was clear that this was a new way for participating teachers to think about art, and that they appreciated the connection between art making and developing skills they wanted their students to learn.

This professional development was as illuminating for Guggenheim staff as it was for classroom teachers. It demonstrated a number of things: even simple art-based tasks require

problem-solving skills; when posed with these problems in a reflective environment, non-art teachers are aware of the skills they use, and can appreciate the utility of these activities; and "art as problem" is a new way for most teachers to think about art. The Art of Problem Solving (APS) will contribute to both the accomplishments and understandings of students and teachers in LTA schools, and the field of arts education.

Significance for Students and Teachers

With sufficient funding, The Art of Problem Solving will determine the best methodologies for utilizing the arts to teach problem-solving skills to elementary school students, particularly those at-risk. Past DOE funding has similarly allowed LTA to study and confirm the significance of viewing and discussing art (which the Guggenheim calls "inquiry") within art-making workshops. As a result of this study, every LTA residency now includes inquiry in nearly every session, and the Guggenheim is in the midst of a national initiative to share both findings and tools with others.

LTA is committed to the notion that arts integration can simultaneously teach art and achieve the larger curricular goal of teaching thinking skills, particularly problem solving. This is reflected both within the structure of projects, which are designed around large, or "essential," questions, and the structure of individual lessons, which challenge students with both skill-based (technical) and idea-based (curricular) problems. Student achievement in the arena of problem solving is measured in the program's rubric; problem solving-related outcomes include:

- Students will explore choices and generate several ideas;
- Students will be able to identify and explain the choices they make. Each student's work will look very different from that of other students;
- Students' work will show evidence of a synthesis of information from various sources; and

- Students will recognize and communicate when they meet a problem; they will be able to describe problems and suggest ways to fix them in their own artwork and that of their peers.

Specific student outcomes for APS, which will be determined in detail during a planning year, indicate the Guggenheim's expectation that students engaging in art-making can and will learn both problem-solving and art skills, and that these skills will affect both performance and attitude. Current categories of outcomes for participating fifth-grade students include:

- Students will demonstrate stronger problem-solving skills than those of a matched control school;
- Students will demonstrate art learning, as defined in the above-referenced hallmarks;
- Students will score higher on the Torrance Test or another similar test measuring creativity or problem solving (the exact test to be used will be selected during planning year). [13]
- Students will better complete assessment tasks related to Career Development and Occupational Studies Standard #3: Universal Foundation Skills, specifically Key Idea #2, Thinking Skills, which states, "Thinking skills lead to problem solving, experimenting, and focused observation and allow the application of knowledge to new and unfamiliar situations."
- Students will have a more positive attitude toward school, and a more positive attitude when confronted with unfamiliar academic, artistic, and social problems.

Teachers working with APS will:

- Understand the ways in which art can teach problem-solving skills better than their counterparts at a matched control school;
- Demonstrate confidence in their students' abilities to solve problems, and interest in the

unique solutions students devise.

- Structure their lessons to help students develop problem-solving skills across the curriculum.

Art Teachers and Teaching Artists trained by the Guggenheim will be more likely than non-trained instructors to teach art in such a way that it cultivates student problem-solving skills.

Artists solve problems in unique and creative ways. In a letter to the *New York Times* dated March 31, 2006, Governor of Arkansas Mike Huckabee writes, "Creative students are better problem solvers; that is a trait the business world begs for in its work force."[14] In the current educational climate, with enormous pressures on classroom teachers to train students in basic reading, writing and math skills, art remains an appropriate and available area to focus on these skills.

Significance for the Arts Education Field

APS will contribute to the arts education field in four important ways. It will:

(1) Bring specialists in art together with specialists in education and cognitive science to list and define student outcomes related to problem-solving skills that might result from art classes. These specialists will then determine – given these outcomes – hallmarks for successful arts teaching and learning.

(2) Provide valid, reliable quantitative data measuring the impact of LTA (and thus other art programs and teaching using these hallmarks) on students' problem-solving skills.

(3) Involve experts across art disciplines (notably theater, music, dance, and creative writing) to determine applicability of research and findings to these other arts areas and to in-school art teaching including art clusters and teacher-led art projects.

(4) Result in the dissemination of hallmarks, tools and findings through the Web, academic and

[13] The Torrance Tests of Creative Thinking are among the most widely used creativity tests. They were developed by E. Paul Torrance and first published in 1966. The Torrance Test, and others like it, are often used by schools to determine placement in

practical articles, conferences, teacher workshops and a Summer Institute.

