Global Challenge Award

External Evaluation
Year 2
2007 - 2008

Douglas Harris
Penny Nolte

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Final Report

Prepared by Douglas Harris, Executive Director, The Vermont Institutes and Penny Nolte, Evaluation Specialist, The Vermont Institutes

Part 1: Executive Summary
Introduction

During the 2007-2008 academic year the Vermont Institutes conducted an independent external audit of the Global Challenge Awards (GCA). VI worked with GCA Leadership to plan a multi-year comprehensive evaluation design.

The goals of the evaluation are 1) to document key project activities and processes; 2) to provide formative feedback to project leadership for program improvement and 3) to provide summative recommendations for decision makers, including project staff, Board, and supporters.

Evaluation Team
Summary of Qualifications

Dr. Douglas Harris, Executive Director, The Vermont Institutes Harris is presently and formerly PI, PD, Co-PI, and program evaluator on several corporate, NSF and U.S. Department of Education projects, including the Intel Mathematics Initiative, GrowLab, 21st Century Schools, Teacher Quality Enhancement, the Ongoing Assessment Project, Vermont's Statewide Systemic Initiative, and the Vermont Mathematics Partnership. As an evaluator, he has been involved in development of research and evaluation protocols, analysis instruments and collaboration tools for education interventions, and systemic change with partners such as Measured Progress, EDC, the Dana Center, University of Texas, the Connecticut Academy, and the National Initiative for Community Innovations. He has served on the Validation Panel for the *Student Evaluation Standards* developed by the Joint Committee on Standards for Educational Evaluation and approved by the American National Standards Institute (ANSI). He also served on the Executive Council of the Association for Supervision and Curriculum Development (ASCD).

Harris's doctorate in special education administration, with a specialization in gifted-talented education, experience as a teacher, principal, and superintendent, and experience in program evaluation provide a deep experience base for this evaluation.

Penny Nolte, Evaluation Specialist, The Vermont Institutes

Penny holds a BFA from Syracuse University, an MS in Management Systems from Clarkson University, and an Ed D. in Leadership and Policy Studies at the University of Vermont. Her areas of particular research interest are technology and program evaluation topics: survey design, qualitative design, NVivo qualitative software, organizational systems theory, staff evaluation, and using data for school reform.

Penny has presented her research at the annual MSP NSF Evaluation Summits, and is lead author with Doug Harris on a paper discussing the qualitative methodology used in their evaluation of the Vermont Mathematics Partnership – an MSP funded by the National Science Foundation and United States Department of Education. Penny is also an adjunct faculty member at Woodbury College, teaching graduate and undergraduate courses in research methods, evaluation, and assessment. She is a peer reviewer for the American Educational Research Association of conference papers in both their science teaching and learning, and program evaluation in school settings strands.

Prior to joining the Vermont Institutes Evaluation Center Penny served as grant-writer and PI for numerous regional and state-wide arts, women's, teacher training, and technology projects in Vermont, New York, and Colorado. She has taught online technology applications and lead research workshops in local and national teacher and librarian training programs for more than ten years.

Vita are included in Appendix A.

The Project Goals

Global Challenge Awards has established seven project goals that serve as the underlying organizer of this evaluation.

Goal 1: Intensively develop future science, engineering, and mathematics (STEM) professionals by engaging high school students for up to three years in a series of content experiences and challenging hands-on projects.

Goal 2: Focus on access and encouragement for underrepresented populations being prepared for and entering STEM majors.

Goal 3: Develop a pipeline for admissions to higher education in which successful GCA participants have facilitated access to and admission support into the University of Vermont College of Engineering and Mathematical Sciences.

Goal 4: Offer substantial privately raised scholarships and other incentives to participants.

Goal 5: Provide ongoing mentoring expertise and personal support for students to become STEM majors

Goal 6: Involve STEM majors and graduates, parents, and STEM experts as mentors in GCA.

Design Considerations

The evaluation requires an array of program evaluation methods (a mixed methods evaluation plan). This plan enables the evaluators and project staff to continually monitor and adjust implementation of the product design and program components. It also assesses impact in the areas of the program goals.

The guiding framework for the evaluation of the Global Challenge Award Project is a logic model (Carr and Harris, 2005; adapted from Chen, 1990, Julian, et al., 1995, Patton, 1997) for developing exemplary models and systems. The logic model is used to document project achievements, organize data, and define any variance between the planned program and the actual program.

Logic Model:

Resources/Inputs – Activities – Outputs – Outcomes – Impact

While the application of this logic model is recursive rather than linear, the evaluation documents the sequence of actions leading from resources/inputs through impact.

> **Resources/Inputs** – What are the human, fiscal, organizational, and community resources (materials, time, money, people, expertise, conceptual model) available to build and implement the Global Challenge Award Project?
>
> **Activities** – What are the processes, tools, and events, technology, and actions planned for and actually delivered?
>
> **Outputs** – What are the direct products and results of the implementation of the Project? What are the types, levels, and targets of services provided to Participants? What are the student results?
>
> **Outcomes** – What are the specific changes in participants' behavior, knowledge, skills, status, and levels of functioning?
>
> **Impact** – What fundamental intended and/or unintended changes occurred as a result of the Global Challenge Award?

The specific evaluation questions also directly impact project goals as shown in the chart below.

The Logic Model elicits a series of causal questions related to the impact of the project on participants, including students, their parents, their teachers, their mentors, and project staff. These causal questions formed the basis of the evaluation report's findings and recommendations.

Sources, Types of Data and Methods – Year 3

Overarching Questions: Formative evaluation questions addressed included the following questions:	Surveys	Interviews	Focus Group	STEM Explorations	Team Projects
To what extent has the project met its stated goals to date?	X	X	X	X	X
Which components of each program are most effective? Least effective? Need improvement?	X	X	X	X	X
What contextual factors are important in meeting the goal? Which appear to be creating or reinforcing barriers?	X	X	X	X	
What were the roles of stakeholders in meeting the goals, including participants, parents, teachers, mentors, and STEM staff ?	X	X	X	X	

Year 1 Recommendations for Year 2

The chart below, organized by the project goals, summarizes recommendations that were made for data collection in Year 3 at the end of Year 2.

Recommendations	Met	Progress
I.i Clearly identify roles, responsibilities, and expectations for participants at each tier.	X	
I.ii Clearly identify roles, responsibilities, and expectations for mentors and staff based on analysis of needs of participants at each tier. Based on this analysis determine feasibility of providing this support and match the number of participants at each level with the available support.	X	
I.iii Develop pre-post assessments for the STEM experiences that have been completed and utilized in Year 1. Refine experiences based on student performance and feedback.	X	
I.iv Develop a pre-post assessment of STEM content and concepts mastery.	X	
I.iv Develop reward structures at each tier, commensurate with expectations and demands at each level.	X	
II.i Refine the registration process to collect and compile information related to socio-economic status as well as gender and ethnicity data.	X	
II.ii Develop an articulated plan for recruiting and retaining female, minority, and low SES participants and mentors.		X
III.i Working closely with leadership at the University of Vermont and Vermont Governor's Institute to completely revamp the recruitment and college connection processes. Part of this plan calls for direct targeting of high minority districts.		X
IV.i Provide context and key information for use in development activities. Evaluators and staff should collaborate to that end.		X
V.i Develop clear expectations for communications between mentors and project staff and mentors and participants at each tier.	X	
V.ii Develop a mentor guide for GCA.	X	

Recommendations	Met	Progress
V.iii Continue to explore potential partnership with Microsoft to develop an optimal 3-D online space for GCA.		X
VI.i Develop communication protocols for STEM teachers of GCA participants.		X
VI.ii Consider ways to involve teachers in professional development in support of this goal.		X

Year 2 Recommendations for Year 3

Recommendations	Met	Progress
I.i Continue to study through survey, observation/document review, and interviews the impact that GCA has on students' & college level mentors' lives – particularly the impact on their course, major, and career choices, patents, etc.		X
I.ii Continue to analyze how the student teams work together, what they learn from each other.		X
I.iii Continue to collect and analyze demographic data for significant differences (gender, SES, race/ethnicity)		X
I.iv Include students' STEM evaluations (required in Year 3) as an evaluation data source.		X
I.v Develop reward structures for students' correct responses to STEM and Multiple Choice content pre/post surveys.		X
I.vi Continue to monitor students'& mentors' time spent on GCA – is there a correlation between time spent and major/career choice, on grades, etc.		X
II.i Track reliability of the updated SCANS survey		X
II.ii Track correlations across all survey results, develop comprehensive summative findings.		X
II.iii Continue to track and address the gender, SES, and racial/ethnic data for disproportionality.		X
III.i Assess effectiveness of the GGA and GIV targeting of high minority districts.		X
IV.i Provide context and key information for use in development activities. Evaluators and staff should collaborate to that end.		X
IV.ii Develop further incentives for students to complete all pre/post assessments so that significant, reliable data may be obtained		X
V.i Survey mentors about their use of and thoughts for any improvements of the mentor guide.		X
V.ii Continue to explore potential partnership with Microsoft to develop an optimal 3-D online space for GCA.		X
VI.i Develop communication protocols for STEM teachers of GCA participants.		X
VI.ii Consider ways to involve teachers in professional development in support of this goal.		X
VII.i Continue to track students' barriers to completion. In particular, survey students who drop out at the various gate-keeping stages of team formation.		X
VII.ii Administer the IT survey both fall and spring, make comparisons across years, demographic groups, winners/non-completers, etc.		X
VIII.i Hold separate focus groups of US/International students. Consider holding groups made up exclusively of girls/boys as well.		X
IX.i Continue to test hypotheses regarding distribution of scores on students' pre/post assessments through comparison to other data sources/student & teacher survey/interview, etc.		X
IX.ii In order to truly provide a pipeline to UVM engineering program specifically, more emphasis needs to be placed on recruiting younger students or providing a guaranteed admission to juniors and senios.		X

Sources, Types of Data and Methods – Year 2

In planning for the Year 2 evaluation, the five data types utilized in Year 1 – surveys, interviews, focus groups, review of STEM Explorations, and review of Team Projects were continued. In addition, the following evaluation tools were completed or developed in Year 2:

Summary of Technical Reports for Year 2

Fall 07-Spring 08	Items	N
TR 1 Spring 08 Exit Survey	31	52
TR 2 Spring 08 Experiences and Expectations (NELS PISA AWE)	18	52
TR 3 Winter 08 Mentors Survey	20	6
TR 4 Spring 08 IT and Global Problem Solving (ISTE & 21st C)	35	42
TR 5 Fall 07/Spring 08 Multiple Choice -- Pre and Post Assessment	42	29
TR 6 Fall 07 Short Essay Pre Assessment	6	14
TR 7 Summer 08 Student Focus Group	15	21
TR 8 Fall 07/Spring 08 STEM Explorations Content Questions -- Pre and Post Assessment	34	24
TR 9 Spring 08 International Teams Post Survey	35	16
TR 10 Summer 08 GCA/GIV Presentations	n/a	
TR 11 Spring 08 Test Scores	9	25

Summary of Assessment Instruments in place for Year 3

Fall 08-Spring 09	Items
TR 1 Exit Survey (folded into TR 9 & TR 2 in 08/09)	
TR 2 Fall 08/Spring 09 Experiences and Expectations (NELS PISA AWE)	18
TR 3 Winter 09 Mentors Survey	20
TR 4 Fall 08 IT and Global Problem Solving (ISTE & 21st C)	35
TR 5 Fall 08/Spring 09 Multiple Choice -- Pre and Post Assessment	42
TR 6 Fall 08 Short Essay Pre Assessment	6
TR 7 Summer 09 Student Focus Group	15
TR 8 Fall 08/Spring 09 STEM Explorations Content Questions -- Pre and Post Assessment	34
TR 9 Spring 09 International Teams Post Survey	35
TR 10 Summer 09 GCA/GIV Presentations	n/a
TR 11 Fall 08 Test Scores	9

Part 2: Findings from GCA Technical Reports

Findings[1] in this section are organized around the areas posed, and the data sources available to answer the question. Whenever possible, students' own words are used to

[1] Some sections previously reported to NSF as an evaluation update on 6/22/08.

tell the story of their experiences in the 2007-2008 Global Challenge Award. Full-text technical reports of the data are listed in the Table of Contents and are available from the evaluators.

Areas	**Data Source Yr 2**
1) Students' knowledge in the STEM disciplines.	Student Post Survey Student Interviews Mentor Interviews Pre-Post Content Assessment Pre-Post STEM EXP Assessment
2) Students' knowledge of "global perspective elements," e.g. trends in globalization, the global economy, et.al.	Student Post Survey Student Business Plans Student Essays SCANS Pre-Post Survey STEM Pre-Post Survey Student Interviews Pre-Post Content Assessment Pre-Post STEM EXP Assessment
3) Students' ability to collaborate in global teams.	Student Post Survey SCANS Pre-Post Survey STEM Pre-Post Survey Student Business Plans Student Interviews Yr 1 to Yr 2 comparisons
4) Students' awareness of and interest in solving problems associated with climate change.	Student Post Survey Student Business Plans Student Interviews Student Essays
5) Students' interest in pursuing STEM disciplines at the college level.	Student Exit Survey Student Post Survey Student Interviews GI Students' "Technocratic Oaths"

In Year 2 increased attention was focused on demographic breakdowns of the evaluation data. It is possible now to look at the proportions of female to male students across various points in time through which students who successfully complete the project must pass. (figure 1)

Demographics -- Gender

Gender, racial/ethnicity, and socio-economic status data was collected during the GCA registration process in Year 2 and followed for students who worked through the gate-keeping stages of first Country and then International team formation, and ultimately those who won the challenge.

