Evaluation Resources

Design and Discovery

Evaluation Summary

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The Intel Design and Discovery curriculum provides an inquiry-based exploration of key engineering principles and guidance through the interdisciplinary design process. The 45-hour curriculum, intended for students aged 11 through 15, can be downloaded from the Intel Education Web site and printed free of charge. Additional resource materials and an implementation guide are also available at no cost to support the program.

The curriculum features a series of 2.5-hour sessions of increasing complexity suited for sequential presentation in extended informal educational settings, such as summer enrichment programs or after-school programs. Students in these programs design and build original engineering products and communicate about their work through presentations, peer feedback sharing, and design process documentation.

Through this experience, students expand and deepen their knowledge of engineering, design, and science; develop their inquiry learning skills; and practice sustained problem solving. They can also use their work in the program as part of preparation for science and engineering fairs, such as the Intel International Science and Engineering (ISEF) annual fair and its affiliated regional fairs.

Evaluations

Several key evaluations of specific implementations of the Design and Discovery curriculum have been conducted. The most wide-ranging evaluation in terms of the number of sites reviewed was conducted by EDC/CCT in 2004. The study encompassed 38 Design and Discovery sites, of which 29 had planned for, begun, or completed an implementation of the curriculum at the time the study was concluded. The sites included 36 Girl Scout councils, a middle school math program, and an after-school program.

In addition, researchers at the Division of Psychology in the College of Education at Arizona State University released a study of the Design and Discovery program in October 2004, focusing on the implementation of the curriculum at four locations in the Phoenix area during the summer of 2004. In June 2004, researchers at the School of Education at Dublin University, Trinity College in Ireland also reported on the implementation of Design and Discovery at two schools in the Dublin area.

Taken together, these studies present a broad perspective on how the curriculum is being used as well as a focused look at the program's impact on student participants across a wide range of settings.

EDC/CCT: How Curriculum Intent Is Reflected in Implementations

A key focus of the EDC/CCT global study was how the core activities and concepts of the curriculum are communicated and carried out in a range of settings.

Of the 29 active implementation sites studied, 13 used the entire curriculum. These implementations were most often delivered in 2-week summer camps and structured to support the curriculum intent to engage students in the design process through sessions that build on one another. The curriculum's progressive process helps students achieve increasingly challenging results.

The 16 sites that did not implement the entire curriculum used portions of the curriculum in either a camp or a long-term workshop or course, and typically focused on increasing student awareness of science and science-related careers without emphasizing the design process that the curriculum seeks to support.

	Curriculum Use			
Implementation Model	**Entire/Most**	**Parts/ Activities**	**As a Reference**	**Total**
1- or 2-week camp	10	7	0	17
Course	2	5	2	9
2-day camp	0	1	0	1
Total	12	13	2	27

Curriculum models and scope of curriculum use for Girl Scout Councils

Of the 36 Girl Scout Councils included in the EDC/CCT evaluation, 27 of the sites had begun or completed an implementation, or had plans in place that were substantial enough to cite in this report of curriculum use.

Reasons program facilitators chose not to implement the entire curriculum include the following potential challenges:

- Lack of access to content experts who could help facilitate or serve as mentors
- Perception that the curriculum was too difficult for the students
- Perception that the goals did not match existing local programs
- Time constraints

The implementations in which curriculum intent was most closely supported shared the following characteristics:

- At least two weeks in length
- Participants from the intended age group with preexisting interests in science and engineering
- Facilitators with prior experience in leading project-based curricula
- Access to mentors and assistant facilitators with content expertise
- Facilitators familiar with science fairs and who could link the design process to fair requirements

Arizona State University: How the Program Deepens Content Knowledge and Promotes Problem Solving

The ASU study of Design and Discovery programs at an elementary school and three Computer Clubhouses in the Phoenix area primarily measured how well these implementations achieved the curriculum objectives of fostering knowledge, skill development, and problem solving in science, engineering, and technology.