1) Defining Problem-Solving Outcomes and Hallmarks for Successful Art Teaching

A great deal has been written about teaching problem solving in science and math, but little has been written about how this critical thinking skill relates to arts education. Recently, Problem Based Learning (PBL) has become popular in education; PBL has been described as "an approach which helps the learner [to] frame experience as a series of problems to be solved, where the process of learning unfolds through the application of knowledge and skills to the solution of … problems."[15] Cognitive science also provides models of problem solving, and the criteria by which problem-solving ability can be measured.

Another much-examined subject is what constitutes good art teaching. Countless books have been written with suggested projects and approaches for art teachers. In 1972, the team of Nelson Goodman, David Perkins, and Howard Gardner published *Basic Abilities Required for Understanding and Creation in the Arts: Final Report for the US Office of Education*. In a 2005 presentation at the annual conference of the New England Board of Higher Education, Rebecca Shulman Herz, Guggenheim Museum Education Manager of Learning Through Art, cited four characteristics of good art teaching: (1) art education must value students' own ideas; (2) art education must challenge students by posing difficult but solvable problems, with multiple satisfactory solutions; (3) art education must be reflective, engaging students in thinking about the choices they make and why they make them; and (4) art education must address looking at as well as making art, rooting the subject in a context that is larger than the school art room.

APS will bring together advisors familiar with the literature of problem solving and art education. The project will not merely propose another theory of how art should be taught; it

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gifted programs and to evaluate programs meant to spur creativity.
[14] Mike Huckabee, "Schools Need the Arts," in *New York Times*, Letters, April 2, 2006.

will root ideas in cross-disciplinary research, and empirically test them in a rigorous evaluation.

(2) Providing Research Data Regarding Art Education and Problem-Solving Skills

In 2004, Arts Education Partnership (AEP) published *The Arts and Education: New Opportunities for Research.* Under the heading "The Arts and Cognitive Development," this publication calls for "Research… to examine how students develop these [cognitive] skills and their inclinations and dispositions to use them." The same publication states that "Future research would benefit from the involvement of scholars who bring a range of tools and perspectives to the study of cognitive processes."[16] A great deal of research remains to be done on how the visual arts can teach higher level thinking skills, and particularly problem solving. In *The Arts and the Creation of Mind*, Elliot Eisner poses a challenge to researchers: "Among the most important kinds of research needed in the field are studies of teaching and learning. By studies of teaching and learning, I mean studies that try carefully to answer the question 'What do teachers of the arts do when they teach and what are its consequences?'"[17] Eisner continues, "What would it take to get the kind of evidence that would provide credible support for claims about transfer?... We would need to determine the kinds of academic outcomes that we cared about; we would then need to decide what would count as evidence and … how that evidence might be secured, measured, and evaluated."[18] Eisner recommends random selection of students; use of both study and control groups; an intervention lasting five to ten months; and assessing learning in both art and other outcomes.

The Guggenheim, with the evaluation and research firm Randi Korn & Associates, will

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[15] Tara J. Fenwick and Jim Parsons, "A Critical Investigation of the Problems with Problem-Based Learning," 1997, p.2. Report available on ERIC.
[16] Arts Education Partnership, *The Arts and Education: New Opportunities for Research*, p. 4. Full text available at http://www.aep-arts.org/PDF%20Files/OpportunitiesResearch.pdf.
[17] Elliot Eisner, *The Arts and the Creation of Mind. (*New Haven, CT: Yale University Press, 2002), p. 215.

[18] Ibid, 220-223.

follow a process very similar to the one Eisner describes. It will produce valid, reliable data on whether ongoing classroom engagement with the visual arts can teach problem-solving skills.

(3) Applying Findings to Related Disciplines and Educational Settings

After the research has been completed, the Guggenheim will hold a two day symposium with experts in dance, theater, music, and creative writing to share the project and discuss ways in which arts hallmarks and research findings are relevant to these fields. The symposium will result in specific recommendations for art teaching in these four arts fields, and ideas regarding the relationship of the arts to problem solving. It will generate a comparison of educational practices in these different arts disciplines.

The Guggenheim also will invite arts supervisors from New York City and around the nation to attend a workshop at which hallmarks, rubrics, and research findings will be shared, and participants will identify ways in which they can use this information within their own arts programs.

(4) Dissemination of Hallmarks, Tools, and Findings

The Guggenheim will disseminate the products of APS, including research findings, tools, and hallmarks, in a number of ways. Methods of dissemination will include a section of the LTA teacher website; a week-long Summer Institute for art educators; teacher workshops; publications, including both academic and practical articles; and conference presentations.