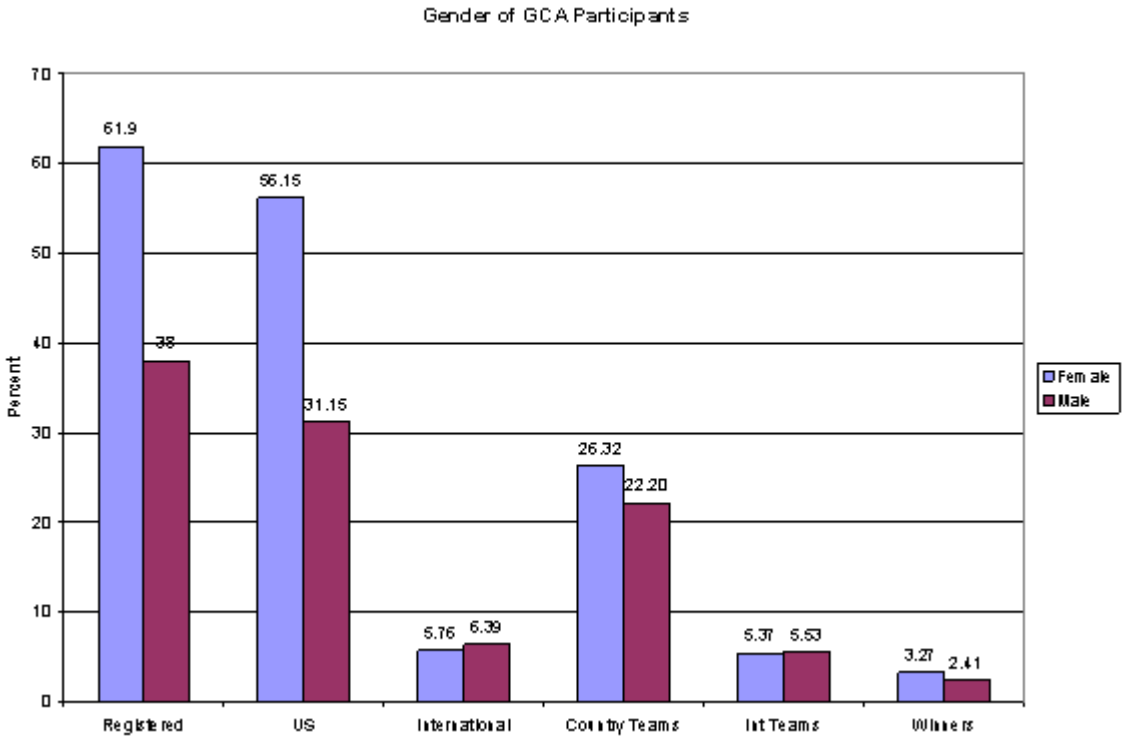


Figure 1

Girls outnumber boys in the GCA by nearly a third, but if the ratio of female to male students at registration is accepted as the ideal distribution for that ratio throughout the project, then proportionally fewer girls would have joined from the US and approximately 52 more international girls would have taken part. (figure 2)

In addition, 127 more girls would have formed country teams, 47 more would join international teams, and 9 more have been selected as winners of the GCA. In order to complete the highest levels of the challenge successfully both country and international team development are gate-keeping processes. Thus there may be a disproportionate drop-out rate for girls at each step of the "team forming" stages.

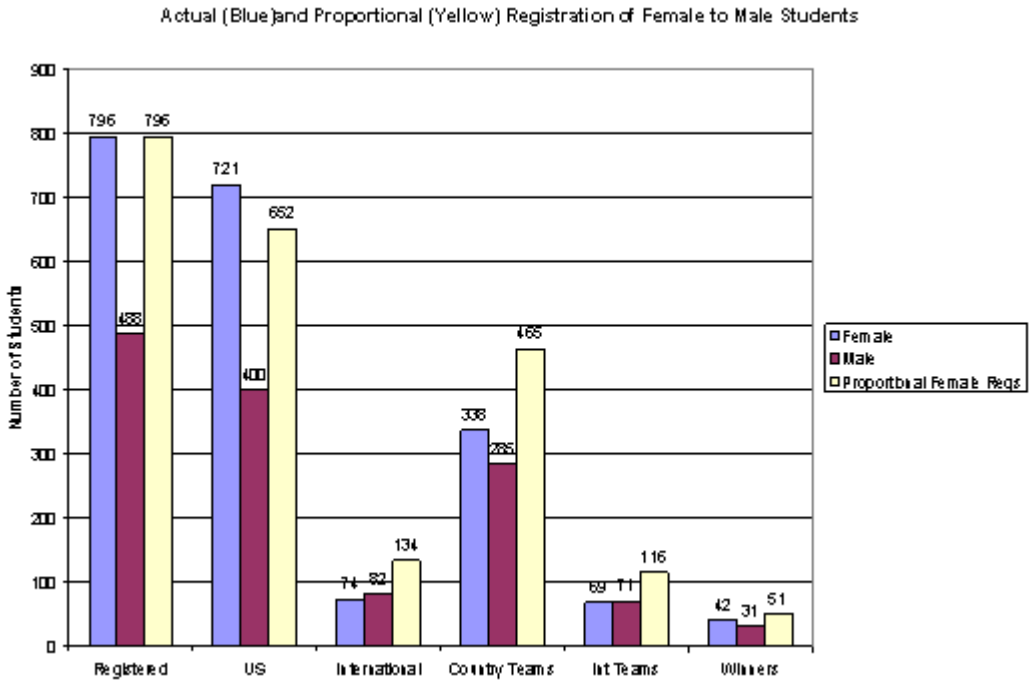


Figure 2

Demographics – Income

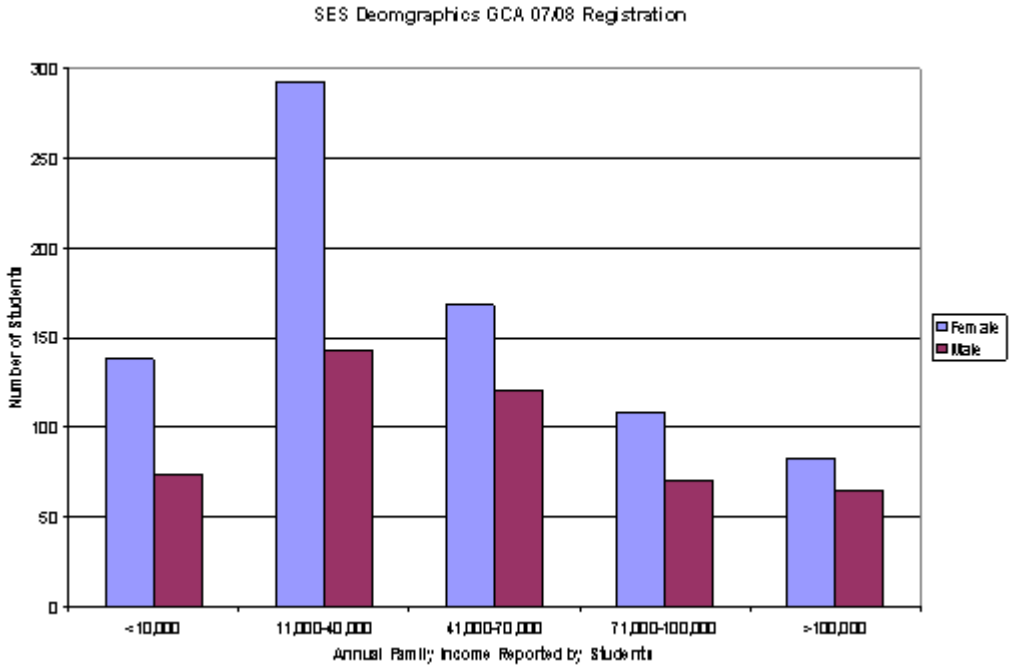


Figure 3
Girls register at a rate twice that of boys in the below $40,000/year family income groups. The difference in registration rate is not as great in groups making above $40,000.

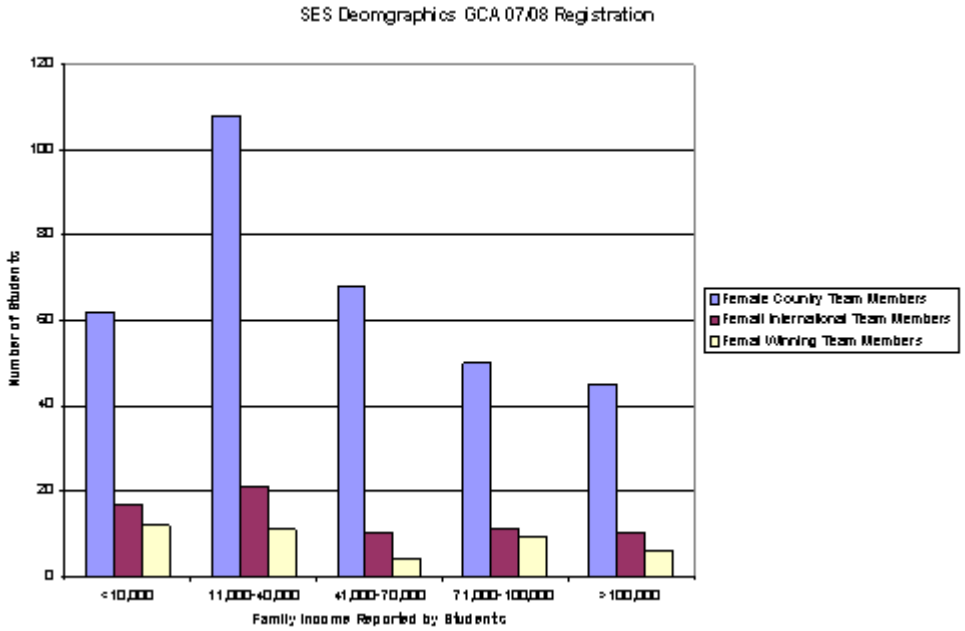


Figure 4

When looking at the “gate keeping” activities of forming country and international teams, girls in the middle category, $41,000-$70,000 family income group, are disproportionately less likely to be members of winning teams.

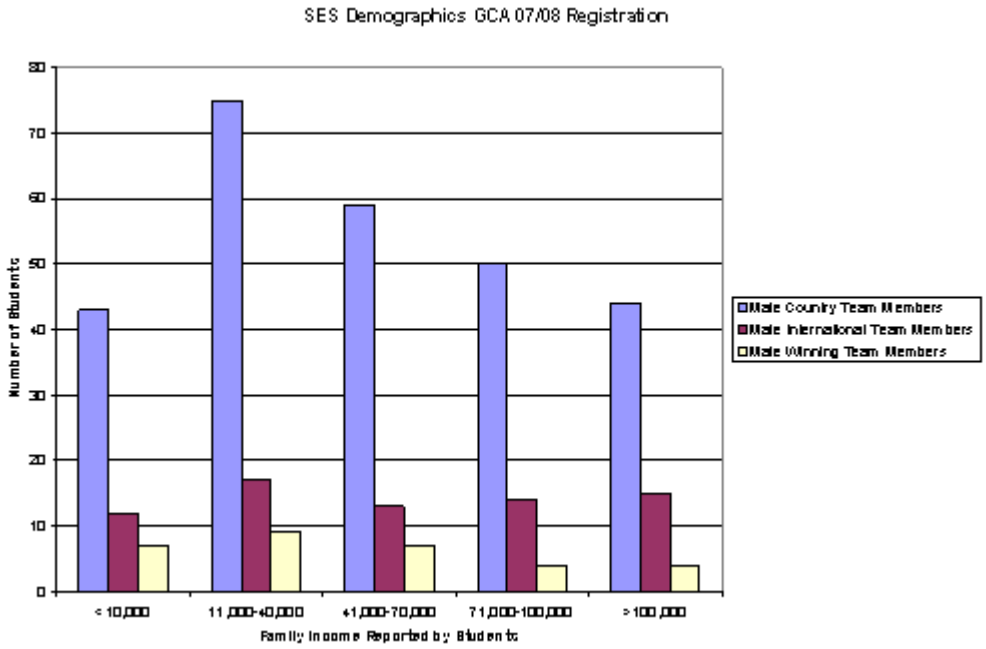


Figure 5
Boys who go on to form international teams are disproportionately more likely to be from the higher family income groups.

Statistics

Ethnicity			CountryTeams	Int_Teams	WinTeams
Missing Demo Data	N		20	0	1
African American	N	Valid	77	8	5
		Other	156	225	228
Asian	N	Valid	187	72	37
		Other	84	199	234
Hispanic	N	Valid	59	8	4
		Other	96	147	151
Indian	N	Valid	1	0	0
		Other	0	1	1
Non-US	N	Valid	30	6	6
		Other	12	36	36
Other (non-White)	N	Valid	31	9	2
		Other	34	56	63
White	N	Valid	221	37	19
		Other	277	461	479

Students who identify themselves as being of Asian ancestry go on to form teams, and to win, at a greater rate than would be expected from their distribution in the initial registration data. Students who identify themselves as African American, Hispanic, or White move into the team-forming stages at a lesser rate than their initial registration. Students who are Black but not of African American ancestry may be choosing to use the Non-US or are part of the Missing Demographic Data groups, this is not clear from the data.

