Build IT

Girls Building Information Technology Fluency Through Design

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Inspiration: National Need

While women constitute 46% of the U.S. workforce, they make up only 27% of workers in the areas of computer science, engineering, and other mathematical fields such as physics.

— U.S. Department of Labor, 2006

Computer science instruction that emphasizes the 'web' of associations between programming, design, and other areas of the curriculum would help to attract a more diverse group of learners, and would advance computer fluency for all students.

— *Tech-Savvy*, AAUW, Commission on Technology, Gender, and Teacher Education, 2000.

Inspiration: Partnership

- **Girls Incorporated of Alameda County** (GIAC) needed a technology program for their middle school program.
- Background on Girls Inc.
  - National organization with 1,500 program sites Serves more than 600,000 K-12 girls each year
  - Established in the 1800s as sewing circles.
  - Today its focus is serving the whole girl with the motto: Strong, Smart, and Bold
  - Provides out-of-school experiences: sports, STEM, health, leadership & interpersonal relationships, homework help, career & college exploration

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Participants at Girls Inc.

- 180 middle school girls in Alameda County who experience Build IT as a part of GIAC's middle school program
- 82% are African American and Latina
- Majority come from low socio-economic households

Build IT's Mission

Motivate middle school girls to

- Use technology to strengthen and build their technology fluency
- Take high school

algebra and geometry courses in preparation for postsecondary STEM education and IT careers

- Explore IT and pursue IT careers

And enhance staff capacity to offer IT fluency programming

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Research Questions

- Are girls who participate in Build IT more likely to become interested in IT careers and make plans to take courses in high school to help prepare them for those careers?
- Do girls who participate in Build IT become more knowledgeable about IT careers and learn more basic IT concepts?
- Do girls who participate in Build IT develop more contemporary IT skills and intellectual capabilities for IT?
- Does Girls Inc. grow in its capacity to offer programs focused on developing IT fluency over the course of the project?

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Guiding Research

- Girls' identity, achievement, and profession choices
  - Eccles *Understanding Women's Educational and Occupational Choices*
  - Brickhouse *What Kind of Girl Does Science?*
- Girls' interest in technology (communication tools) and design
  - Honey, M., Moeller, B., Brunner, C., Bennett, D. E., Clements, P., & Hawkins, J. D. *Girls and design: Exploring the question of technological imagination*
  - AAUW's *Tech Savvy: Educating Girls in the New Computer Age.*

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Guiding Research (Continued)

- Technology fluency & Workforce skills
  - SCANS's *What Work Requires of Schools*
  - NRC's *Being Fluent with Information Technology*
- Curriculum development approach
  - Wiggins & McTighe's *Understanding by Design*

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Using the UbD Approach

- What do we want girls to learn?
  - Being Fluent with Information Technology
  - Secretary's Commission on Necessary Skills
  - National Council of Teachers of Mathematics
- What evidence will show that they've learned it?
  - Embedded Performances (activities and Family Tech Night presentations)
  - Interviews & Observations
  - IT Attitudes Survey
  - IT Concepts Survey
- *Then* develop the activities

Computer Science Content

Design	• Design is a process with specific stages and elements: brainstorming, planning, gathering user data, scenario development, storyboarding, requirements and documentation, prototyping, user testing, and revising (NRC). • An initial solution is often revised or improved by iteration, which often causes a refinement in the definition of the problem (NRC, SCANS). • Testing entails determining whether a proposed solution meets design goals (and whether the design addresses the problem) and works under diverse conditions, taking into account that most systems will be used in ways that were not intended, as well as in expected ways (NRC, SCANS).
Computers	• All computers are programmed, meaning they follow a sequence of basic steps (NRC). • Computers, in a variety of sizes, can be used independent of networks and as part of networks (NRC, SCANS).
Systems and Networks	• Information systems include a variety of human and technology components that can be mapped and analyzed to troubleshoot problems and improve the system (NRC, SCANS). • Networks have physical and logical structures that allow information to be routed between computers. These structures have an impact on the flow (e.g., bandwidth) of information that can affect a user's experience (NRC, SCANS).
Trouble-shooting	• Technology analogies exist and can help one to become adept at using new technologies and to troubleshoot (NRC). • To troubleshoot a problem in an information technology system, application, or operation, it is essential to have some expectation of what the proper behavior should be and how it might fail to be realized (NRC).
Collaboration & Leadership	• Collaboration involves a strategy for dividing tasks associated with a solution into pieces that can be worked on individually and reassembling the work products into a cohesive whole to form the solution (NRC, SCANS). • Leadership involves teaching others new skills, communicating ideas to justify a position and convince others, and supporting a vision that may challenge the status quo (SCANS).