PROJECT DESIGN

In recent years, numerous educators have argued for the importance of teaching problem-solving skills. Lorin W. Anderson, the editor of the second edition of *Taxonomy of Educational Objectives*" (Bloom's Taxonomy), writes, "That problem solving is an essential objective of education was obvious to the authors of the original *Handbook*…. [W]e agree that virtually all

problems require the use of several cognitive processes." He lists these processes as analysis, comprehension, remembering, synthesis, evaluation, and metacognition.[19] Robert J. Sternberg, Director of the PACE (Investigating the Psychology of Abilities, Competencies, and Expertise) Center at Tufts University (formerly at Yale), presents a theory of "Successful Intelligence," which argues that "intelligence comprises analytical, creative and practical abilities"[20] Many of the examples Sternberg offers for these categories of ability could fall under the heading of problem solving: analyze why a method for solving a math problem works; invent a toy; explore new ways of solving a math or chemistry problem; propose new battle techniques for certain terrain.[21] Sternberg argues, "In teaching students to process information creatively, we encourage them to *create, invent, discover, explore, imagine* and *suppose*."[22]

A primary goal of APS is to look at the work of experts in education and cognition, and apply their ideas to the teaching of art. APS will convene an advisory team of experts and practitioners in a range of fields, including cognitive psychology, education, the arts, and art education, to discuss (a) what constitutes good art teaching, and (b) how good art teaching can result in increases in problem-solving skills. This team will include New York City Department of Education Region 9 and 10 Arts Supervisors, as well as: Michael Hanchett Hanson, Director of the Masters Concentration in Creativity and Cognition, Teachers College, Columbia University; Kyle Haver, Elementary School Instructional Specialist, Department of Social Studies, New York City Department of Education; and Ardina Greco, Guggenheim LTA Teaching Artist and Ph.D. Candidate in Art Education at Teachers College Columbia University,

[19] Lorin W. Anderson, *Rethinking Bloom's Taxonomy: Implications for Testing and Assessment,* 1999, p 11-12. Report available on ERIC.
[20] Robert J. Sternberg, "Creative Thinking in the Classroom," *Scandanavian Journal of Educational Research*, Vol. 47, No. 3, 2003, pp. 325-338; quote from p. 325.
[21] All examples are from Robert J. Sternberg, "Raising the Achievement of All Students: Teaching for Successful Intelligence," *Educational Psychology Review*, Vol. 14, No. 4, December 2002, pp. 383 – 393

[22] Ibid, p 333.

and practicing visual artist. These founding participants will begin by suggesting additional experts to join the advisory team. Learning Through Art teaching artists also will contribute to the dialogue. Although this advisory team will make many of their contributions in the first year of APS, they will be of ongoing importance to the project.

The project will extend over four years. The first year of the project is a planning year; during this year, the Advisory Team and LTA teaching artists will work to create two documents: (1) a list of "Hallmarks of Good Art Teaching," and (2) a rubric indicating problem solving-related student outcomes. Teaching artists will be involved in part to contribute their expertise and to ensure that the findings of APS result in program-wide changes in teaching. This planning year also will allow the Guggenheim to randomly select schools for its rigorous, experimental study. LTA staff will contact the list of schools below to determine their willingness to participate.

Schools that have been selected are all Title I schools in Regions 9 and 10 of New York City; are large enough to allow for research (with at least three fifth-grade classes); have high student need; have less than 50 percent ELL population; and currently do not indicate any participation in the visual arts. The 17 schools that fit these criteria and are matched in terms of demographics and test scores, are:

In Manhattan: P.S. 7 Samuel Stern School; P.S. 57 James Weldon Johnson School; P.S, 115 Alexander Humboldt School; P.S. 123 Mahalia Jackson School; P.S. 128 Audubon School; P.S. 132 Juan Pablo Duarte School; P.S. 135 Luis Belliard School; P.S. 146 Anna M. Short School; P.S. 161 Don Pedro Albizu Campos; P.S. 189; P.S. 192 Jacob H. Schiff School; and P.S. 200 James M. Smith School.

In the Bronx: P.S. 29 Melrose School; P.S. 43 Jonas Bronck School; P.S. 49 Willis Avenue School; P.S. 156 Benjamin Banneker School; and P.S. 277 Children's Literacy Center

The Guggenheim has learned from past experience that schools do not always accurately report level of arts involvement. Therefore, eight randomly selected schools will receive 10-

week residencies for a total of 600 second-grade students in the spring of the planning year, so that the Guggenheim and Randi Korn & Associates (RK&A) can begin to investigate any unreported conflicts or complications which might invalidate the study. Should a problem arise at a school, that school would be eliminated from the pool for Year Two. The Guggenheim also has learned that it is essential to offer control schools sufficient programming to ensure the investment of the school, thus ensuring that consent forms are returned and teachers and administrators are responsive. Therefore, for schools randomly selected as control schools in Years Two and Three, the Guggenheim will offer 20-week residencies for second-grade students, which will not impact the students or teachers in the control fifth-grade classes.

