Engineering Self-Efficacy in Economically Disadvantaged and English Language Learner Middle School Students Learning Game Design

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Abstract

The current study examined students' self-efficacy for learning engineering scores collected over the course of the year in Globaloria classrooms. All students at this charter middle school take a Globaloria class where they research a social issue and work in a student-centered classroom to design an educational, interactive game about the issue. The class is centered on subject matter research, and learning to design and program a computer game. All are minority students and nearly all students qualify for free or reduced lunch programs. The Globaloria class meets daily and includes daily time on computer programming, group work, reflection and writing. The sample included 2 groups of students:

6^{th} graders, who were taking the Globaloria class for the first time, and 7^{th} graders, who for the most part have taken Globaloria in 6^{th} grade and were engaging in the class a second year. The purpose of this study was two-fold: first to validate the self-efficacy for Globaloria survey instrument that was designed for use in the Globaloria setting and second to examine change in students' reported self-efficacy over the course of one school year. Results show that it was sensitive to growth in self-efficacy for 7^{th} graders but not for the 6^{th} grade group as a whole. The discussion includes recommendations for increasing the sensitivity of the survey instrument.

Introduction

Globaloria (www.Globaloria.org), a program established by the World Wide Workshop (www.WorldWideWorkshop.org) in 2006, is an educational intervention for students to develop digital literacies, STEM knowledge and global citizenship by designing and building original web games in a wiki-based collaborative, networked environment. Globaloria is a year-long academic curriculum comprised of programmable wikis, blogs, game-design and programming tutorials, game-content resources, and a virtual support system for educators and students. Students drive the design process, taking an original idea to final product. In a student-centered or 'workshop' classroom, students learn both technical and computational skills and gain content knowledge in preparation for college-level studies, especially in STEM curricula of science, engineering, technology, and mathematics. Educators engage in multi-year, blended (onsite and online), rigorous professional development that prepares them to manage and master this Constructionist learning environment (World Wide Workshop 2010).

Globaloria at EAPrep in 2010-11

All students at East Austin College Prep Academy (EAPrep) are required to participate daily in Globaloria for 75 minutes. The school is a new charter middle

school, opened in 2009, designed for and populated by students who are from the surrounding economically disadvantaged community. The students are 80% Hispanic and 20% African American. Approximately 40% are English Language Learners (ELLs). The founders of the school cite cultivating students' passion towards STEM careers in a community plagued by very low educational attainment rates and high unemployment as a key long-term goal of the Globaloria program.

The Globaloria curriculum was designed as student-centered approach, where students have to find answers for their questions about their game-topic among their peers and using available virtual resources, including live and asynchronous expert helpdesk and tutorials, rather than through direct teaching, thereby enhancing students' research and problem-solving skills. Educators receive just-in-time in-person and virtual training and support to refine their use of this approach. They also create lessons and adapt Globaloria tools to fit the needs of the students in this population, making the game design process accessible and relevant. Educators are also supported by a dedicated mentor and program manager who provides in-person and virtual support for developing games in the Globaloria network.

Game design activities that form an important part of the Globaloria curriculum are related to an ubiquitous activity in students' lives—games and digital interaction—and thus have intrinsic interest for many students. Because of this connection, it is theorized that designing and building games can lead to

interest in or enhance student learning in other STEM subjects. Early research at EAPrep shows an association between student achievement in Globaloria and mathematics (Malerba, 2012).

Literature

Globaloria is a game design and social media program that grew out of constructionist ideas that are closely connected with experiential learning and Piaget's Constructivist ideas. In these theories, and in Globaloria, learners participate in authentic tasks and build a digital entity. In this review, we will examine opportunities for students to build self-efficacy within this learning environment. An individual's self-efficacy is defined as 'beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives.' Bandura writes:

People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided. Such an efficacious outlook fosters intrinsic interest and deep engrossment in activities. They set themselves challenging goals and maintain strong commitment to them. They heighten and sustain their efforts in the face of failure. They quickly recover their sense of efficacy after failures or setbacks. They attribute failure to insufficient effort or deficient knowledge and skills that are acquirable. They

approach threatening situations with assurance that they can exercise control over them.