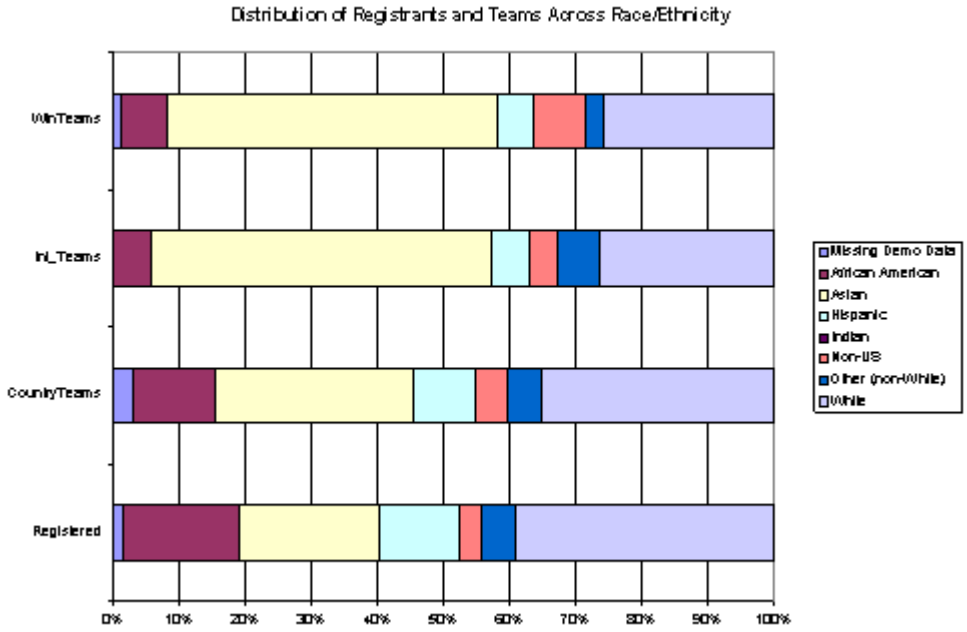


Figure 6

Summary Technical Report #1 – Exit Survey

Student Level (spring 2008)

Fifty two students self-selected to take the spring 08 exit survey. As with all spring surveys, students were not required to take it but instead offered "points" toward their final projects in return. The group was split nearly 50/50 girls to boys and US to international students. Only 9 students had taken part in GCA previously. The group of students who chose to take this survey was made up of approximately 3/5 Asian students and 2/5 other races/ethnicities. Half of the group said their family's income is under $40,000 a year.

Why students join the Global Challenge

- Many students share the feelings of one who notes, "Global Challenge presented an opportunity to get involved in a global issue that my community and I care about. In addition it proved to be a rewarding way to learn about foreign cultures and their way of thinking, in a collaborative environment." Students particularly like the applied learning about math, science, and business, and the personal agency, that GCA promotes.

Among the full-text responses participating students made to this question are these representative answers:

- I am interested in applying my knowledge of math and the sciences
- [GCA] involves science and math both of which I really like!
- I am interested in the problem of global warming and this seemed to be a way to help to try and find a way to change our ways to slow global warming.
- It's online!
- Easy porting for the expression of conceptualizations.
- I was interested in being able to work with someone from another country. I've also been interested in the global warming crisis for sometime now.
- Working with people internationally to serve a worldwide problem

Difference in GCA students' career expectations

- Prior to the challenge US students noted their interest in careers in medicine, engineering, business/public relations. Many were already thinking about something in math or science, but did not know exactly what discipline they wanted to pursue.

GCA students' interest in STEM

- Participating US students report that while they were looking generally toward science or business, they are more likely now to consider specific careers in environmental engineering, global business, and more purposeful community service/humanitarian interests.

Differences by demographics

- Some differences are found in the application of skills during GCA. This may have to do with preparation or personal interest, or it may be a result of the way the teams decide to split the work up.

GCA students interest in higher level math

- US students who have the opportunity to take higher level math and science classes plan to do so. Some say they would, but the courses are not available to them (also noted by international students). They may have had a scientific career in mind, but are more open now to the environmental sciences and global business applications.

GCA helping school work

- Some students say "no," while others say it does but in specific ways (calculating one's global footprint, for instance). There is a sense from the students that GCA is bigger and broader than work they do in school which is more focused on specific skills or operations, and that GCA's big-picture learning is a good thing.

Students' accomplishments, and barriers, in GCA

- Time (zones), time on task, group dynamics, and language issues stand out as the greatest barriers, but one US student summed the experience up saying, "Time was a great barrier because our teammates either had to meet really early or really late during the day to accommodate for a mutual meeting time. When one of our most valuable teammates quit because of family issues we were panic-stricken. But in the end the rest of us rejoiced at the thought that we not only overcame physical barriers but also emotional and social ones. In addition global challenge is not just like a research paper so it demanded from us more than just any information that we can find. Although at first we felt that we were not fully up to the task in the end we all felt a great sense of accomplishment to be pioneers of this new frontier."

Average time spent on GCA

- During the school year, most of the 52 students who answered this survey said they spent between 1 and 4 hours a week working on their GCA project

throughout the year. In the final 2 months, most of the students who took this survey said their time increased by 5 to 6 hours per week.

Discussion:

When asked, "Did the amount of time you spent on the Challenge increase during the months of March and April?" forty-seven students answered "yes." In addition, they used the text box to provide more detail about their work patterns during that final push to complete the project:

- Each TIP represents one night's work
- My time varied
- It was sometimes 5 hours per day, usually it was 16 hours/week

It is understood that time spent on the project is a function not only of the students' varying levels of commitment to their project, but also the working strategies of their team, their other activities in school and commitments at home, etc. Still, it is interesting to note that only one of the US students said their time spent during the last 2 months did not increase, pointing, perhaps, to a short-term rather than long-term commitment

Summary of Technical Report #2 -- SCANS Survey
Student Level, Spring 2008

Fifty two students took the SCANS survey in the spring of 2008. Of those students two thirds were Asian, 30 were female and 21 male, 28 were global business plan winners, and 21 were TIP winners. Twenty five students identified themselves as US and 25 as International. Three students who completed the survey did not go on to win an award in the challenge.

Reliability of the instrument

- While the survey findings include significant differences between some groups, the survey headings and subcategories do not seem to hold together as defined. Factor analysis indicates different groupings of subcategories would be more realistic.

Differences by demographics

- When splitting the data by demographic categories, such as by US or International home, some significant differences in opinion surface between groups. While there is much agreement that thinking skills are very important to the GCA work, more important than basic skills, resources competencies, or systems competencies, US students' surveys show they also believe that thinking skills are more important than information competencies, while international students think they are more important than interpersonal competencies.

Discussion:

Some other differences found include female students report more important use of thinking skills over technology competencies than males; international students report significantly greater systems and technology competencies over research skills.

1. Basic Skills
2. Thinking Skills
3. Personal Qualities
4. Resources Competencies
5. Interpersonal Competencies
6. Information Competencies
7. Systems Competencies
8. Technology Competencies

Table 1. Significant Differences

Group	1	2	3	4	5	6	7	8
All n=52	>4	>1, >4, >5, >6, >7	>1, >4		>4	>1, >4	>4	>4
Girls n=30	>4	>1, >4, >5, >7, >8	>1, >4		>4	>1, >4	>4	>4
Boys n=21		>1, >4, >6, >7	>1, >4		>4	>4		>4
US n=25		>1, >4, >6, >7	>1, >4		>4	>4		
International n=25	>4	>1, >4, >5, >7	>1, >4		>4	>1, >4	>4	>4
Asian n=30	>4	>1, >4, >5, >7, >8	>1, >4		>4	>1, >4	>4	>4
Other ethnicities n=20	>4	>1, >4, >6, >7, >8	>1, >4, >6		>4	>4	>4	>4
Less than $40,000 n=26	>4	>1, >4, >6, >8	>1, >4		>4	>1, >4	>4	>4
More than $40,000 n=22	>4	>1, >4, >7, >8	>4		>4	>4		>4

Significant gains on pre post tests

- The 9 matched students show no significant differences pre to post. However, given the small n, and different years of data collection, this is not necessarily a meaningful comparison. Comparison of all students' pre to post responses in the 3rd year of Global Challenge is strongly recommended.

Data Sources: n=96 Pre/Fall 2006, n=67 Winter & Spring 2008, n=8 Post Spring 2007 (resulting in n=9 matched cases, pre to post)

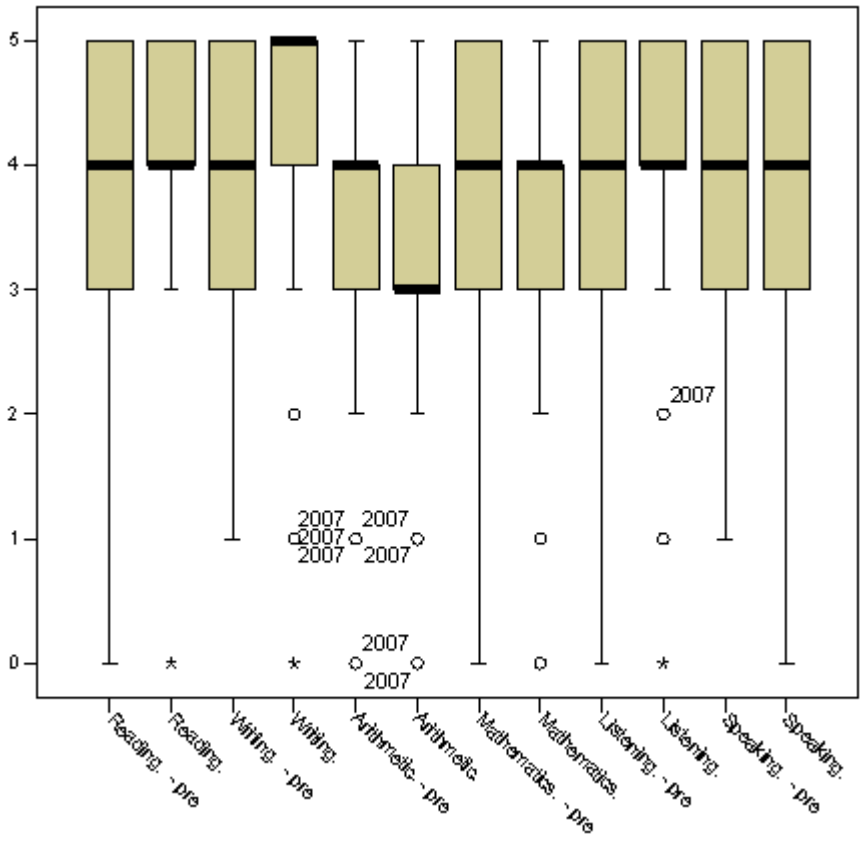


Figure 7

While some specific test items do show significant gains and declines the test as a whole does not find a significant difference pre to post. Students tend to rate necessary skills in math lower on the post test, which agrees with findings from TR5 that students' actual scores in the GCA math content test decline pre to post. It is hypothesized that this is because US students may be "further away" from their studies of basic math skills at this time in their scholastic careers, as was suggested by a participant during the US students' focus group (TR7), meaning that algebra 1 and 2 questions on the GCA math assessment become harder for them as time passes.

Summary Technical Report #3 – Mentors Interviews

Mentor (College Student) Level (Winter/Spring 2008)

Surveys were sent to all 8 of the GCA college student/mentors in mid March, 2008. Mentors were given the option of emailing their responses back, or being interviewed over the phone. One student took part in a telephone interview, which was taped and transcribed so that all responses were "full text" whether written or spoken by the students. Two responded immediately in email. Reminders were emailed a week later to the other 6 students, and 3 more responded to the survey, for a total response rate of 75%.

Effective mentoring

- Mentors who either were or were not students in the program last year feel that mentors who were previously GCA students themselves are able to be more effective

Mentors working as a team

- Some of the mentors keep in regular touch with each other and spontaneously problem-solve together issues that come up for their mentees, while some act as "free agents" removed from any circle of support available from other mentors. Some felt an initial f2f meeting with each other (and all GCA staff) would help them to feel more connected to each other and more apt to seek collegial support.

Interest in pursuing STEM disciplines

- GCA mentoring is not only interesting to the college students, but also helpful in their own studies and influential in their career choices

Mentors' role clearly defined

- Some mentors expressed confusion over changes in their stipends and the reporting structure. Others had no issues with this and felt things were running smoothly and more formalized than last year.

Mentors' suggestions for improvements

- Mentors suggest a "how to get started" type document be developed, while at the same time acknowledging that there is already a lot of material available for the HS students about how to succeed in GCA.

Primary function of a GCA mentor

- Mentors feel their primary role is to help the teams solve problems they encounter in trying to work together, more so than as a content expert. Mentors help teams to keep on track and to resolve inter-personal conflicts.

Full text selections from Mentors' comments follow (a full report is found in TR3):

- I wish in future years that participants now become the mentors later. Because I think that will be great in terms of like, I have research experience, I can tell them what I like the most and all that stuff, but I think that will be great in future years if whoever has been a participant is encouraged to be a mentor. Because it will definitely be like, "Oh, I did this survey and it's great. Push it to the limit." or "That doesn't apply too much to your program, but if you want to do it do it." Like, I wouldn't know how to answer that.
- I think because of the growing interest in climate change, there are more students that are not as much into math and science. At the same time, there are a number of students who are interested in other environmental issues, and don't seem to know that the project is centered around global climate change.
- STEM research topics have become more detailed and investigative, with the teams becoming almost vehemently interested in the STEM papers. So this is an extremely good idea to develop an all-round understanding of the knowledge aspect of the challenge, since it supplements the ability of each participant to present a solid and coherent paper in the end.
- If there were some way to select people that are going to be putting some effort on the program it would be a good way to use it for the next time around.
- I take some Sundays and I'm browsing through their work. And looking at what they are doing, seeing how they, you know. And it is not boring at all, it is actually great. It's really rewarding. I think it is great. It makes me want to go to school more. Because I want to learn more to be a greater impact on others as well as the environment. That's why we are all here, right? So, I mean, I think there are all these positives and I can't think of a negative. I'd have to think hard of a negative. I'm being serious, you know. It is considered a job, but it is not an "Ach." job. It's like, "Hey, you know?", you get to, I mean these students are like way smarter than me when I was in high school. I was like, "Wow, you know all that and you are in high school? Come on, I learned that in college. I see their brighter futures in college, and not to struggle like I did.
- I'm going to be dealing with much more than I can think of. And they have taught me a lot. So it's been great both ways.
- Being a first-hand witness to the new and exciting theories being thrown out by the teams has also helped deepen my knowledge in the Science aspect too.
- It is good to know that I am helping build ideas that could be later use to help the world stop or end global warming.