The second and third years of APS are programming and evaluation years. LTA teaching artists and tour guides will receive substantial professional development in art education practices related to problem solving. From the eight schools that receive ten-week residencies in Spring 2007, RK&A will randomly select nine test classes and nine control classes. During these years, the Guggenheim will lead 20-week residencies with selected test fifth-grade classes, and 20-week residencies with second-grade classes in the control schools, to maintain a productive relationship with these sites. Fifth graders have been chosen for testing, as it has been the Guggenheim's experience that fifth graders are more likely than younger students to experience the academic and social frustration that can be alleviated with additional problem-solving teaching. Test and control sites will be evaluated by RK&A throughout these two years via the techniques outlined in the evaluation plan portion of this narrative.

The fourth year of the project is dedicated to sustainability, dissemination, and forums for dialogue. During the summer of 2009, LTA administrative staff will hold a retreat to discuss preliminary findings and make programmatic changes, as appropriate. Professional development

will be offered to teaching artists and tour guides, ensuring that all teaching staff working with LTA students have a strong grounding in hallmarks of good art teaching, and the relationship between art and problem solving.

Once RK&A completes their presentation of the findings, the Guggenheim will hold a number of trainings, workshops, and symposia, including:

- A two-day symposium with representatives from different branches of art education (dance, music, theater, and creative writing) to determine implications of APS findings for other disciplines;
- A workshop for school arts administrators to discuss applications of APS hallmarks, tools, and findings to their own programs;
- A week-long Summer Institute for arts educators nationwide in best practices for successful art teaching;
- Workshops for educators held in collaboration with university education and art-education programs. These workshops will use *A Year with Children*, the Guggenheim's annual spring exhibition of student art, as a tool for disseminating and discussing best practices and sharing related teaching tools; and
- Open-enrollment workshops for educators held after school and on weekends at the Guggenheim. These workshops also will use *A Year with Children* as a tool for disseminating and discussing best practices and sharing related teaching tools.

The Guggenheim also will share findings with a nationwide audience through articles, conference presentations, and the Learning Through Art website, which is currently being developed with funding from the United States Department of Education. The Learning Through Art website will be evaluated by RK&A to ensure that it is as powerful a tool as possible for

teachers, and a new section on "problem solving" will be added.

MANAGEMENT PLAN

The primary goals of The Art of Problem Solving are to serve at-risk students and to contribute to the increased understanding of (a) what constitutes good art teaching, and (b) how good art teaching can result in increases in student problem-solving skills. Below is a summary of the goals and objectives discussed throughout this narrative, as well as selected outcomes for the project.

GOALS:

• Generate a rubric of arts-education outcomes for problem solving
• Create clear hallmarks for successful art teaching
• Offer successful art teaching to 1,500 New York City public school students
• Evaluate the impact of successful, extended arts teaching on fifth-grade students' problem-solving skills
• Make programmatic changes to LTA in response to evaluation findings
• Meet with representative educators from the different arts disciplines to discuss implications for teaching across the arts
• Meet with school arts administrators to discuss applications of project results to their programs
• Disseminate findings through articles, conference presentations, and the Web
• Train art educators in successful art teaching through a Summer Institute and through workshops offered in conjunction with *A Year with Children*, the Guggenheim Museum's annual exhibition of student art

OBJECTIVES:

• Convene an advisory team of experts and practitioners in education, cognitive psychology, and arts education for the purpose of determining the ways in which the arts can teach problem-solving skills, and hallmarks of good art teaching that will achieve these outcomes
• Organize a series of professional development workshops for Guggenheim teaching staff, focusing on high quality arts teaching, and teaching problem-solving skills
• Engage nearly 1,500 second- and fifth-grade students in 10- and 20-week artist residencies, offered through Learning Through Art
• Empirically test both the delivery of arts education and the impact of this teaching on students' problem-solving skills
• Hold a two-day symposium with representatives from different branches of art education (dance, music, theater, and creative writing) to determine implications of APS findings for other disciplines