Bandura (1977, p. 191) argued that 'expectations of personal efficacy are derived from four principal sources of information: performance accomplishments, vicarious experiences, verbal persuasion, and physiological states'.

Self-efficacy assessment can be used to examine perceptions in multiple domains related to the domain of functioning (Bandura, 2005). Examples of elements of self-efficacy include efficacy for self-regulated learning, self-assertive efficacy, academic achievement self-efficacy, and self-efficacy for enlisting social resources, among other domains.

That self-efficacy beliefs of young adults serve as a factor in academic success has long been well-documented. The development of self-efficacy and its long-term impacts were demonstrated by Jencks and colleagues (1972). In young adults, higher levels of self-efficacy and self-esteem have been found to be associated with better academic performance (Phillips and Gully, 1997). Self-efficacy measures were found to have good internal validity on student success in academic settings (Solberg, O'Brien, Villareal, Kennel, Davis, 1993; Bores-Rangel, Church, Szendre, Reeves, 1990). Although high school has been a focus in the past, researchers at Johns Hopkins identified middle school as the pivotal time for affecting students' academic success or failure (Balfanz, 2009).

Bandura (1989) wrote that ‘In a personalized classroom structure, individualized instruction tailored to students' knowledge and skills enables all of them to expand their competencies and provides less basis for demoralizing social comparison. As a result, students are more likely to compare their rate of progress to their personal standards than to the performance of others. Self-comparison of improvement in a personalized classroom structure raises perceived capability.’ He identified independent learning within the classroom as a way for students to develop self-efficacy, since students are less likely to use a normative standard for success. (p.67)

In the Globaloria classroom, students have the opportunity to observe the behaviors of other students, of teachers, visiting researchers and experts. They also use social media to connect with game designers and content experts. As students observe and learn through observation, they are connecting with a model that can help them to become more confident in their own capability.

Therefore, we hypothesize that a program where students learn independently, solve problems with support and modeling from peers and teachers, but also by using the resources that are available within the curriculum and on the Internet, may support their self-efficacy.

Educational Attainment, Career Aspiration and Self-efficacy

It may be that if Globaloria brings about self-efficacy, then it may also bring about other outcomes, which are outcomes of strong self-efficacy. For instance, Massey found that the extent to which students have positive experiences in high school has important implications for intention to pursue postsecondary education (Massey et al., 2003). Researchers have reported that career-related self-efficacy is positively related to career-related outcome expectations among samples of Latino students (Fouad & Smith, 1996; Gushue, 2006), and also that self-efficacy positively influenced academic and career interests in math- and science-related fields among a sample of mainly Hispanic middle school students (Fouad & Smith, 1996). At the same time, unrealistically low mathematics self-efficacy perceptions may be responsible to avoidance of mathematics-related courses and careers. (Hackett & Betz, 1989).

Interventions involving mastery experiences increase STEM self-efficacy (e.g., Betz & Schifano, 2000; Luzzo, Hasper, Albert, Bibby, & Martinelli, 1999) and several studies specifically point to hands-on projects requiring self-regulation as being the ones that can provide mastery experiences, and thus higher self-efficacy (Bandura, 1997; Britner & Pajares, 2006). Researchers have found that women successfully working in the fields of engineering and mathematics attribute their self-efficacy to the confidence that significant others expressed in the women's abilities *(*Zeldin, & Pajares, 2001)

As a way to begin to understand the ways in which a game design and social media program can support change in efficacy for learning these new skills, and the efficacy to regulate learning in this environment, examining longitudinal data from the students engaged in this program is valuable.

Gender Differences and Self-efficacy

The Globaloria program aims to impact those under-represented in the STEM disciplines. This includes students from lower income and minority backgrounds and females. Researchers have explored gender and ethnicity and the relationships among these factors with the measurement and development of self-efficacy. Findings have suggested that boys tend to be more self-congratulatory in their responses to these sorts of instruments, whereas girls tend to be more modest (Pajares, 2003). Zeldin & Pajares (2001) also affirmed that self-efficacy beliefs were an important factor in helping women to select careers in mathematics, science, or engineering.