Mathematics Content

Enduring understandings in mathematics will arise from the applications of mathematical processes throughout the design process. The NCTM Standards and Principles (2001) outline these process standards: problem solving, reasoning, communication and representation.	• A "mathematical disposition" toward problem solving requires analyzing given information, drawing on specific strategies, and having the ability to monitor and adjust strategy use. • Mathematical reasoning includes making conjectures and using deductive reasoning to prove or disprove them and can be applied to computer science strategies such as troubleshooting algorithms. • Mathematical communications and representations involve effective use of diagrams, equations, and other mathematical symbols. Developing the skills to communicate mathematically can make collaborative design work easier and more productive.
Algorithmic Thinking	Develop a simple understanding of an algorithm, such as text compression, search, or network routing, using computer-free exercises. Understand the fundamental ideas of logic and its usefulness for solving real-world problems. Gain a conceptual understanding of the basic steps in algorithmic problem-solving (problem statement and exploration, examination of sample instances, design, program coding, testing and verification) Design algorithms and programming solutions to a variety of computational problems

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Key Components of Build IT

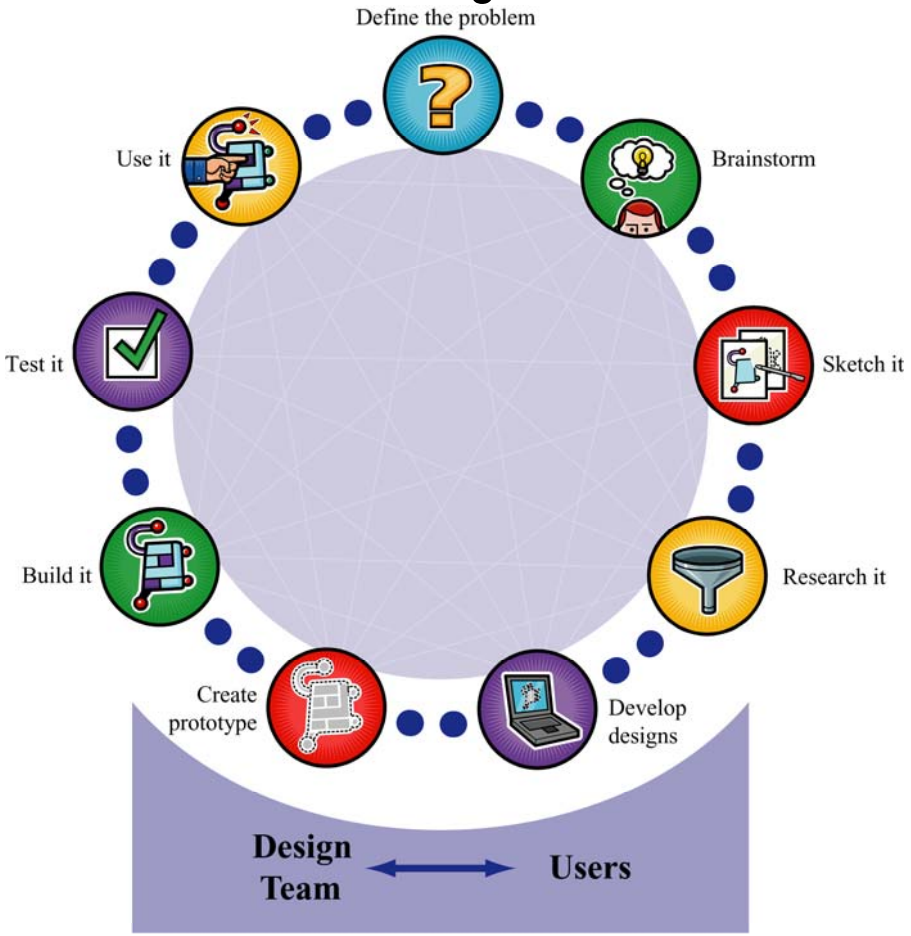
- Problem-based curriculum that uses the *Understanding by Design* approach
- Embedded performance tasks for evaluating technology fluency
- Family Tech Nights
- Professional development materials for staff
- Guides for involving IT professionals
- Evaluation instruments for measuring girls' interests and understandings

Build IT Curriculum

Six curriculum units

- Unit 1: Redesigning Your World (one semester)
- Unit 2: Design Online: Communication Tools and the Internet (one semester)
- Unit 3: Redesigning the Web (two weeks during the summer)
- Unit 4: Design in Networked Technologies (one semester)
- Unit 5: Collaborative Game Design & Troubleshooting (one semester)
- Unit 6: Joining a Design Team (two weeks during the summer)

The Design Process



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Addressing Girls' Needs

- GIAC has 50 years of experience working with girls and this Alameda County community.
- SRI drafts the curriculum, GIAC reviews. We iterate often: before & after PD and implementation

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Build IT Successes

- Girls image of IT careers as solitary and boring have changed significantly to collaborative, fun, and intellectually stimulating
- Girls have increased their technology skills and conceptual knowledge
- Girls expressed more interest in mathematics and computer science courses
- Staff have developed greater IT knowledge and skills

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Next Steps & Research Needs

- Scaling Build IT project started October 2007. Comparing implementation in different Girls Inc. settings (e.g. rural vs urban).
- Research needs:

– Organizational memory

- How critical is the middle layer of management for organization memory of implementing STEM programming?
- Is the curriculum taught better the second (third etc.) time because of institutional memory?

– Define features of successful out-of-school girls & STEM programs. These are a start; both call for more research:

- National Center for Women & Information Technology (NCWIT) (2007). *Guide to Promising Practices in Informal Information Technology Education for Girls*.
- U.S. Department of Education (2007) *Encouraging Girls in Math and Science* (NCER 2007-2003).

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