• Host a workshop for school arts administrators to discuss applications of APS hallmarks, tools, and findings to their own programs
• Offer a week-long Summer Institute for arts educators nationwide in best practices for successful art teaching
• Offer workshops for educators held in collaboration with university education and art-education programs; these workshops will use *A Year with Children* as a tool for disseminating and discussing best practices and sharing related teaching tools
• Lead open-enrollment workshops for educators held after school and on weekends at the Guggenheim, these workshops also will use *A Year with Children* as a tool for disseminating and discussing best practices and sharing related teaching tools
• Publish articles and present at conferences, including the annual National Art Education Association conference, museum conferences, and conferences recommended by the advisory team
• Create a new section of the LTA website, focusing on problem solving. This website, currently in development in collaboration with the web firm Eduweb, also features tools and findings from Teaching Literacy Through Art, funded by the US Department of Education 2003-2006. The Guggenheim also will work with RK&A to evaluate this website, and will make changes accordingly, ensuring that it is a useful resource for teachers nationwide.

A timeline outlining dates for each project component, and noting project milestones is below:

Date ⊗ - denotes project milestone	**Task**
September – December 2006	
	Approach 17 statistically matched Title I schools within Regions 9 and 10 of New York City regarding their interest in working with Learning Through Art.
	From the schools that are interested in working with Learning Through Art, randomly select eight to work with in Spring 2007, establishing a relationship with these schools so as to make the testing years to follow proceed more smoothly.
	Gather together an Advisory Team including experts and practitioners in Education, Art Education, Art, and Cognitive Psychology.
January – May 2007	
	10-week residencies with approximately 600 students at eight randomly selected schools, in order to forge relationships with test and control schools. LTA will work with second-grade classes at each school, thus assuring that neither teachers nor students who will participate in the APS study are affected.
⊗	Work with the advisory team to • describe expected or desired student outcomes related to problem solving;

	• identify hallmarks for successful art teaching that will result in increased problem-solving skills; and • develop rubrics and test instruments, and identify existing tests (such as the Torrance Test) that might be used in this research. (This work will continue into Summer 2007)
June – August 2007	
	Reflect on work with schools eligible for study; eliminate schools where there might be confounding factors (such as other previously unknown arts programming). Randomly select nine test classes at three test schools, and nine control classes at three control schools.
September 2007 – June 2008	
	Four-day, intensive professional development for all Guggenheim teaching staff in successful art teaching and problem-solving outcomes.
	Professional Development for all classroom teachers participating in LTA.
	20-week residency program with nine classes at test schools.
	20-week residency program with second-grade classes at three control schools (to keep schools invested).
	RK&A evaluation, Year One • Observations of residencies on randomly-selected dates (January – April) • Student questionnaires and interviews administered (May)
Summer 2008	
⊗	RK&A Year One findings presented to LTA staff and APS Advisory Team.
September 2008 – June 2009	
	Four-day, intensive professional development for LTA Teaching artists.
	Professional Development for all classroom teachers participating in LTA.
	20-week residency program with nine classes at test schools.
	20-week residency program with second-grade classes at three control schools.
	RK&A evaluation, Year Two • Observations of residencies on randomly-selected dates (January – April) • Student questionnaires and interviews administered (May)
⊗	Begin presenting project and preliminary findings at conferences.
Summer 2009	
⊗	LTA Administrative Staff retreat, at which preliminary findings are analyzed and programmatic changes made accordingly.
September – December 2009	
⊗	RK&A final report.
	Implement LTA program with changes based on findings.

	Professional development for all Guggenheim elementary education teaching staff in successful art teaching and problem-solving outcomes.
⊗	Write and publish related articles.
January – August 2010	
⊗	Hold a two-day symposium to discuss the relevance of the visual arts hallmarks to the fields of dance, theater, creative writing, and music, other disciplines. Findings from this symposium will be collected, published and disseminated.
⊗	Host a workshop for school arts administrators to discuss applications of APS hallmarks, tools, and findings to their own programs.
⊗	Add findings, lesson plans and tools to LTA website; evaluate website and make changes and improvements as needed.
	Continue to present at conferences.
⊗	Host workshops in partnership with university education and art-education departments, in conjunction with *A Year with Children*.
⊗	Offer after-school and/or weekend workshops for tri-state area educators, in conjunction with *A Year with Children.*
⊗	Week-long Summer Institute for arts educators nationwide in successful art teaching.

In addition to completing the objectives and tasks outlined above, Learning Through Art will continue to conduct high quality 10- and 20-week artists residencies in at least 11 schools throughout New York City, serving 1,500 plus elementary students annually.

Management Team and Responsibilities:

The following chart outlines key staff and advisors for this project and their major responsibilities. Biographies for these staff members are attached separately.