Conceptual Model of Self-efficacy for Game Design and Social Media

The mission of Globaloria at EAPrep is to provide STEM experiences in secondary school that will equip low-income and ELL students with the content knowledge, aspirations, and motivation to enroll and succeed in college and, if they desire, to follow STEM career paths, both of which may be significant departures from the educational and work lives of their parents and other adults in their community.

An important way of ensuring that students will meet these long-term goals is by monitoring the extent to which the Globaloria program experience helps build students' self-efficacy, i.e., the sense that students can persevere in the face of both significant personal and technological challenges. For this reason, the Globaloria research team is working to develop and refine a self-efficacy scale to measure students' initial levels of self-efficacy for learning engineering and to monitor growth in self-efficacy both during individual school years and over multiple years of participation in the program.

The associations between students' educational experiences and long-term academic and career success are multifaceted and complex; however, we propose that one key pathway for moving a young student from having little or no knowledge and experience with game design engineering to a young adult with realistic STEM career aspirations is through the influence that Globaloria participation will have on students' self-efficacy for learning engineering. This

growing self-efficacy will, in turn, influence student academic and career success. Please see Figure 1 on page 12.

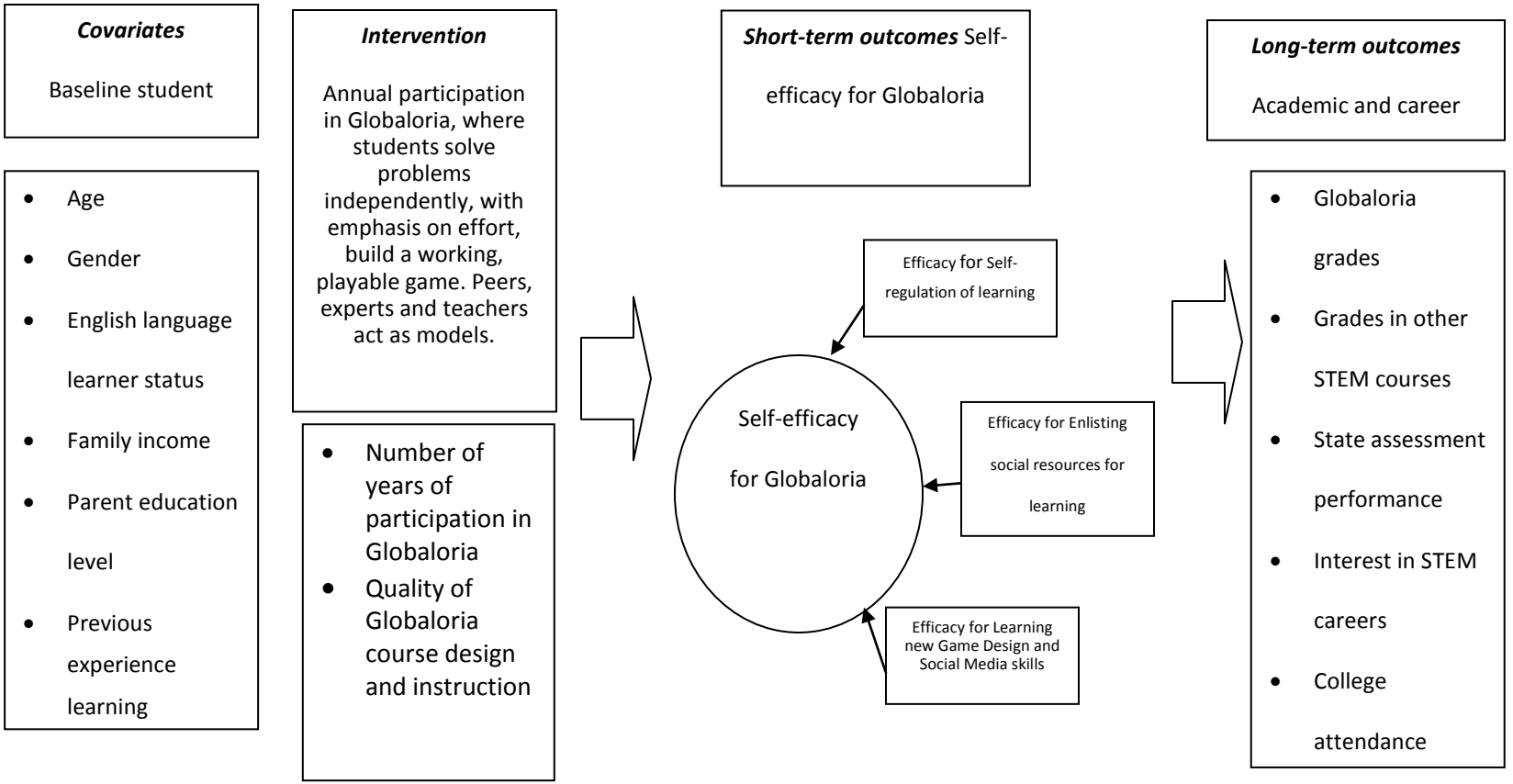
A series of papers are planned to explore the various associations between student demographic and personal factors, the extent of participation and the quality of implementation of the Globaloria course, self-efficacy for learning new game design and social media skills, the short- and long-term educational outcomes, and career outcomes for EAPrep students. The present paper will begin this work by determining the consistency and outcomes of the *Self-efficacy for Globaloria* survey that was developed for use specifically in Globaloria classrooms (Minnigerode, 2010).