Summary of Technical Report #4 – Information Technology Survey
Student Level, Spring 2008

Differences between US and International responses

- US students were more likely to say they had opportunities for analyzing advantages of technology, demonstrating or advocating form legal and ethical behaviors, using technology tools, and developing a global supply chain. International students were more likely to say they had opportunities for identifying capabilities and limitations, collaborating with peers and experts, and practicing in a global work group.

Differences between opportunities and engagement

- US students report overall greater opportunities to engage in meaningful educational activities than do the international students.

Discussion:

Sixty-one students responded in the spring of 2008, their prompt was:

You will be asked two questions about your recent educational opportunities - how frequent and at what level of sophistication have you had opportunities to do the following?

1a) Identify capabilities and limitations of contemporary and emerging technology resources and assess the potential of these systems and services to address personal, lifelong learning and workplace needs....b) same opportunities at what level of sophistication?

2a) Make informed choices among technology systems, resources, and services...b) same opportunities at what level of sophistication?

3a) Analyze advantages and disadvantages of widespread use and reliance on technology in the workplace and in society as a whole...b) same opportunities at what level of sophistication?

4a) Demonstrate and advocate for legal and ethical behaviors among peers, family, and community regarding the use of technology and information...b) same opportunities at what level of sophistication?

5a) Use technology tools and resources for managing and communicating personal/professional information (e.g., finances, schedules, addresses, purchases, correspondence...b) same opportunities at what level of sophistication?

6a) Evaluate technology-based options, including distance and distributed education, for lifelong learning...b) same opportunities at what level of sophistication?

7a) Routinely and efficiently use online information resources to meet needs for collaboration, research, publication, communication, and productivity.

...b)same opportunities at what level of sophistication?

8a) Select and apply technology tools for research, information analysis, problem-solving, and decision making in content learning...b) same opportunities at what level of sophistication?

9a) Investigate and apply expert systems, intelligent agents, and simulations in real-world situations...b) same opportunities at what level of sophistication?

10a) Collaborate with peers, experts, and others to contribute to a content-related knowledge base by using technology to compile, synthesize, produce, and disseminate information, models, and other creative works...b) same opportunities at what level of sophistication?

11a) Practice intercultural communications...b) same opportunities at what level of sophistication?

Practice global group work...b) same opportunities at what level of sophistication?

12a) Develop solutions from concept & design to manufacturing & distribution. ...b)same opportunities at what level of sophistication?
Develop a global supply chain & management plan...b)same opportunities at what level of sophistication?

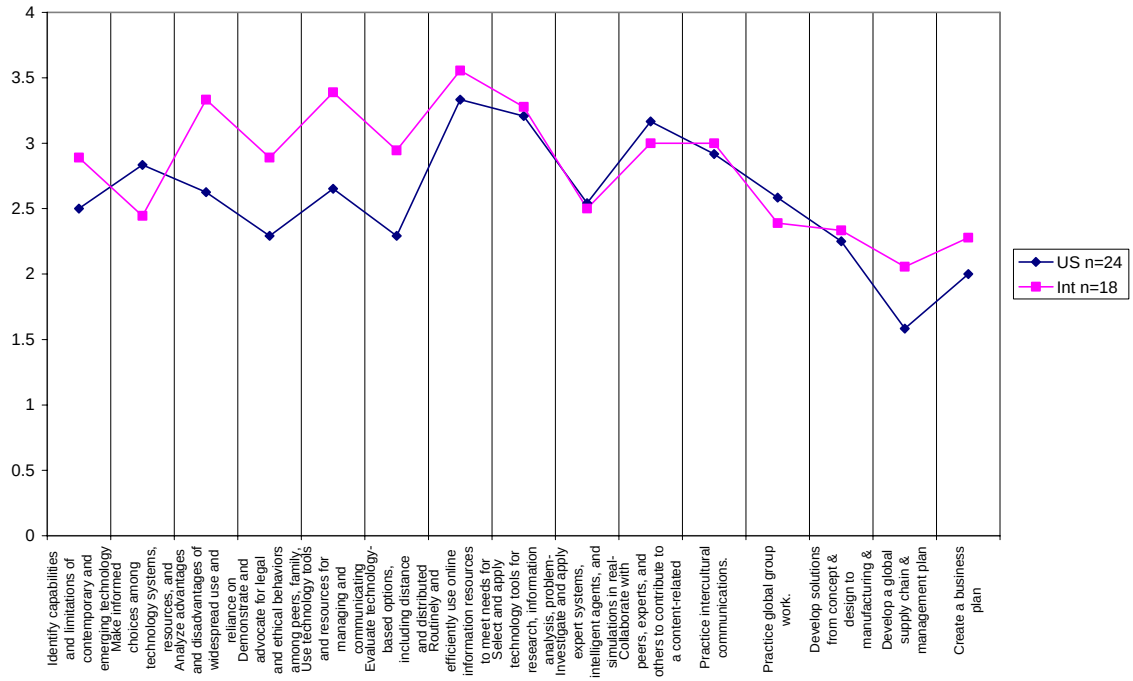
13a) Create a business plan...same opportunities at what level of sophistication?

Questions	Int-Mean	N	Std. Deviation	US-Mean	N	Std. Deviation
1a) Identify capabilities and limitations of contemporary and emerging technology resources and assess the potential of these systems and services to address personal, lifelong learning and workplace needs.	2.8889	18	0.8324	2.5000	24	1.0215
...b) same opportunities at what level of sophistication?	3.4444	18	1.2472	2.9167	24	1.4116
2a) Make informed choices among technology systems, resources, and services.	2.4444	18	0.8556	2.8333	24	0.8681
...b) same opportunities at what level of sophistication?	3.6111	18	0.9164	3.6250	24	1.1349

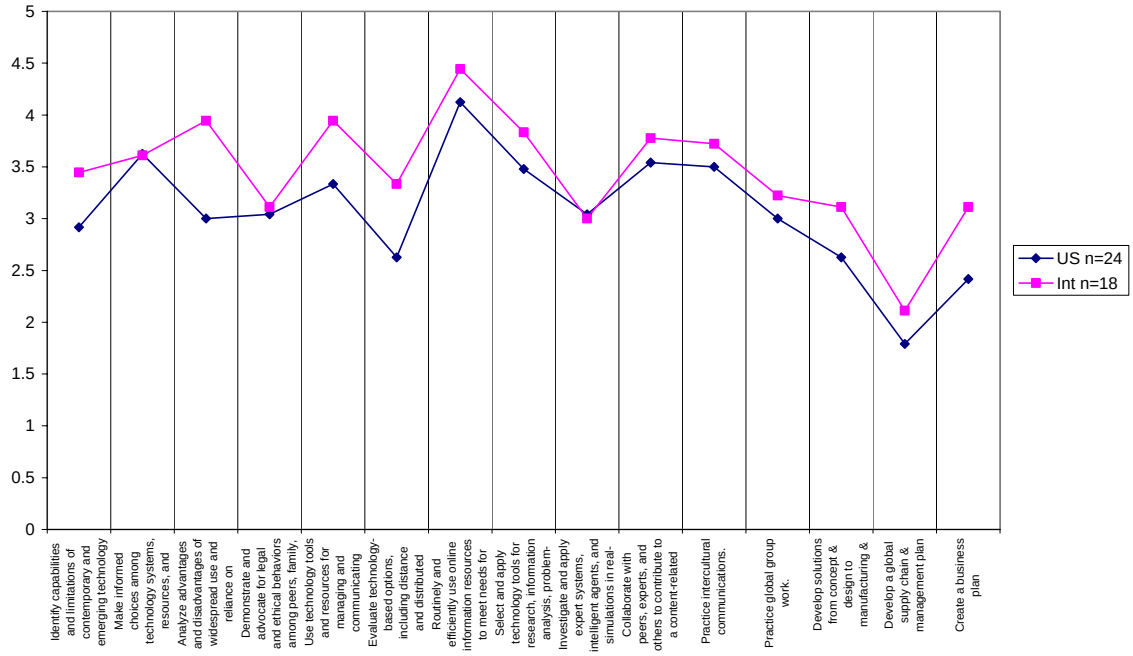
Of those 61 students, 42 identified themselves as either US or International students. Difference in responses between the two groups follow. US students were more likely to say they had opportunities for analyzing advantages of technology, demonstrating or advocating form legal and ethical behaviors, using technology tools, and developing a global supply chain. International students were more likely to say they had opportunities for making informed choices among technology systems, collaborating with peers and experts, and practicing in a global work group.

Of the "opportunities" questions, those that show marked difference between importance and sophistication of the opportunity to engage are the US students' responses to 2) about having opportunities to make informed choices among technology systems, and 4) demonstrating and advocating for legal and ethical behaviors.

IT Survey Spring 2008 Post -- Student Responses to 1st Part Questions -- Opportunities



IT Survey Spring 2008 Post -- Student Responses to 2nd Part Questions, IT Level of Sophistication



Summary of Technical Report #5 – Multiple Choice Pre-Post

Content Knowledge, Student Level (fall/winter 2007, spring 2008)

GCA students were given a multiple choice test at the beginning (pre) and end (post) of their GCA work this year. Each test presented the same 30 items, 4 Earth Science, 3 Chemistry, 3 Physics, 4 Environmental, 6 Biology, and 9 Mathematics. Items were drawn from the New York State Regents released item bank, found online at http://www.nysedregents.org/testing/hsregents.html This is a validated test and the items are assumed to be highly reliable.

In the fall of 2007 83 students took the pre test, where as in the spring of 2008 45 took the post test. Students "self selected" in deciding to take the tests or not. However in the spring there was an incentive added for students to receive bonus "points" toward their final projects for completing any of the post GCA surveys, including the multiple choice post test.

Is the instrument reliable?

- Yes, as measured by test source, and performance. An alpha of .8 or higher indicates a significant correlation between the response patterns students make for each question on an assessment. The pre alpha of .917 and post alpha of .931 indicate that students who missed a particular question also consistently missed or answered correctly the full array of items on the test.

Significant gains on pre post tests

- As a whole, the test shows that 29 matched students gained an average of .5 points, which is not significant. However, some specific test items show significant gains.

Discussion:

A graph of the pre to post responses made by the 29 matched students finds some instances where correct responses generally increased across a content area, where as in other areas, in particular mathematics, there were more incorrect than correct responses made on the post test.

While some specific test items do show significant gains and declines the test as a whole does not find a significant difference pre to post. It is hypothesized regarding mathematics that this is because US students may be "further away" from their underpinning study of math at this time in their scholastic careers, a theory suggested by a participant during the US students' focus group (TR7), meaning that algebra 1 and 2 questions on the GCA math assessment become harder for them as time passes.

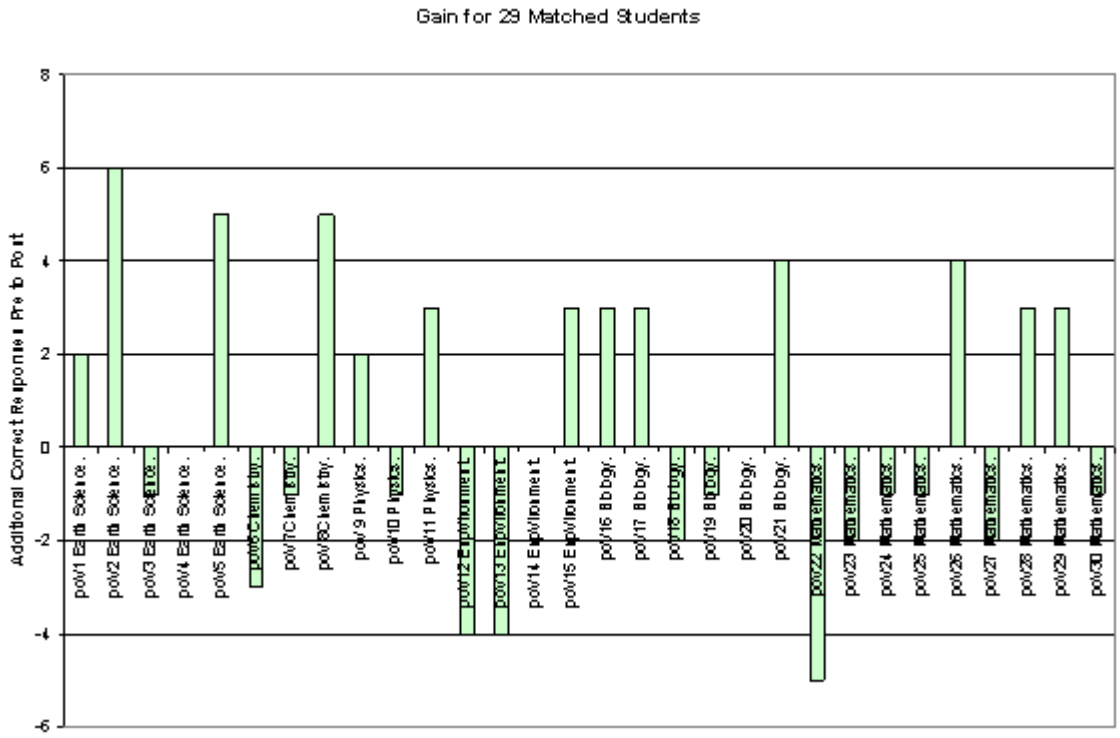


Figure 8

Differences by demographic groups

- Some differences found include female students' lower range of scores compared to male students, US students also produced a wider range of scores compared to international student.