Team Member	**Responsibilities**
Guggenheim Staff	
Kim Kanatani, Gail Engelberg Director of Education	• Work with staff to gather advisory teams featuring both university-based experts and practitioners • Recommend sites for dissemination (publications and conferences); work with team to ensure strong articles and conference proposals • General oversight
Sharon Vatsky, Senior Education Manager, School Programs	• Work with staff to gather advisory teams featuring both university-based experts and practitioners • Attend advisory team meetings; participate in art education advisory team as a practitioner-advisor

	• Recommend sites for dissemination (publications and conferences); work with team to ensure strong articles and conference proposals • Advise in developing and marketing week-long Summer Institute (Summer 2009)
Rebecca Shulman Herz, Education Manager, Learning Through Art	• Manage LTA Program • Approach schools for study; form relationships with school administrators • Gather advisory teams; lead advisory team meetings • Collaboratively develop and lead professional development for Guggenheim educators • Lead professional development for participating classroom teachers • Lead LTA staff retreats; ensure programmatic changes are made where appropriate and beneficial • Present at conferences • Write articles for publication • Develop and lead fall 2009 two-day symposium • Lead workshop for school arts administrators to consider application of best practices and findings to their programs • Develop workshops offered in partnership with universities • Co-develop 2009 Summer Institute
Jackie Delamatre, Education Program Coordinator, Learning Through Art	• Directly coordinate grant-related residencies at test and control schools • Participate in advisory team meetings • Liaise with RK&A; help as needed to ensure smooth research • Present at conferences • Develop workshops offered directly to tri-state educators • Develop lesson plans and tools to be added to website; oversee creation of this new component of website and evaluation and update of the website • Co-develop 2009 Summer Institute
Project Consultants	
Randi Korn & Associates - Randi Korn, Director - Johanna Jones, Senior Associate - Stephanie Downey, Senior Associate - Dr. Margaret Menniger, Statistical Consultant	• Evaluate project and codify assessment
Michael Hanchett Hanson, Director of Masters Concentration in Creativity and Cognition,	• Serve on Advisory Team • Recommend other experts for this team

Teachers College Columbia University	
Kyle Haver, Elementary School Instructional Specialist, Department of Social Studies, New York City Department of Education	• Serve on Advisory Team • Advise in planning cross-disciplinary symposium for Fall 2009
Ardina Greco, LTA Teaching Artist and Ph.D. Candidate in Art Education at Teachers College Columbia University	• Serve on Advisory Team • Advise in designing advisory team meetings • Serve as teaching artist at selected test residencies
Anette Jacque, LTA Teaching Artist	• Serve as teaching artist at selected test residencies
Eileen Goldblatt, Region 9 Arts Supervisor	• Serve as liaison for test and control schools • Serve on Advisory Team
Karen Abramovitz, Region 10 Arts Supervisor	• Serve as liaison for test and control schools • Serve on Advisory Team

EVALUATION PLAN

The Guggenheim proposes a research-based evaluation to examine the LTA model of building problem-solving skills using art instruction to be conducted by Randi Korn & Associates (RK&A). Below are the evaluation goals and research design; the evaluation budget details are attached in the budget narrative section, and RK&A's credentials and past clients are included in the biographies attachment.

Evaluation Goals

The evaluation plan has been designed to measure two sets of APS program outcomes: the hallmarks of excellent art instruction as measured by teaching artist and student outcomes, and problem-solving-related outcomes for students, classroom teachers, and teaching artists. The Guggenheim Museum has been working with RK&A since 2002, first in 2002-2004 to define measurable outcomes for teachers, teaching artists, and students (see Optional Other Attachment – LTA Program Rubric) and then to define measurable outcomes for and conduct the

evaluation of *Teaching Literacy Through Art* (*TLTA*) in 2003 – 2006 (the *TLTA* preliminary report was submitted to the U.S. Department of Education in Fall 2005 and the final report is due June 2006). Similar rubrics will be developed for the problem solving-related teacher and student outcomes during the planning phase of the project (Year One of the grant).

The evaluation will measure:

- Whether LTA is meeting stated student outcomes related to problem-solving skills as measured by a program rubric (to be developed in Year One of the grant and informed by problem-solving and creativity objectives in the LTA Program Rubric as well as New York City Applied Learning Standards[23]);
- Whether LTA is meeting stated student objectives related to art learning (as measured by the hallmarks of good art instruction that will be developed in Year One of the grant);
- Whether LTA is meeting stated student objectives related to specific standards of Career Development and Occupational Studies;
- What correlation exists between participation in LTA and students' scores on the Torrance Test or similar test measuring creativity or problem solving;
- Whether LTA is meeting teaching artist objectives related to problem-solving skills as measured by the program rubric (which will be developed in Year One of the grant);
- Whether LTA is meeting stated teaching artist objectives related to art learning (as measured by the hallmarks of good art instruction that will be developed in Year One of the grant).