The 11-item survey used in the current study considers self-efficacy to be a latent construct with three components that are expected to change in response to participation in the Globaloria course. The content and design of the course is hypothesized to increase students' proficiency in independent and self-guided learning (efficacy for self-regulation of learning), increase their ability to collaborate with other students and adult facilitators (efficacy for enlisting social resources for learning), and increase their game design and social media skills (efficacy for learning new game design and social media skills).

To determine the validity of the survey instrument, we began by examining (a) descriptive statistics for each item and the total score; (b) change in student ratings over the course of the school year for all students and for grade level, gender and, ELL groups; and (c) the internal consistency of the scale

itself. This paper describes the findings and includes recommendations for improving the survey instrument in the discussion.

Figure 1. Conceptual Model of the Impact of Self-efficacy for Globaloria



Methods

Sample

All students in the sample are students at the charter middle school. They are informed of the research, and take part in the study voluntarily. All students are given the option to not take the survey if they wish. Both parent consent and student assent are obtained, using a form that has been IRB approved. The total number of students in the sample was 189, including 95 6th graders and 92 7th graders. While most of the 7th grade students were in their second year of Globaloria participation, there were some students (n = 9) who joined the school for 7th grade after attending another school for 6th grade. Overall, the sample had 50% male students and 50% female students; the majority of students were non-white, and a large proportion of students qualified for free and reduced lunch (92%). A significant proportion (39%) of students were considered English language learners (ELLs) during the 2010-2011 school year (Table 1).

Table 1. Demographic characteristics of Globaloria participants, 2010-2011

	6th Graders (n = 97)		7th Graders (n = 92)		Full sample (n = 189)	
	N	Percent	N	Percent	N	Percent
Male	44	45%	51	56%	95	50%
Female	53	55%	41	44%	94	50%
Ethnicity						
African American	11	11%	13	14%	24	13%
Hispanic	73	75%	75	82%	148	78%
White	5	5%	0	0%	5	3%
Other or not known	6	8%	4	4%	10	6%
English language learners (ELL)	41	42%	33	36%	74	39%
Qualified for free and reduced price lunch	88	91%	85	92%	173	92%

Instrument

The items used in this survey were derived, in part, from the *Children's Self-efficacy Scale* included in Bandura's *Guide for Constructing Self-efficacy Scales* (2006) and were based on Bandura's work with adolescents (2001). Items 1, 2, 3, and 8 were modified slightly from Bandura's items that were designed to measure *self-regulation for learning*. Items 5, 6, and 7 were modified slightly from Bandura's items that were designed to measure students' self-efficacy for

enlisting social resources. Items 4, 9, 10, and 11 were written specifically for this study, and are designed to measure students' ability to persist in the face of difficulty when *learning new engineering skills* including: editing a wiki, communicating effectively in a blog, programming in Actionscript, and using the internet to search for help. The survey also included 3 open-ended questions: (a) What career are you pursuing?, (b) What ideas do you have for a game you'd like to make? (c) What would you like to share with your teacher about what would improve learning in your classroom? These data are being used in other contexts, but the results will not be discussed here.