Gender		N
PreTotals	Female	40
	Male	40
PostTotals	Blank	1
	Female	24
	Male	21
Pre_Totals	Female	14
	Male	15
Post_Totals	Female	14
	Male	15

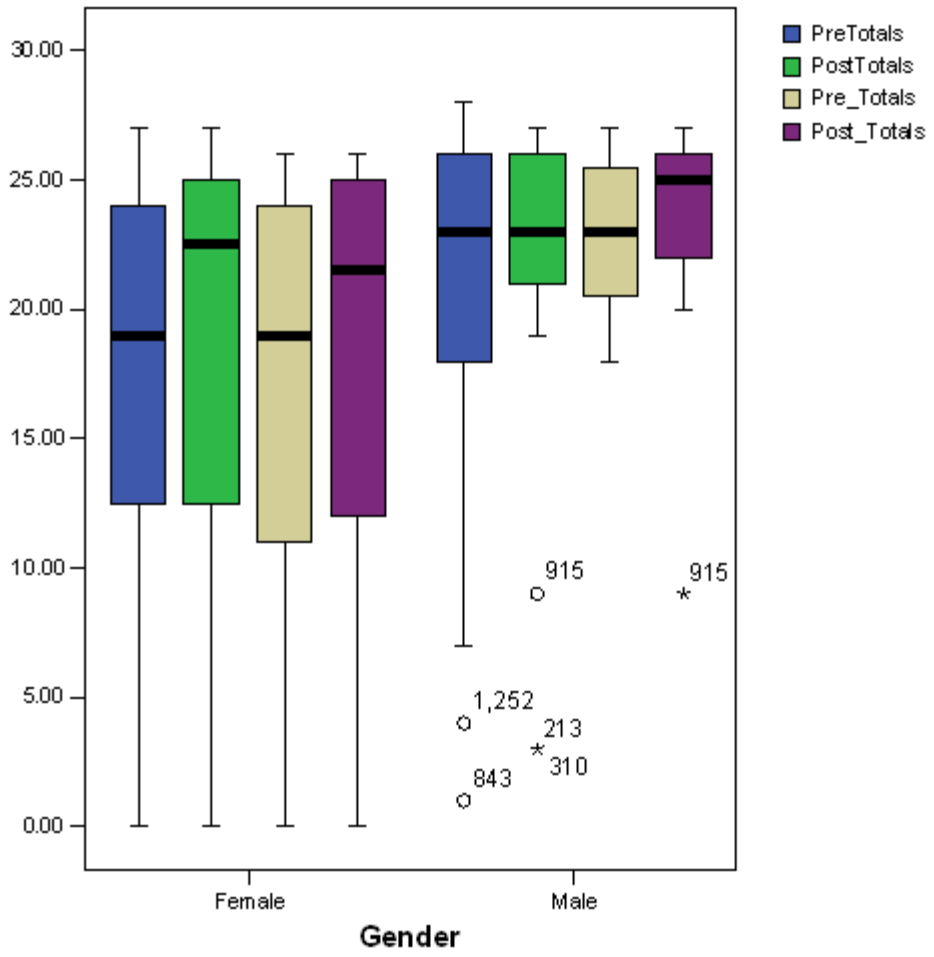


Figure 9

Analysis by gender finds that the range of responses in greater for the girls than the boys. The median (black horizontal lines in the graph below) for matched students increases for girls pre to post in both the entire population of GCA students who took the multiple choice tests, and the matched student group. The median increases for the boys in the matched data set, it does not change in the unmatched set. While the amount of increase in mean pre to post for both girls and boys is nearly the same, girls scores start lower on the pre. Their post scores do not quite meet the boys' pre scores.

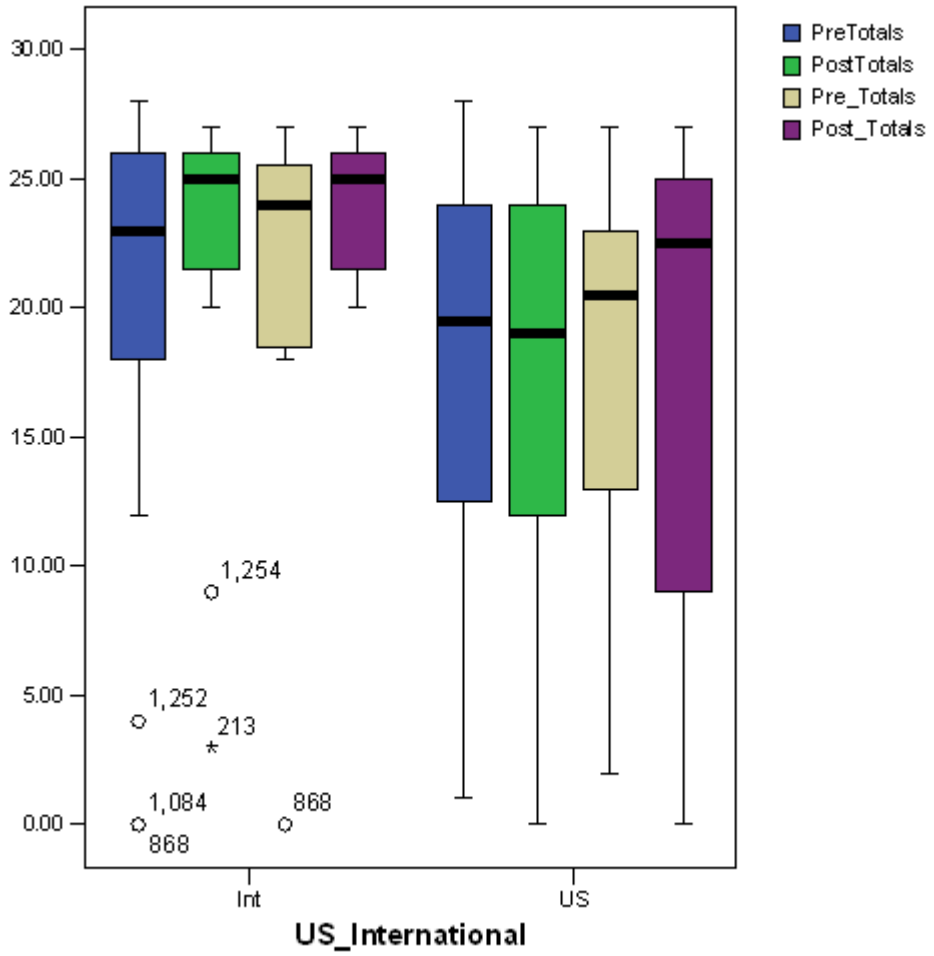


Figure 10. Mean Correct Scores on 30 Pre Post Multiple Choice Questions

US_International		N
PreTotals	Int	32
	US	48
PostTotals	Int	24
	Blank	1
	US	21
Pre_Totals	Int	15
	US	14
Post_Totals	Int	15
	US	14

US students' scores increased pre to post more than international students' scores did. However, they started and ended lower and with a greater range of responses.

Summary of Technical Report #6 – Pre Essay

Student Level (fall/winter 2007)

Differences in winning and non-winning students' approach

- Drawn from this sample, winning participants are more likely than non-winners to write about themes of "think tank," "manufacturing," "self critique."
- Non-winners are more likely than winners to write about "incentives," "partners," "social responsibility."
- Both groups are likely to write about a technical or manufacturing solution prior to assessing a need.

Gender or ethnic differences found between winners' and non-winners' responses

- Based on the small n little can be said about any differences of gender and race/ethnic group at this time. With more data, any differences may become more clear.

Discussion:

Fifty-seven students completed the pre-essay between 11/20/2007 and 2/5/2008 by responded to a writing prompt: "Using up to 300 words, describe how you might go about developing a new product or service to address a global issue that is of concern to you. Include in the description a brief explanation of the product or service as well as steps you might want to take to develop the idea."

Of those students, 7 went on to become finalists in the competition while 50 did not. In order to balance the findings between students who achieved "success" in the GCA, and those who did not, a random sample was drawn of 7 students who did not succeed, and whose responses were analyzed along with those of the 7 students who won.

Nearly half of the total GCA registered students go on to form country teams. Five of the 7 non-finalist students selected for this analysis formed their country teams, and of course all of the 7 finalists did so.

Table 2. Characters Coded at Themes (an average page of text ~ 300 characters)

Themes	non-finalists n=7	rank	Finalists n=7	rank
solution then application	1940	1	1304	1
manufacturing	389	8	1037	2
think tank	715	5	885	3
self critique	132	9	597	4
social responsibility	1521	4	482	5

Themes	non-finalists n=7	rank	Finalists n=7	rank
alternative fuels	117	10	297	6
partners	1832	3	234	7
publicity	683	6	184	8
incentives	1869	2	92	9
better quality	423	7	85	10
totals	9621		5197	

Table 2 shows the number of alpha-numeric characters coded by each of 10 themes recognized in the full text of students' pre essay responses. The rank order is designated by 1= most often and 10=least often for each student group.

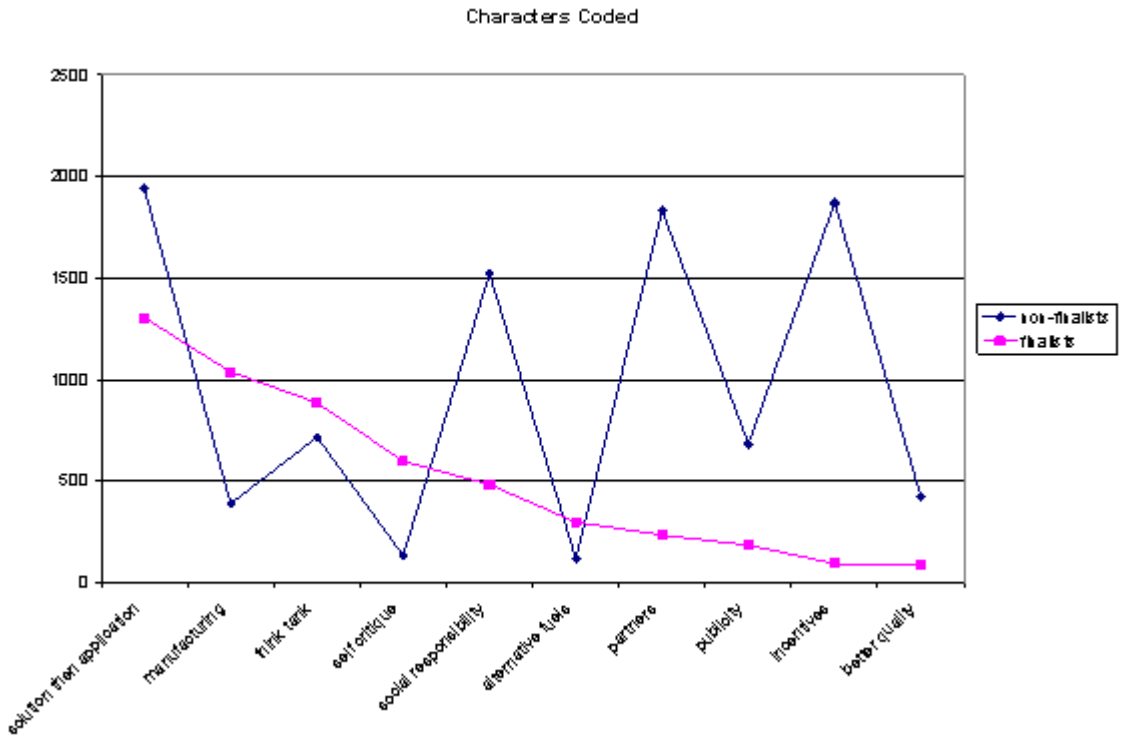


Figure 11

The themes found in finalists' compared to non-finalists' essays, are not found in similar quantities of text for the most part (think tank, and alternative fuels being the exceptions). Finalists used far fewer words to describe their ideas, and this agrees with the finding that they report having spent less time on the essay. Finalists and non-finalists alike tend to present solutions, then address potential uses for their ideas (solution then application theme).

Summary of Technical Report #7 – Focus Groups

Student Level (spring 2008)[2]

Two focus groups were held with GCA participating students during their residency at the Governor's Institute of Vermont in July, 2008. Ten International students took part in the first group, and eleven US students took part in the second.

Students' experiences collaborating in global teams

- For successful teams, difficulties in working with strangers who speak different languages and live in different time zones are overcome through active participation by all team members and with support from adult GCA staff and mentors. Participants who don't complete the challenge find the barriers too great, or lose interest in the project which is competing with their "real life" activities of school and home.

Awareness of and interest in solving global warming

- Some students come into the GCA with a strong interest in helping to overcome global warming. Others develop a more "global perspective" as a result of their work.

Differences between US and International focus groups

- Few differences were found in the focus group data between US and International team members. Each group gives the other its due in describing contributions to the final project, with US students more apt to take credit for business planning and International students somewhat more apt to say they provided content knowledge in math and science.

Interest in pursuing STEM disciplines

- Year 2 focus group data supports that of surveys and interviews in that many students say they were already thinking about math or science careers, but participation in GCA helps to reify what those careers might be -- they learn how a scientific community "works." They build greater interest in working on global warming, and in an international setting.

Discussion:

The focus groups were approximately 1 hour each. Due to a mix-up with unlocking the auditorium the International students' group began on the lawn outside, and later moved

[2] Previously reported as thematic summary, for formative project planning.

to the foyer. Students and the evaluator sat in a circle facing each other in both of the locations. The US group was held in the auditorium, with students in stadium seating and the evaluator sitting directly in front, facing them. While the mix-up with the room was unexpected, the round seating arrangement of the first group worked just as well, if not better than, the more formal auditorium setting used with the second.