[23] New York City Department of Education Applied Learning Performance Standards are at http://www.nycenet.edu/offices/teachlearn/documents/standards/applied/preface/9aplearnps.html

Research Design

Evaluation Plan Overview

To examine the above goals, RK&A has proposed an experimental design. The design is experimental because the school selection, assignment to either the treatment or control group, and selection of specific teachers/classes will be done so at random. Using a random sampling method at all three stages will enable a rigorous evaluation.

Random selection of schools will be done by contacting eligible schools to determine willingness to participate; "participation" will be defined as (1) receiving free LTA residencies, (2) allowing fifth-grade students whose parents consent to participate in interviews, observations, and written tests given by Randi Korn & Associates, and (3) agreeing to other logistical support as needed to ensure a valid and reliable study.

As discussed in Project Design, eligible schools that have been selected are all Title I schools in Regions 9 and 10 of New York City and are matched in terms of size, need level, percentage ELL population and lack of participation in the visual arts.

In keeping with the modified "posttest only control group design," the teachers and their students will be randomly assigned to either the treatment or control group. The evaluation plan proposes a highly quantitative study using standardized questionnaires, rubric-scored student activities, and rubric-scored observations. The focus on quantitative data will enable RK&A to collect responses from many individuals and statistically analyze the data in a variety of ways. A set of qualitative teacher interviews is also proposed to complete the comprehensive evaluation. The general plan is outlined on page 25. The following text explains and details the table.

LTA Evaluation Plan – Years Two and Three (School Years 2007-2008, 2008-2009)[24]

Sample	**Pre-program Measure**	20-Week APS Program	APS Teaching Artist Professional Development	**Program Measure II**	**Post-program Measure**	**Follow-up Measure I**	**Follow-up Measure II**
1. Control Group 9 classes	Student questionnaire and rubric-scored student interview Principal and teacher questionnaires	—	—	—	—	Student test scores on the Torrance Test	Teacher interviews
2. Treatment Group 9 classes	Principal questionnaire	⊕	⊕	Observations of teaching artist and students scored with rubric (3 for each class)	Student questionnaire and rubric-scored student interview Teacher and teaching artist questionnaires	Student test scores on the Torrance Test	Teacher interviews Teaching artist interviews

Note. A "⊕" in a cell indicates that the respective group experiences the particular program element. A "—" signifies that the experience of the group with respect to the program or evaluation element is irrelevant to the purposes of the study.

[24] RK&A will collect data using the same evaluation plan over both years 2 and 3, in order to collect sufficient data.

Fifth-grade classes will be randomly assigned to one of two treatment groups as follows:

1. Groups "tested" who have not experienced the LTA program to gauge baseline understanding and skills (control group)
2. Groups "tested" after they have experienced the 20-week LTA program, working with teaching artists who have received substantial professional development in arts education related to problem solving (treatment group).

The word "tested," as used in the context above, refers to the measurement which will be taken of each student's ability to utilize problem-solving skills.

Data Collection Instruments

Students

Student performance will be measured using standardized questionnaires, activities, and test scores on the Torrance Test or other similar test that measures creativity or problem solving.

- The questionnaire will include demographics and attitude-rating scales and other questions to examine additional variables that may impact students' experiences in the LTA program. Both close-ended questions (e.g., multiple choice, scales) and open-ended questions will be used. Students in the control and treatment groups will complete identical questionnaires.
- To complement the questionnaire, activities (that will be devised in Year One) will be included in the student interview, and the resulting student work will be scored using a rubric. Students in the control and treatment groups will complete identical activities.
- At the end of the school year, RK&A also will administer the Torrance Test (or a similar test) and use the test scores as a second way to gauge whether there are differences among the control and treatment groups in creativity and problem solving.

Teachers and Teaching Artists

Teacher and teaching artist impact and performance will be measured using standardized questionnaires, interviews, and observations.

- The teacher and teaching artist questionnaires will primarily provide context for student data. The questionnaires will include demographics, experience teaching, and level of training in the arts, as well as other questions to examine additional variables that may impact their experiences and those of their students in the LTA program. Both close-ended questions (e.g., multiple choice, scales) and open-ended questions will be used. Teachers in the control and treatment groups will complete identical questionnaires.
- The observations will enable RK&A to examine how well teaching artists are using LTA and the degree to which they meet the hallmarks of good art teaching. Their performance will be scored using a rubric.
- The in-depth interviews will allow teachers and teaching artists to talk about their experiences with LTA, and for teaching artists to also speak about the professional development offered by the program. The qualitative interview data will help provide a rich analysis of the LTA program from the perspective of teachers—which is key to building a sustainable program. Classroom teachers in the control and treatment groups will complete nearly identical interviews to allow for comparison.