Over the year-long study, some changes were made to the instrument in response to student confusion and feedback. Table A-1 shows the final version of the survey and Table A-2 shows a crosswalk between the original and final items. The 3 open-ended questions remained constant across survey administrations.

Data collection

In 2010-2011, the survey was administered to a cohort of 6th graders (n = 95), who were new to EAPrep and to Globaloria, and to a cohort of 7th graders (n = 94) most of who had attended EAPrep as 6th graders and had already completed one full year of the Globaloria course. The survey was administered electronically 4 times during the school year: (1) October, (2) January, (3) early March, and (4) late May.

After participating in an example exercise formulated to give students practice in responding to the instrument, students were asked to enter a number from 1-100 for each of the items that corresponded to their confidence that they could accomplish each task. Students were instructed that scores close to 1 were associated with low confidence and scores close to 100 were associated with complete confidence.

We examined the internal consistency of the instrument at each time point. Because there were strong indications that student grade level, or perhaps prior experience in the course, was associated with student ratings on the survey, we also examined internal consistency separately for each grade level cohort.

When the responses of all students were examined together, there was high internal consistency for the full scale. However, within the 7^{th} grade cohort, the internal consistency was somewhat lower at time 2 ($\alpha = .784$) and time 3 ($\alpha = .686$) than at time 1 ($\alpha = .917$) or time 4($\alpha = .888$). The lower level of internal consistency among 7^{th} graders likely was the result of several low item-scale correlations within time points 2 and 3. However, there was no clear pattern that particular items were consistently poorly correlated with the entire scale, so there is no reason to recommend that any items should be removed from the instrument. See Tables 3 and 4 for Descriptive Statistics from the survey.

Results

We found significant differences between average student ratings at time 1 and time 3, $t(345)$ 2.45, $p < .05$ and between time 1 and time 4, $t(330) = 2.32$, $p < .05$. This shows that on average, 6th and 7th grade students showed modest increases in self-efficacy for learning engineering from the beginning of the year to end of the year. All other time point comparisons were non-significant, including the difference between scores at time 3 and time 4.

Table 2: Results of the Self-Efficacy for Globaloria Survey

	Time 1	Time 2	Time 3	Time 4
Average scores for all students	77.6	80.6	82.6	82.0

Item Descriptive Statistics

Descriptive statistics for each item and for the total score on the *Self-efficacy for Learning Engineering* survey are included in Tables 3 and 4 below.

Table 3. Descriptive statistics from the Self-efficacy for Globaloria survey, items 1-6

Item number	How confident are you that you can…	Time point	N	Min	Max	Mean	SD	Skewness	Kurtosis
Item 1	finish assignments on time?	1	165	6	100	76.7	23.0	-0.95	0.23
		2	149	10	100	80.3	21.9	-1.08	0.16
		3	173	5	100	83.1	21.9	-1.75	2.73
		4	167	1	100	82.2	21.3	-1.82	3.63
Item 2	always concentrate on school subjects during class?	1	165	10	100	79.9	21.7	-1.33	1.16
		2	147	23	100	84.8	17.3	-1.43	1.65
		3	174	5	100	85.0	19.9	-1.96	4.12
		4	166	1	100	82.9	19.9	-1.88	4.17
Item 3	remember information presented in class?	1	165	0	100	71.3	27.5	-0.92	-0.13
		2	149	6	100	78.6	21.5	-1.09	0.56
		3	174	5	100	79.1	24.7	-1.40	1.16
		4	167	0	100	79.9	20.8	-1.54	2.50
Item 4	can figure out new things about editing the wiki?	1	165	0	100	76.3	26.4	-1.09	0.26
		2	149	1	100	77.6	24.8	-1.24	0.74
		3	174	5	100	79.7	24.2	-1.37	1.27
		4	167	0	100	80.5	23.7	-1.73	2.61
Item 5	get help from another student when you get stuck on something?	1	165	1	100	82.2	26.3	-1.58	1.48
		2	150	0	100	84.4	22.7	-1.79	3.01
		3	174	3	100	84.6	22.5	-1.79	2.69
		4	167	0	100	84.1	22.1	-1.99	3.86
Item 6	get help from a teacher when you get stuck on something?	1	165	0	100	85.6	22.0	-1.80	2.75
		2	150	10	100	87.3	21.6	-2.05	3.67
		3	174	1	100	90.4	24.0	-2.06	3.52
		4	167	0	100	85.0	22.9	-1.89	3.15