Participatory Learning

The following passages are drawn from US students' responses:

Text Patterns	US Students	International Students
Team	68	53
Teams	11	11
Time	21	34

Regarding the GCA as an activity on college applications (given that application deadlines earlier fall than GCA awards): You can say you are part of a GC team and competing for a scholarship, might get a scholarship from it. Just say activities, after school activities, state it like that sort of thing.

Regarding the final project: Getting exposed to a lot of new materials and talking with a lot of experienced adults that really know what they are doing.

It's mostly about the world, like the stuff the people make you read stuff, read books and articles, which that also expands your knowledge of things. And not just, I mean there is questions afterwards and so you can't just like skip through it, you really have to read it.

Yeah, and then the best thing of the experience for me I think was just being able to research and come up with our own project, especially like after you finish it and look at it and think wow, this took a whole nine months to do. And, um, for like hours, we built [it] up ourselves and it is nice to see it collectively at the end.

Regarding serving humanity: The good thing about the STEM is it doesn't only like the first part, the first section, it tells us about how it connects with humanity. Because most engineering is just about design as the purpose. But this one is more about this is done to benefit humanity.

I would say the best part, because we are doing it at a high school level, I think it allows us to start thinking in the way of global solutions, and that is good to start thinking about at a young age, and when we become adults and older, we can refer back to this as a first experience and just keep on developing from this. Because the world has so many energy problems and such, that we need to start at an earlier age and this is going to be a good experience for us.

Regarding students' interest in joining GCA: International teams, meeting people with the same youth and aspirations.

My parents signed me up on the website.

Regarding forming an effective team: Make sure your international team is already alive.

A team, just because they sign up, and then they forget to check in to GC ever again, and then they reply to your email once or twice, and then they forget their password or whatever, so it just, if you can get their phone number like the first time you talk to them, so when they don't show up just bug them, call them, instead.

One thing that didn't work was if some person asks me to be in their team, I said yes and I never heard back. So I just went on my own.

Yeah, but in order to actually have anything in efolio you have to have an active international team, first. Before you join efolio.

I think for us, we got really lucky, because my team member actually did it the year before, I think, and so had placed, I'm not sure what, and so had the other team in [Asia] and so they looked and they connected so we had already formed a team pretty early.

Yeah, and my international friend is a different time zone and all, so I guess I only made him do research, so find this for me and send this to me and then he'll write it up and I'll use it and then after I use it I'll send it to my friend who refines it and then sends it back to me. So it is like a proof, set up like proof.

And then also, the kids, in my school, one was a freshman, but teamed up with a senior, so I think maybe in our school, reach out to someone in a different grade because they will have different strengths and year-knowledge.

Well, I think for us we assigned designated sections to team members based of our strengths, so I think one person had a lot of knowledge about mathematics and using statistics and projections on populations and the effect that our product would have on that, so I thought that was a bit more higher level math than me and my team member in the U.S. had had, so that was great that he was able to do that. So I think just finding what each team member is good at and then having to do those sections and teaching the rest of us how they did it, or how they thought about it.

Yeah, I think we decided within the first meeting. I mean, come to your first meeting with your team mates with a couple ideas and use that meeting to just throw them into the playing field, I guess, and decide what one you want to do as a team. And then, don't procrastinate, I mean it seems like a lot, but then it is going to be a lot, you wait. So I think start right when you form your team. If you form your team in Sept. or early Oct. I would start work right away.

I would email the winners from last year, and look at their email addresses, and then get with them as soon as possible, because they are all going to form teams before you are going to be able to. I think.

Regarding literally forming a team: Ok, oh a team, so I think what we did is email David Gibson and then tell him and I'm not really sure how we did it, but just keeping contact.

How to start, that was hard to get started.

I've got two people international that want to make the team, but I need a US member.

I know we did that with just putting 2 teams together, but when it was the small teams the other person knew how to do it, so they sent an acceptance letter, something.

I didn't actually form mine, they just, put me in. I still don't know how it formed, really,

Or you can do it like, once you login on the globenet, that thing, you can just like, there is like steps, form country team, form international team, and I can show you that on the computer.

Regarding working online: Yeah, or just name one work space, I think what they are talking about the work, I think that is all we really used all the year was like those two things, but I think there are a zillion other folders. I mean except for the surveys and the team building exercises. But I think with like the team building we also submitted those back in the same thing. But yeah, it was like really confusing and so some of your stems never got counted. Or there was a work group, or some of your team building exercises never got counted.

Skype is like, Mr. Gibson, like all the adults, and my mentor and teammates. But then my teammates uninstalled theirs so every time we meet I have to make them reinstall again, wait half an hour, and then I can talk to them.

Some [survey] questions you were asked before you start, and then when you finish some of those questions and some new questions, like you might not know the answers, but they are just getting your points and that helped your score. And then afterwards that would help your score, too.

Those surveys are like optional, but then the thing is they didn't tell us this in March but then the thing is after you complete each STEM challenge, the survey that goes along with that, earns points. Those 2 questions. And I thought that was tricky… Yeah, a lot, and we had to review, now what was the answers to that one?

Yeah, that bothered me once in a while, I didn't put, because first it says efolio and then another thing drops down. It said put it in work, but I put it in just folder, so none of my stuff got submitted and I had to do it over again.

That happened to me, I had then time to fix stuff. [group laughter]

Regarding most difficult barriers: Culture, language, particularly in writing a collaborative paper

Yeah, I think working especially with international students, we were lucky because our international students went to an English school, but I think some language barriers across, I think even with skyping, might arise, and even when they wrote some of their sections we had to kind of reword it or rewrite it into our American English so that it could be understood. So I thought that was a bit tricky but I think overall they were good partners.

Time zones – with up to a 12 hour difference, finding "fair" times to meet online, not too early, not too late, in the day

Time zones, it is like really annoying, and like arranging a time to meet. Usually you work really hard on one day and you may have come up with a lot of things for like 2 hours and then you don't need to do anything with GCA for 2 weeks. Just because school, life, bla, bla, bla. And then the next time we'd meet it is like, what did we talk about? And every time we'd meet, we'd leave a week or two doing nothing, we'd kind of take a step back.

But as we got closer to the due date, then we'd get into it.

[also] "Lost" members who express interest in forming a team but then don't follow through

Regarding greatest supports:
GCA staff, adult supervisors, teachers

I think my mentors were pretty helpful, I think the nice thing about this project is it forces you to be very independent in the way that you think and even if you hit an obstacle you should try to work around it before you contact them. So for our mentors we didn't really use them as much as we could have but I think that really helped us in the long run. But toward the end in the last few days we were asking them to look after it to see what they thought. But that was just to have someone look to have a final check, so that is basically all we used them for. But I think they were there for us.

Regarding interest in pursuing STEM disciplines: For me, I think it is about the same, I just had an interest in doing it, beforehand, in like science, and applying science to a given problem, so I think it is about the same.

Well, I guess, how it strikes me, is that I reach agreement with my family, they want you to be either doctor, engineer, lawyer, and so they want me to be in engineering, and I don't like math so much, and so wanted to be in computers, but they want engineering. So we settled in the middle ground for me to go into environmental engineering, so I guess environmentalism, it is ok for me, it is pretty good, I guess.

Regarding how to "win" the challenge (from a question by another student who said," the requirements sound kind of difficult"): I think it is pretty much up to, basically, you want to think of a product or a type of process that is going to help the environment in some sense, and so you want to take a year to really delve into that subject in all areas, how it is financially, how useful, political views, the industry, the market. Yeah, there is a whole list of things and I think just being really thorough in your implementation, what the cost of that really is. You do the core of that.

And maybe it is a good idea to start reading the grading rubrics. It is a great walk through.

Yeah, follow the rubric.

An international student's response to this question, from their focus group: We knew the expectations of the project, and I thought the science problem was going to be more involved in the project so I took it upon myself. But then we went into the business plan we realized we needed to do an analysis of each industry and market, and then interlay that with a cost analysis, and then bring that to why our product is effective, and that is a lot of work for one individual to do.

Summary of Technical Report #8 – STEM Assessment

Content Knowledge, Student Level (fall/winter 2007, spring 2008)[3]

Twenty four STEM content questions were answered by 68 students in fall '07, and by 46 students in spring '08. Of these, twenty four students answered both the pre and the post surveys; the following analysis is based on the responses of these "matched" students except where noted.

Is the pre-post test a reliable instrument?

- While the Alpha test does not show that the STEM assessment "holds together" as a set of items, that is not necessarily its primary purpose.

Do GCA students show significant gains on pre post tests

- As a group, no. Specific items do show significant gains or loses pre to post.

Are there differences between groups when the data is split by demographics (gender, country, income)?

- Yes, by item.

Can we tell from the data if students are taking their own tests, that is if they are working on them independently?

- Item analysis leads us to believe that students are taking their own tests independently.

Discussion:

The STEM assessment is designed by GCA staff to address the specific content of the STEM Explorations which students complete throughout their Business Planning and TIP work. But, just as in the Multiple Choice pre-post test of more generic content knowledge (TR 5), the STEM assessment is another "low stakes" test in that answering correctly earns no more reward than answering incorrectly.

Students self-selected when deciding to take the pre test, there was no incentive for doing so. In the spring, the post test offered the same incentive as every other GCA spring survey – a reward of a set number of "points" toward one's final project. In Year 3 the offer of points toward the final project has been extended to the pre test as well, thus increasing the stakes for students to complete it, but not providing additional motivation for answering correctly.

[3] Previously reported as data summary, for formative project planning.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Post_Total - Pre_Total	.41666667	1.99818758	.40787833	-.42709395	1.26042728	1.022	23	.318

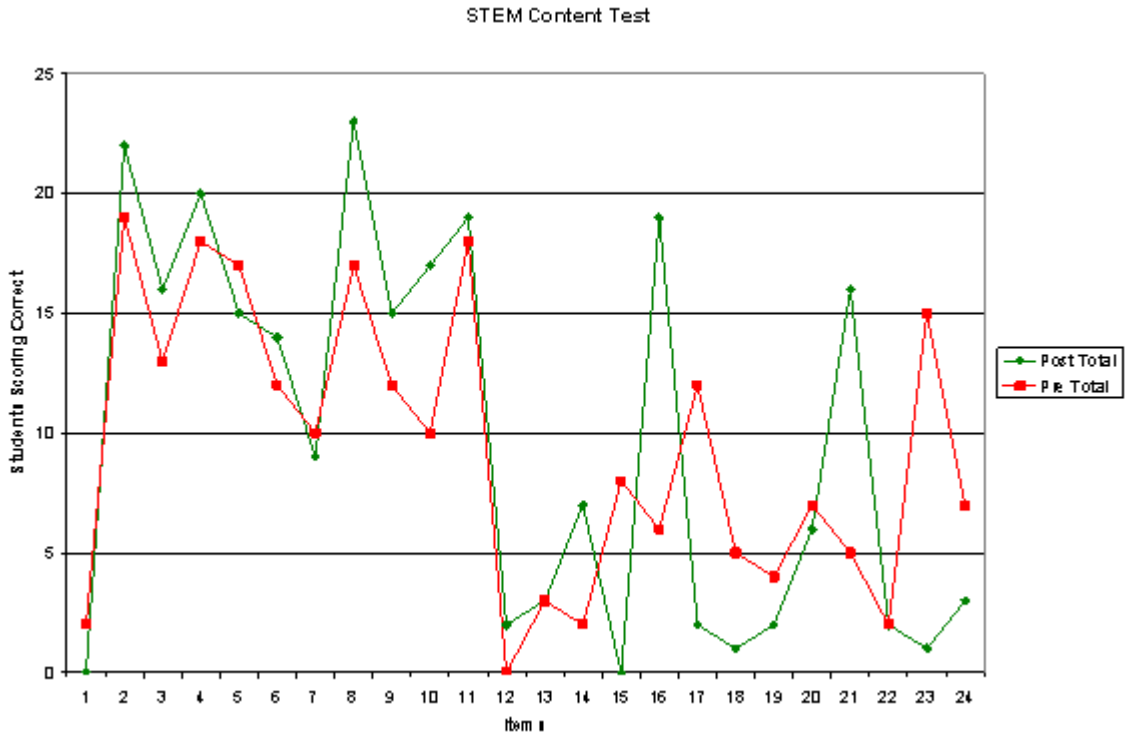


Figure 12

Figure 12 shows students' scores on the test pre (green) and post (red). Figure 13 maps their gain on the test pre to post. Of the 24 items on the test, 12 received more correct answers on the post test than they did on the pre, 2 received the same number of correct answers, and 10 received a greater number of incorrect answers on the post.