Selection of Sample

To limit the variability and strengthen the internal validity of the research, the sample will include:

- Students from schools similar in demographics and socioeconomic characteristics;
- Only fifth-grade classes;

- Students and teachers who have never participated in LTA prior to the grant and are not receiving any other visual arts programs during the grant period;
- Random assignment to one of two treatment groups at the beginning of the school year; and
- Simultaneous data collection (data will be collected from the control and treatment groups in May 2008 and May 2009 so that differences in student learning throughout the course of the school year is mitigated).

A total of eighteen classes per year will comprise the sample (approximately 900 students over the course of two years). Following educational research procedures, RK&A will analyze the student data by class and treatment/control group. RK&A will analyze the teacher data by individual and then will associate the teacher data with the student data to provide context for student responses.

Parental permission will be secured for all students participating in the evaluation. IRB-approved permission letters will be sent home to the parents to be signed and returned to the evaluator. All data generated from this study will be confidential and anonymous.

Data Analysis and Reporting of Findings

Data collection instruments that include both closed-ended and open-ended inquiries, as discussed above, produce both quantitative and qualitative data. The resulting quantitative data will be entered into a computer and statistically analyzed. Calculations performed on categorical data (e.g., demographic characteristics) would include frequency distributions and percentages. Calculations for interval variables (e.g., rating scales) would include summary statistics, such as the mean (average), median (point at which one-half of the responses fall above and one-half fall below), and standard deviation (spread of scores: ±). To make comparisons among experimental groups and program elements, analyses of variance and multiple regressions will be performed.

Based on the research design, RK&A anticipates developing a multiple regression model to examine students' work in light of participation in the LTA program, their teachers' characteristics, and a number of other variables.

The data resulting from verbatim responses to interview questions will be analyzed qualitatively, meaning that the evaluator studies the responses for meaningful patterns. As patterns and trends emerge, similar responses are grouped together. Each grouping is then assigned a name or category that conveys the meaning the responses embody and is exemplified with verbatim quotations.

A final report will be prepared to present the evaluation findings, through text, tables, and figures. All findings will be synthesized and discussed, and concrete, applicable recommendations will be offered by the evaluators.

Quality Assurance

The Guggenheim and RK&A understand that examining students' experiences of a particular program is complex. Many factors in a student's life can impact their behavior. To account for the multiple variables that influence student experiences, RK&A has carefully structured the evaluation's methodology and analysis. First, RK&A will select separate control and treatment samples. That is, one sample of teachers and students will be asked to complete questionnaires having never experienced LTA and a separate sample of demographically identical respondents will be asked to complete questionnaires after participating in LTA. This strategy will allow the evaluators to examine the effect that the program had on students while maintaining the integrity of the data (i.e., talking to the same person before and after their experience would sensitize them and bias the data). Second, RK&A will conduct multiple regression analysis to identify which combination of variables (e.g., characteristics such as

student gender, student's prior visits to the Guggenheim, teacher's level of training in the visual arts) best predicts or explains students' behavior. If the control groups' ratings were simply compared with those of the treatment samples using standard statistical procedures (e.g., analyses of variance), the reader would not know whether the program actually explained the ratings or if other variables had an effect.

RK&A will develop all instruments according to stringent questionnaire construction techniques, assuring appropriate item wording, order, format, and internal validity. All instruments will be reviewed and approved by Guggenheim Museum staff, school partners, and the New York City Department of Education's Office of Assessment and Accountability (which will serve as the project's IRB).

Quality of research and instrument design is key, as is quality data collection. To standardize the procedure and ensure data collection proceeds in an unbiased manner, RK&A will provide extensive training to data collectors. None of the RK&A researchers who know the research hypotheses will collect any data. During observations, two data collectors will score the teaching artists' performance so that inter-rater reliability can be tested.

Quality data analysis also is essential. Again, none of the RK&A researchers who know the research hypotheses will score any of the data. Rather, RK&A will train research assistants to score student responses, and two separate researchers will score the data so that inter-rater reliability can be tested.

CONCLUSION

The Art of Problem Solving will directly serve 1,500 additional at-risk elementary students, using exploration with art to improve their problem-solving skills. It also will produce research data and replicable teaching tools of great importance to the field of arts education.