Note. These items measure the three components of self-efficacy for Globaloria as follows: 1, 2, and 3 measure efficacy for self-regulation for learning, item 4 measures efficacy for learning new game design and social media skills, and items 5 and 6 measure efficacy for enlisting social resources for learning.

Table 4. Descriptive statistics from the Self-efficacy for Globaloria survey, items 7-11

Item number	How confident are you that you can…	Time point	N	Min	Max	Mean	SD	Skewness	Kurtosis
Item 7	help other students who are stuck on something in Globaloria?	1	165	1	100	78.6	26.7	-1.32	0.83
		2	149	1	100	80.8	24.4	-1.50	1.62
		3	174	5	100	80.9	24.9	-1.65	1.89
		4	167	0	100	80.7	22.9	-1.69	2.71
Item 8	participate in class discussions in Globaloria class?	1	165	0	100	80.5	25.3	-1.47	1.36
		2	150	1	100	80.6	23.8	-1.41	1.45
		3	174	5	100	82.7	24.5	-1.77	2.43
		4	167	0	100	81.6	22.8	-1.52	1.83
Item 9	put your thoughts and ideas into words that are easy for people to understand on your blog?	1	165	0	100	76.5	28.6	-1.15	0.10
		2	150	10	100	82.2	21.6	-1.58	2.04
		3	174	4	100	82.1	23.3	-1.56	1.96
		4	167	1	100	83.1	20.1	-1.78	3.68
Item 10	figure out what to do when you are stuck on something doing Flash in Globaloria?	1	165	0	100	68.4	30.1	-0.78	-0.54
		2	150	0	100	75.4	24.6	-0.98	0.13
		3	174	1	100	79.8	23.6	-1.60	2.20
		4	167	0	100	79.9	24.2	-1.66	2.29
Item 11	search on the internet to find help when you get stuck on something in Globaloria	1	165	0	100	77.7	27.3	-1.25	0.61
		2	150	0	100	75.4	25.8	-1.04	0.44
		3	174	0	100	82.7	23.7	-1.74	2.55
		4	167	1	100	82.3	24.3	-1.75	2.38
	Total score	1	165	20	100	77.6	18.3	-0.95	0.23
		2	164	32	100	80.6	14.5	-0.96	0.42
		3	182	5	100	82.6	18.3	-0.76	7.85
		4	167	7	100	82.0	16.3	-1.90	5.02

Group differences in self-efficacy – grade level and gender

Because 6th grade students were in their first year of the Globaloria course and the majority of 7th grade students were in their second year of the program, and because there also may have been differences in the way boys and girls rated their self-efficacy, we examined item level and total score mean differences across grade level, gender, and grade level-gender groups. Table 5 summarizes the significant grade level differences found.

At time 1, 6th graders had higher total scores than 7th graders, $F(1, 163) = 3.98$, $p < .05$; however, total scores were not significantly different between the grade level groups at any other time point. These results show a tendency toward overconfidence among 6th graders at the beginning of the year, supported by literature.

There were two significant gender differences at the item level. At time 2, girls gave higher ratings to their ability to figure out what to do when they are having problems in Flash $F(1, 149) = 4.71$, $p < .05$. At time 3, boys gave higher ratings than girls to their ability to get help from the teacher $F(1, 172) = 6.71$, $p < .05$. There were no significant gender differences on total self-efficacy ratings.