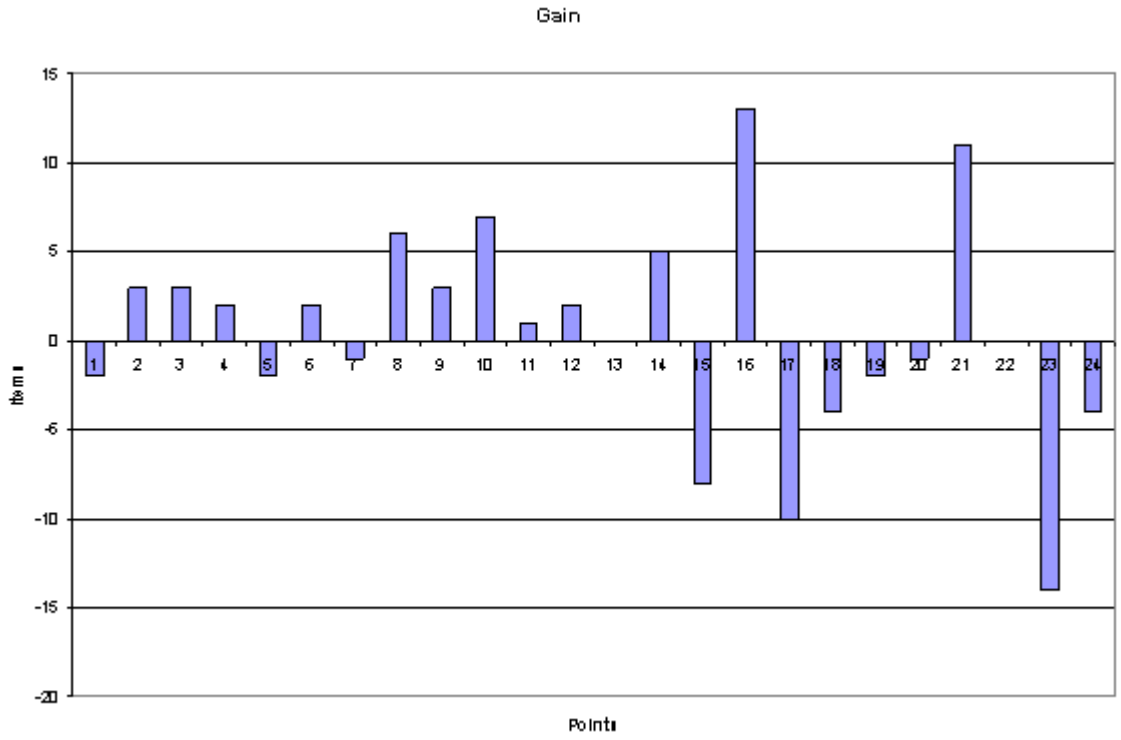


Figure 13

Analysis for significant differences pre to post finds 3 items received significantly lower correct responses on the post, while 5 received significantly higher responses.

Differences by demographic groups

When the data is split by gender then girls scored significantly better on 3 items, and significantly worse on another three. Boys scored significantly better on 1 item, and worse on another.

Paired Samples Test

Gender			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Female	Pair 1	v1 - v1d	-.13333	.35187	.09085	-.32819	.06152	-1.468	14	.164
	Pair 2	v2 - v2d	.00000	.53452	.13801	-.29601	.29601	.000	14	1.000
	Pair 3	v3 - v3d	.20000	.41404	.10690	-.02929	.42929	1.871	14	.082
	Pair 5	v5 - v5d	-.20000	.56061	.14475	-.51046	.11046	-1.382	14	.189
	Pair 6	v6 - v6d	.00000	.53452	.13801	-.29601	.29601	.000	14	1.000

Gender			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
	Pair 7	v7 - v7d	-.13333	.51640	.13333	-.41930	.15264	-1.000	14	.334
	Pair 8	v8 - v8d	.26667	.45774	.11819	.01318	.52015	2.256	14	.041
	Pair 9	v9 - v9d	.20000	.41404	.10690	-.02929	.42929	1.871	14	.082
	Pair 10	v10 - v10d	.26667	.59362	.15327	-.06207	.59540	1.740	14	.104
	Pair 11	v11 - v11d	.06667	.45774	.11819	-.18682	.32015	.564	14	.582
	Pair 12	v12 - v12d	.13333	.35187	.09085	-.06152	.32819	1.468	14	.164
	Pair 13	v13 - v13d	.00000	.53452	.13801	-.29601	.29601	.000	14	1.000
	Pair 14	v14 - v14d	.13333	.35187	.09085	-.06152	.32819	1.468	14	.164
	Pair 15	v15 - v15d	-.40000	.50709	.13093	-.68082	-.11918	-3.055	14	.009
	Pair 16	v16 - v16d	.46667	.63994	.16523	.11228	.82105	2.824	14	.014
	Pair 17	v17 - v17d	-.40000	.63246	.16330	-.75024	-.04976	-2.449	14	.028
	Pair 18	v18 - v18d	-.13333	.51640	.13333	-.41930	.15264	-1.000	14	.334
	Pair 19	v19 - v19d	.06667	.45774	.11819	-.18682	.32015	.564	14	.582
	Pair 20	v20 - v20d	-.06667	.59362	.15327	-.39540	.26207	-.435	14	.670
	Pair 21	v21 - v21d	.66667	.48795	.12599	.39645	.93688	5.292	14	.000
	Pair 22	v22 - v22d	.00000	.37796	.09759	-.20931	.20931	.000	14	1.000
	Pair 23	v23 - v23d	-.60000	.50709	.13093	-.88082	-.31918	-4.583	14	.000
	Pair 24	v24 - v24d	-.13333	.63994	.16523	-.48772	.22105	-.807	14	.433
Male	Pair 2	v2 - v2d	.33333	.50000	.16667	-.05100	.71767	2.000	8	.081
	Pair 5	v5 - v5d	.11111	.60093	.20031	-.35080	.57302	.555	8	.594
	Pair 6	v6 - v6d	.22222	.44096	.14699	-.11673	.56117	1.512	8	.169
	Pair 7	v7 - v7d	.11111	.60093	.20031	-.35080	.57302	.555	8	.594
	Pair 8	v8 - v8d	.22222	.44096	.14699	-.11673	.56117	1.512	8	.169
	Pair 10	v10 - v10d	.33333	.70711	.23570	-.21020	.87686	1.414	8	.195
	Pair 11	v11 - v11d	.00000	.70711	.23570	-.54353	.54353	.000	8	1.000
	Pair 13	v13 - v13d	.00000	.50000	.16667	-.38433	.38433	.000	8	1.000
	Pair 14	v14 - v14d	.33333	.50000	.16667	-.05100	.71767	2.000	8	.081

Gender			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
	Pair 15	v15 - v15d	-.22222	.44096	.14699	-.56117	.11673	-1.512	8	.169
	Pair 16	v16 - v16d	.66667	.50000	.16667	.28233	1.05100	4.000	8	.004
	Pair 17	v17 - v17d	-.44444	.52705	.17568	-.84957	-.03932	-2.530	8	.035
	Pair 18	v18 - v18d	-.22222	.44096	.14699	-.56117	.11673	-1.512	8	.169
	Pair 19	v19 - v19d	-.33333	.50000	.16667	-.71767	.05100	-2.000	8	.081
	Pair 21	v21 - v21d	.11111	.60093	.20031	-.35080	.57302	.555	8	.594
	Pair 22	v22 - v22d	.00000	.50000	.16667	-.38433	.38433	.000	8	1.000
	Pair 23	v23 - v23d	-.55556	.72648	.24216	-1.11398	.00287	-2.294	8	.051
	Pair 24	v24 - v24d	-.22222	.66667	.22222	-.73467	.29022	-1.000	8	.347
	Pair 4	v4 - v4d	.22222	.44096	.14699	-.11673	.56117	1.512	8	.169

When the data is split by country, international students scored significantly better on 2 items and significantly worse on two others. US students scored significantly better on 2 items and worse on three.

Paired Samples Test

US_International			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Int	Pair 1	v1 - v1d	-.07692	.27735	.07692	-.24452	.09068	-1.000	12	.337
	Pair 2	v2 - v2d	.23077	.59914	.16617	-.13129	.59283	1.389	12	.190
	Pair 3	v3 - v3d	.07692	.27735	.07692	-.09068	.24452	1.000	12	.337
	Pair 4	v4 - v4d	.07692	.27735	.07692	-.09068	.24452	1.000	12	.337
	Pair 5	v5 - v5d	-.15385	.55470	.15385	-.48905	.18136	-1.000	12	.337
	Pair 6	v6 - v6d	.15385	.55470	.15385	-.18136	.48905	1.000	12	.337
	Pair 7	v7 - v7d	-.15385	.55470	.15385	-.48905	.18136	-1.000	12	.337
	Pair 8	v8 - v8d	.23077	.43853	.12163	-.03423	.49577	1.897	12	.082
	Pair 9	v9 -	.23077	.43853	.12163	-.03423	.49577	1.897	12	.082

US_International			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
		v9d								
	Pair 10	v10 - v10d	.30769	.48038	.13323	.01740	.59799	2.309	12	.040
	Pair 11	v11 - v11d	.00000	.70711	.19612	-.42730	.42730	.000	12	1.000
	Pair 12	v12 - v12d	.07692	.27735	.07692	-.09068	.24452	1.000	12	.337
	Pair 13	v13 - v13d	-.15385	.55470	.15385	-.48905	.18136	-1.000	12	.337
	Pair 14	v14 - v14d	.23077	.43853	.12163	-.03423	.49577	1.897	12	.082
	Pair 15	v15 - v15d	-.23077	.43853	.12163	-.49577	.03423	-1.897	12	.082
	Pair 16	v16 - v16d	.38462	.65044	.18040	-.00844	.77767	2.132	12	.054
	Pair 17	v17 - v17d	-.23077	.59914	.16617	-.59283	.13129	-1.389	12	.190
	Pair 18	v18 - v18d	-.38462	.50637	.14044	-.69061	-.07862	-2.739	12	.018
	Pair 19	v19 - v19d	-.15385	.37553	.10415	-.38078	.07309	-1.477	12	.165
	Pair 20	v20 - v20d	.00000	.40825	.11323	-.24670	.24670	.000	12	1.000
	Pair 21	v21 - v21d	.46154	.66023	.18311	.06257	.86051	2.521	12	.027
	Pair 22	v22 - v22d	.00000	.57735	.16013	-.34889	.34889	.000	12	1.000
	Pair 23	v23 - v23d	-.61538	.65044	.18040	-1.00844	-.22233	-3.411	12	.005
	Pair 24	v24 - v24d	-.15385	.80064	.22206	-.63767	.32998	-.693	12	.502
US	Pair 1	v1 - v1d	-.09091	.30151	.09091	-.29347	.11165	-1.000	10	.341
	Pair 2	v2 - v2d	.00000	.44721	.13484	-.30044	.30044	.000	10	1.000
	Pair 3	v3 - v3d	.18182	.40452	.12197	-.08994	.45358	1.491	10	.167
	Pair 4	v4 - v4d	.09091	.30151	.09091	-.11165	.29347	1.000	10	.341

US_International		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
	Pair 5 v5 - v5d	.00000	.63246	.19069	-.42489	.42489	.000	10	1.000
	Pair 6 v6 - v6d	.00000	.44721	.13484	-.30044	.30044	.000	10	1.000
	Pair 7 v7 - v7d	.09091	.53936	.16262	-.27144	.45326	.559	10	.588
	Pair 8 v8 - v8d	.27273	.46710	.14084	-.04107	.58653	1.936	10	.082
	Pair 10 v10 - v10d	.27273	.78625	.23706	-.25548	.80093	1.150	10	.277
	Pair 11 v11 - v11d	.09091	.30151	.09091	-.11165	.29347	1.000	10	.341
	Pair 12 v12 - v12d	.09091	.30151	.09091	-.11165	.29347	1.000	10	.341
	Pair 13 v13 - v13d	.18182	.40452	.12197	-.08994	.45358	1.491	10	.167
	Pair 14 v14 - v14d	.18182	.40452	.12197	-.08994	.45358	1.491	10	.167
	Pair 15 v15 - v15d	-.45455	.52223	.15746	-.80539	-.10370	-2.887	10	.016
	Pair 16 v16 - v16d	.72727	.46710	.14084	.41347	1.04107	5.164	10	.000
	Pair 17 v17 - v17d	-.63636	.50452	.15212	-.97531	-.29742	-4.183	10	.002
	Pair 18 v18 - v18d	.09091	.30151	.09091	-.11165	.29347	1.000	10	.341
	Pair 19 v19 - v19d	.00000	.63246	.19069	-.42489	.42489	.000	10	1.000
	Pair 20 v20 - v20d	-.09091	.53936	.16262	-.45326	.27144	-.559	10	.588
	Pair 21 v21 - v21d	.45455	.52223	.15746	.10370	.80539	2.887	10	.016
	Pair 23 v23 - v23d	-.54545	.52223	.15746	-.89630	-.19461	-3.464	10	.006
	Pair 24 v24 - v24d	-.18182	.40452	.12197	-.45358	.08994	-1.491	10	.167

Analysis of students' responses to individual STEM items reveals what may be strong distracters in the answer key, which compete with the correct responses. The complete question/answer format can be found in TR8 and its appendix.

Summary of Technical Report #9 – Post Student Survey

Student's Learning Context, Student Level (spring 2008)

Research questions:

Is the pre-post test a reliable instrument?

- Yes, as measured by test scores. Further study with larger number of students this year will add to our understanding of its performance.

Do GCA students show significant gains

- As a post test only in Spring 08, there is no comparison group. In the Fall of 08 the survey has been administered to the new cohort of students, and so comparisons will be available in the Spring of 09 to questions of interest.

Differences between groups

- Results of this report are limited to US students.

While an early June 2008 pre-report of this data dealt with results from all students who took this survey, this report focuses on results of the 16 US students. Due to the low N, breakouts by gender and income are not made. Rather, results are shown as percent of the US students.

US students' experiences in GCA and in school

Discussion:

Following are summaries and examples from the survey data. Students could select as many items as they felt fit for each of the questions.

Do you agree with the following statements about why you chose to stay involved in Global Challenge?		
percent	count	
87.5	14	I am interested in global warming
87.5	14	The subject is interesting
68.75	11	I am making connections with foreign students
68.75	11	The subject is challenging
62.5	10	Education is important to me
62.5	10	I'm interested in winning the challenge
56.25	9	I am interested in international business
43.75	7	It's a place to make friends
31.25	5	Global Challenge teammates want me to succeed

Do you agree with the following statements about why you chose to stay involved in Global Challenge?		
percent	count	
31.25	5	I am interested in foreign colleges
31.25	5	I am interested in foreign travel
12.5	2	I am interested in global warming
6.25	1	I am interested in foreign travel
6.25	1	I have nothing better to do

(*NELS) 93% of the students who answered this survey report that they have good attendance at school, and many opportunities to make friends with students of other racial or ethnic groups. 87% feel the teaching is good at their local school, and that there are few barriers to their learning.