Using several data-collection methods, including a survey of perceptions about the program, a test of content knowledge, and timed observation protocols, the researchers found that the student participants were engaged throughout the program and:

- Gained a significant amount of curriculum-related knowledge during the program
- Reported higher levels of interest in engineering and improved engineering skills after the program
- Had fewer negative perceptions of engineering among female students after the program

In addition, the study revealed more detailed information about how the curriculum was implemented. For example:

- Participants spent the majority of their time working at the whole class level.
- Participants spent a third of their time engaged in hands-on activity.
- The printed curriculum was not used the majority of the time, although it was used more regularly in school settings than in the Clubhouses.
- Facilitators often adapted the activities in the implementation guide to fit within time constraints or maintain student interest.

Intel's Design and Discovery Learning Environment Observation Protocol

Location: **Session:** **Date:** **Start time:** **End time:**

	Time:													
	Minutes →	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**Notes**
Class Organization	① Individual students working alone ② Pairs of students ③ Small groups (3+ students) ④ Whole class	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	
Type of Instruction	① Teacher led lecture/presentation ② Teacher led lecture with discussion ③ Demonstration by teacher ④ Student presentations of work ⑤ Student reading ⑥ Cooperative learning ⑦ Teacher interacting with student(s) ⑧ Hands-on activity ⑨ Administrative task ⑩ Interruption or break	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	
Classroom Interaction	① Teacher-driven ② Student-driven	① ②	① ②	① ②	① ②	① ②	① ②	① ②	① ②	① ②	① ②	① ②	① ②	
Student Role	① Passive/little response ② Active response ③ Co-construct meaning	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	
Student Engagement	① Low engagement (< 20%) ② Moderate engagement (50%) ③ High engagement (> 80%)	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	
Cognitive Activities	① Receipt of knowledge ② Applied procedural knowledge ③ Knowledge representation ④ Knowledge construction ⑤ Other (specify)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤	
Technology Integration by Teacher	① Not used ② Add-on ③ Partially integrated ④ Fully integrated	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	
Students' Technology Use	① Not used ② Single application used ③ 2 + applications used	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	① ② ③	
Students' Study Guide Use	① Not used ② Readings used or referenced ③ Handouts used or referenced ④ Other (specify)	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	① ② ③ ④	

APPENDIX A
Timed Interval Observation Sheet

Timed observation protocol

To capture complex classroom interactions in a standardized way across differing sites, researchers developed a timed observation sheet. The researchers recorded several related variables at 5-minute intervals throughout a session observation. Taken as a whole, the protocol enabled researchers to paint a detailed, moment-by-moment picture of the interactions.

Trinity College: How the Program Can Be Adapted to Suit Unanticipated Requirements

In 2004, the Design and Discovery curriculum was adapted for use in two secondary schools in the Dublin area. Although the curriculum was designed for students aged 11 through 15 and had been most successfully implemented so far at the middle school level, the evaluation found some surprisingly positive results in student engagement among the 16- through 18-year-olds in the Dublin implementation. The evaluation also found more expected mixed results for other areas of impact, such as deepening participant knowledge or motivating students to choose a career in science, engineering, or technology.

Through surveys, small group interviews, and observations, researchers concluded that overall, student engagement among both boys and girls in the curriculum was high. For example, in open-ended questions, student responses were generally positive, such as, "really interesting to do the practical work, imaginative," or "I like the whole engineering aspect of it…making things." Also, the students reported that they had gained a deeper awareness of engineering, its processes, and its role in society.

However, students also reported that they were unaware of attaining specific learning outcomes as a result of the program, and they were somewhat confused about the purpose of the program, failing to distinguish it from a physics course. The report produced a series of recommendations for how to better tailor the program to fit the older age group by making it more challenging, incorporating additional prior knowledge, and changing some of the logistical structure of the sessions to fit the scheduling needs in secondary schools.

Further Reading

Atkinson, R. (2004). *Final report: An evaluation of Intel's Design and Discovery summer program.* Tempe, AZ: Arizona State University, College of Education, Division of Psychology in Education.

Matthews, P. (2004). *Report on Intel Design and Discovery curriculum project.* Dublin, Ireland: Trinity College, Dublin 2, Education Department.

McMillan Culp, K., Thompson Keane, J., Meade, T., & Nudell, H. (2004). *Formative evaluation of the Intel Design and Discovery Curriculum.* New York: EDC/CCT.