There was only one significant difference between grade level-gender groups at the item level within time point. At time 1, 6th grade rated their ability to help other students significantly lower than 7th grade boys, $F(3, 161) = 2.73$, $p < .05$. There were no significant differences across the four gender-grade level groups on total self-efficacy scores across the year.

Because the most consistent patterns were the tendency toward overconfidence among 6th graders at the beginning of the year and that, on average, total scores increase from the beginning of the year to the second semester, we proceeded with examining change in item level and total self-efficacy ratings from the time 1 to time 4.

Table 5: Summary of Significant Grade-level Differences

Significant Grade-level Differences	6th grade	7th grade	*Significance*
Confident that I can get help from teacher	89.1(T 1, Item mean)	81.8(T1, Item mean)	$F(1, 163) = 4.64$, $p < .05$;
Confident that I can help other students	83.6(Time 1)	73.1(Time 1)	$F(1, 163) = 6.53$, $p < .05$;
Confident that I can figure things out when stuck in Flash	72.8(Time 1)	63.5(Time 1)	$F(1, 163) = 4.06$, $p < .05$
Confident that I can concentrate in class	79.7(Time 4)	86.3(Time 4)	$F(1, 163) = 4.64$, $p < .05$
Confident that I can participate in class discussions	78.3(Time 4)	85.3(Time 4)	$F(1, 165) = 3.91$, $p < .05$

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Number of years of Globaloria experience, or experience level, and gender within experience level are associated with change in self-efficacy ratings from time 1 to time 4. As noted in the previous section, there was a trend for 6th grade students to rate their self-efficacy more highly than 7th grade students at the beginning of the year; there also were two significant item-level gender differences.

Students with two years of Globaloria experience showed average gains of more than 10 points on two items about efficacy for self-regulation of learning within the Globaloria classroom, i.e., confidence in that they could finish assignments on time and remembering information presented in class. They also rated two items regarding academic efficacy in game design and social media more than 10 points higher at the end of the year than at the beginning. These items were:

- **Confidence in their ability to figure out new things about editing the wiki.**
- **Confidence in their ability to figure what to do when stuck in Flash Actionscript programming.**

As shown in Table 6 below, students with two years of Globaloria experience (7th graders) showed much more change from time 1 to time 4 on 6 of the 11 self-efficacy items and the total score than did 6th grade students. This is further indication that as 6th grade students become more familiar with the challenges the course offers, their sense of self-efficacy may stay the same or even decline. Of the three subscales on the survey, the most consistent declines

were on the efficacy for enlisting social resources' items. From time 1 to time 4, 6th grade students showed declines in their confidence ratings about getting help from other students, getting help from their teacher, and helping other students.

Table 6. Self-efficacy for Globaloria Rating Change

	Average self-efficacy rating change from Time 1 to Time 4		
How confident are you that you can…	**6th graders (n = 82)**	**7th graders (n = 71)**	**F-test**
finish assignments on time	1.8[a]	11.1[b]	$F(1,151) = 5.74$, $p < .01$
always concentrate on school subjects during class	-1.9[a]	7.0[b]	$F(1,150) = 5.15$, $p < .05$
remember information presented in class	6.9	11.0	$F(1,151) = 0.90$, *ns*
can figure out new things about editing the wiki	-0.8[a]	10.1[b]	$F(1,151) = 5.62$, $p < .05$
get help from another student when you get stuck on something	-2.8	5.9	$F(1,151) = 3.20$, *ns*
get help from a teacher when you get stuck on something	-7.0[a]	5.7[b]	$F(1,152) = 7.73$, $p < .01$
help other students who are stuck on something	-4.8[a]	8.6[b]	$F(1,151) = 8.31$, $p < .01$
can participate in class discussions	-4.0[a]	6.9[b]	$F(1,151) = 6.25$, $p < .05$
can put your thoughts and ideas into words that are easy for people to understand on your blog	3.5	+9.0	$F(1,151) = 1.33$, *ns*
figure out what to do when you get stuck on something doing Flash	6.5	16.3	$F(1,151) = 3.24$, *ns*
search on the Internet to find help when you get stuck on something	1.9	8.3	$F(1,151) = 1.49$, *ns*
Total score	**-0.1**[a]	**9.1**[b]	$F(1,151) = 10.24$, $p < .01$

Note. Superscripts indicate significant mean differences between 6th and 7th grade students.