87% report they became involved in the GCA because of their interest in global warming, they find the subject interesting. 62% say they find the subject matter harder in Global Challenge than in their High School. However, 81% feel they have fewer opportunities to demonstrate leadership in GCA.

(*NELS) 100% of the students report their family has a computer at home. 81% have more than one computer. 62% have an Ipod, a daily newspaper, and a specific place to study. 43% have a set of reference books and only 18% have a typewriter.

100% of the students said their family owns the house they live in, 81% live at home with 2 parents. 43% have 3 or more cars. 18% do not take vacations, and 6% own a vacation home.

(*NELS) 75% say members of their family go to college, 31% graduate from graduate school, 25% work in math, 18% in industry. 12% graduate from trade school. 12% work in banking.

Students' STEM experiences and expectations

US students who answered the survey come from predominantly lower to upper middle class families. They have access to technology and an interest in school but have not participated in many after-school activities. They like their local school and have good attendance. They feel that GCA gives them harder content and an opportunity to make friends but not necessarily to demonstrate leadership.

(*NELS) In your current or most recent science class did you		
percent	count	
81.25	13	Learn or memorize scientific facts rules and principles
68.75	11	Increase your interest in science
68.75	11	Prepare for further study in science
68.75	11	See the importance of science in daily life

(*NELS) In your current or most recent science class did you		
percent	count	
62.5	10	Think about what a problem means and the ways it might be solved

(*AWE) Read the following statements about what scientists and mathematicians might do and indicate your agreement or disagreement with each statement		
percent	count	
93.75	15	Can choose to do many different kinds of jobs
75	12	Mainly work with other people to solve problems
75	12	Work on things that help the world
31.25	5	Mainly work on machines and computers
6.25	1	I don't know what scientists and mathematicians do
6.25	1	Mainly work on things that have nothing to do with me

* Questions used or adapted from NELS or AWE sources.

Summary of Technical Report #10 – GCA/GIV Presentations

Students' Learning Context, Student Level (spring 2008)

University of Vermont/Governor's Institute of Vermont Engineering Summer Institute

- The University of Vermont/Governor's Institute of Vermont (UVM/GIV) Engineering Summer Institute is a one week residential program of the UVM campus. Students focus on one of four areas: aeronautical engineering, biomass, wind energy, or robotics.

What are the working protocols and learning experiences

- Students typically work in teams of four. Each team works with scientists science educators, and engineers throughout the week. These partners serve as mentors as each team develops one or several prototypes, testing and refining prototypes as the week progresses. In addition students participate in field trips, lectures, simulations, and demonstrations.

Opportunities for presentation, communication, and public discourse in the program

- In 2008 the Project Exhibition was held in the University Mall, South Burlington, VT. The exhibition is free and open to the public. The exhibition begins with a period of time in which the public can examine the prototypes and research summaries and ask questions of team member.
- This public browsing continues throughout the day. It is estimated that 200-300 members of the public reviewed at least some of the projects.
- Beginning about an hour into the program teams begin to present their findings to a panel of distinguished engineers, scientists, and educators. Projects are judged on four criteria: Sustainability, Benefit to Humanity, Cost-Benefit Analysis, and Communication.

Outcomes achieved by attending Global Challenge for students

- In July 2008 thirty (30) Global Challenge Award participants attended the Governor's Institute of Vermont. Of these sixteen had participated on Global Challenge Award teams (seven teams total represented) in 2007-08. The other thirteen students were introduced to the GCA program through the Governor's Institute.
- Of the thirty students sixteen were on winning teams: fourteen were Global Business Plan winners while two won Technical Integration Program (TIP) awards.
- Sixteen of the students won scholarships while three won STEM Awards.

Summary of Technical Report #11 – Test Scores

Student Level (spring 2008)

Research questions:

How do GCA students perform on the SAT?
N= 25 responses

Averages: Math - 713 Reading - 624 Writing - 626

- Half of the US students who took the test are in the top 10% of their class, a little more than a fourth did not know their class standing or their scores.

How do GCA students perform on the PSAT?
N=20 responses

Averages: Math - 73.85 Critical Reading - 71.00 Writing - 70.29

- Half of the US students who took the test are in the top 10% of their class, nearly half did not know their class standing or their scores.

How do GCA students perform on the ACT?
N=4 responses

- 3 did not know their scores at the time of the survey

Appendix A

Evaluator Vita

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PROFESSIONAL EXPERIENCE

Executive Director, The Vermont Institutes, Montpelier, VT. 1998-Present.

Direct Non-Profit Organization supporting State Department of Education, schools, and partners in higher education and business. Programs include research and development, an Evaluation Center, data analysis and utilization support, technology applications, leadership support, equity strategies, and extensive reform of teacher professional development, state standards and assessment. Operate a statewide interactive learning network linking all Vermont high schools with high speed broadband video for student offerings and professional development.

Director, The Center for Curriculum Renewal. 1993-Present.

Provide consulting services in systems design, curriculum, instruction, professional development, administration, and program evaluation throughout the U.S. and abroad.

Adjunct Professor, University of Vermont, St. Michaels College, and Trinity College of Vermont 1983-1997

Taught graduate courses in research methods, program evaluation, assessment, curriculum, and leadership over a fifteen year period. Also worked with students in independent study in curriculum, assessment, and leadership. See list of representative courses below.

Director of Education, National Gardening Association, Burlington, VT. 1994-1998.

Managed two major work groups (Education and Marketing). Responsibilities include program development, marketing, publications, professional development, grant development, and administration of national educational programs serving approximately 42,000 educators.

Superintendent of Schools, Franklin Northwest Supervisory Union, Swanton, VT 05488. 1990-1994.

Responsibilities included strategic planning, program evaluation and improvement, student well-being, school board operations, district management, budget/finance, personnel, administrator supervision and evaluation, and school/community relations.

Assistant Superintendent of Schools, Essex Town School District, Essex, VT. 1984-1990.

Responsibilities included curriculum, instruction, program evaluation, staff development, and staff evaluation.

Principal, Blue Mountain Union School, Wells River, VT.

Responsibilities included student well-being, community relations, curriculum, instruction, personnel, evaluation, and plant management in a rural K-12 school.

Teaching/Research Fellow/Adjunct Faculty, Kent State University, Kent, OH. 1980-1981.

Media Specialist and Director of Gifted Education, Bethlehem-Center School District, Fredericktown, PA 15333. 1976-1982.

Teacher, California Area High School, California, PA 1971-1976.

Other

1983-Present – Adjunct Faculty, University of Vermont, Burlington, VT
1978-Present – Consultant, program evaluator, inservice provider, and presenter in school districts, organizations, and agencies nationwide.

EDUCATION

Kent State University, Kent, OH. Ph.D., Special Education Administration, 1982.
York University, England. Doctoral Studies, 1975-1976.
West Virginia University, Morgantown, WV. MA, 1975.
California State College, California, PA. BS, 1971.
Other graduate study at the University of Vermont, St. Michael's College, and Princeton .

SELECTED PUBLICATIONS AND PROFESSIONAL ACTIVITIES

- *Succeeding with Standards* (with Judy Carr) ASCD, 2001.
- "Putting standards to work in schools: the big picture." *ASCD Curriculum Handbook*. (with Judy Carr). ASCD, 2001.
- "Standards-based assessment and action planning: implications for leaders." *Inside* Education June 2001.
- How *to Use Standards in the Classroom* (with Judy Carr, et al.), ASCD, 1996.
- *Getting It Together: A Process Workbook for Curriculum Development, Implementation, and Assessment* (with Judy Carr). Allyn and Bacon, 1993.
- "The school board's role in curriculum development." (with Michele Campbell, Judy Carr) *American School Board Journal*, April, 1989.

- Association for Supervision and Curriculum Development (ASCD). Member of Executive Council, 2000-2003. Member of Board of Directors, 1990-95. Chairperson, Issues Committee, 1994-96. Member, Consortium on Authentic Assessment, 1991-Present. President, Vermont Chapter, 1993-95.
- Currently in press: *Shared Journey* (with Judy Carr and Nancy Herman), anticipated publication, Spring, 2003.
- Vermont Department of Education. Consultant on numerous projects, including Vermont Common Core for Learning, Vermont Framework of Standards and Learning Opportunities, Standards Across the Department, Vermont Portfolio System, Vermont Comprehensive Assessment System, and others.
- Program Evaluation. Program evaluator on numerous projects for school districts, private foundations, universities, and the National Science Foundation. Taught graduate courses in program evaluation at the University of Vermont. Member, American Evaluation Association Validation Panel for Student Performance Standards, Robert Lynn, Chair.

PARTIAL LIST OF CLIENTS AND COLLABORATORS

Association for Supervision and Curriculum Development
Cambridge (MA) Public Schools
Charles Dana Center, University of Texas
Cleveland Municipal School District
Connecticut Academy for Math and Science
Indianapolis Public Schools
Intel Corporation
Joint Committee on Standards for Educational Evaluation
Louisiana Board of Regents/LASIP
Los Angeles Unified School District
Massachusetts Department of Education/PALMS
National Initiative for Community Innovations
National Science Foundation
New York City District 15, Brooklyn
Republic of Colombia
Republic of Trinidad and Tobago
St. Louis Public Schools
UCLA
University of Minnesota
UNC Chapel Hill/North Carolina Botanical Garden
University of Puerto Rico/Puerto Rico SSI
Vermont Department of Education
Vermont Mathematics Initiative
Western Michigan University Evaluation Center

Evaluator Vita

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Montpelier, VT 05601
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Recent Work History

5/03 – Present

Evaluation Specialist, Vermont Institutes – internal and external evaluation of K-12 and teacher training programs. Data analysis, survey design, quantitative analysis, qualitative study design, application of organizational systems theory and using data for school reform

1/06 – Present

Adjunct Instructor, Woodbury College – undergraduate Assessment & Evaluation courses, online graduate courses in Research Methods

10/99 – 8/03

National Institute for Community Innovations, Senior Associate – creation, evaluation of on- and off-line materials. Staff training and supervision, teacher participant support in an online campus

6/99 – 8/03

Art Responding through Technology (ARTT), Coordinator – responsible for overseeing training and programs in an online community of students, teachers, and artist-mentors

1/96- 9/00

The Web Project, Project Manager – responsibility for day-to-day grant and office management of this award winning 2.5 million dollar USDOE funded Technology Innovation Challenge Grant program

Education

University of Vermont, Burlington, VT
Ed.D. in Educational Leadership & Policy Study

Clarkson University, Potsdam, N.Y.
Master of Science, Management Systems

Regents Scholar, Syracuse University, Syracuse, N.Y.
Bachelor of Fine Art

Woodbury College, Montpelier, VT
Certificate in Legal and Paralegal Studies

Additional Graduate Coursework completed on Education, Technology, and Business Topics at Norwich University, Rhode Island College, University of Ottawa, and Potsdam College

Syracuse University, London England
Graduate Internship, ABC News London Bureau

Other Relevant Experience

2007 Selected as AERA Conference Paper Peer Reviewer: Science Teaching and Learning, and School Evaluation and Program Development

2007 Lead Author and Presenter, VMP Evaluation Findings Related to Changes in Teaching Practice, Drawn from Qualitative Focus Group Data
MSP-NSF Evaluation Summit II, Minneapolis, MN

2000-2003 Co-Instructor, VT MIDI/ARTT Graduate Courses and Summer Institutes, University of Vermont, Burlington VT

1996 Visiting Instructor, Workshop Presented on Grant Writing
Jefferson Community College, Watertown, N.Y.

Awards & Honors

NVivo7 Qualitative Software "Train the Trainer" assistant to NVivo creators Lyn & Tom Richards, Madison, WI Spring 2006

NVivo2 Qualitative Software "Train the Trainer" assistant to Lyn Richards, Athens, GA Spring 2005

Co-Author, National Endowment for the Arts, 2002 Arts Organization Support Grant awarded for the Vermont MIDI/ARTT Project, Inc.

Author & PI, AAUW Community Action Grant to provide technology training for underserved girls and women in Vermont

Grant Consultant, NEA Community Arts Project Support award for the *Mary Miller Historic Mural*, Public Library, Lafayette, Colorado

Lead Author, SITE Conference paper, March 2001; Art Responding through Technology

Co-Author, Co-Presenter, AACE Conference, Oct. 1999; Distance Learning in Rural Schools of Vermont: Online Arts Mentoring

Arts Administration Fellowship, 1995
National Endowment for the Arts, Washington, D.C.

Potsdam College United University Professional Development Tuition Award, toward completion of the Museum Management Certificate Program, Colorado University at Boulder

Visiting Professional Program: Records Management and Research
Smithsonian Institution, Washington, D.C.

Partial List of Evaluation Clients in the Arts and Sciences

Global Challenge Award *(http://www.globalchallengeaward.org/)*
"Teams of US high school students collaborate with international counterparts to address global climate change and compete for prizes and scholarship awards."

MathPix *(Chris Hancock, ch@tertl.com)*
"Students use MathPix to make models of problems and situations to help them better understand mathematical concepts."

MSOSW *(Gerald Knezek, gknezek@gmail.com)*
"Energy-monitoring devices are used as the interface between students and their understanding of their real lives and the abstract world of 'energy.'"

New Perspectives in Arts Integration
(http://www.vermontartscouncil.org/tabid/158/Default.aspx)
"Undertaken to investigate how and why three exceptional arts education programs are successful at improving students' performance and knowledge and also at keeping them excited about learning."

Non-Profits Management Certificate Program *(http://woodbury-college.edu/programs/Nonprofit_Cert/index.html)*
"This series offers nonprofit leaders and staff the opportunity to gain and refine the essential skills needed to strengthen their organizations and achieve their missions."