These results show that the self-efficacy for Globaloria survey measures the changes in confidence that students experience after participating in Globaloria for at least a year, encountering some genuine challenges, and rising to meet those challenges.

Table 7. Average change on the Self-efficacy from Time 1 to Time 4, by grade level and gender

	Average self-efficacy rating change from Time 1 to Time 4				
How confident are you that you can…	**6th grade boys (n = 53)**	**6th grade girls (n = 44)**	**7th grade boys (n = 41)**	**7th grade girls (n = 52)**	**F-test**
finish assignments on time	-2.8	5.5	11.4	10.8	$F(3,149) = 2.73$, $p < .05$
always concentrate on school subjects during class	-6.2	1.5	6.0	8.2	$F(3,148) = 2.45$, *ns*
remember information presented in class	5.4	8.1	13.1	8.3	$F(3,149) = 0.55$, *ns*
can figure out new things about editing the wiki	-5.5	3.0	8.7	12.0	$F(3,149) = 2.56$, *ns*
get help from another student when you get stuck on something	-2.0	-3.5	2.4	10.6	$F(3,149) = 1.50$, *ns*
get help from a teacher when you get stuck on something	-6.0[a]	-7.8	0.3 [a]	12.6[b]	$F(3,149) = 3.76$, $p < .05$
help other students who are stuck on something	-3.9	-5.5	8.7	8.5	$F(3,149) = 2.76$, $p < .05$
can participate in class discussions	-4.0	-3.9	6.2	7.8	$F(3,149) = 2.08$, *ns*
can put your thoughts and ideas into words that are easy for people to understand on your blog	6.8	0.8	7.5	11.0	$F(3,149) = 0.81$, *ns*
figure out what to do when you get stuck on something doing Flash	3.5	8.9	13.6	19.8	$F(3,149) = 1.45$, *ns*
search on the Internet to find help when you get stuck on something	5.1	-0.8	7.9	8.9	$F(3,149) = 0.54$, *ns*
Overall	**-1.0** [a]	**0.6**	**7.8**	**10.8**[b]	$F(3,149) = 3.60$, $p < .05$

Note. Superscripts indicate significant mean differences between grade level-gender groups.

There also were four significant group differences across gender-grade level groups (Table 7); however, there were only two significant post hoc tests, likely

due to the small number of students in each of the grade level-gender groups. Significant item level differences included: 7th grade girls had significantly higher gains from the time 1 to time 4 in their confidence that they could get help from a teacher when they get stuck on something than did 6th or 7th grade boys. Girls in 7th grade also had bigger gains on the total score than did 6th grade boys. These results indicate that girls were somewhat inclined to have lower ratings at the beginning of the year and that they showed bigger gains from time 1 to time 4 than other groups.

Table 7: Significant Gender Differences

	Male	Female	*Significance*
Confident that I can figure things out when stuck in Flash	(Time 2)	(Time 2)	$F(1, 149) = 4.71$, $p < .05$
Confident that I can get help from teacher	(Time 3)	(Time 3)	$F(1, 172) = 6.71$, $p < .05$

Because there were significant grade level differences and because limited English proficiency might be expected to influence students' performance and self-efficacy in Globaloria, we also conducted analyses for grade level-English language learner (ELL) groups.

Item Descriptive Statistics –Grade Level and English language learner (ELL) status

Table 8 shows the means for each item and for the total self-efficacy score for non-ELL and ELL students by grade level. ELL students in 7th grade showed the greatest gains and had significantly higher gains than 6th grade non-ELL students on:

Total self-efficacy score

Efficacy for getting help from the teacher

Efficacy for participating in class discussions

There were a few significant differences between the four groups. At time 1, non-ELL 6th grade students gave higher ratings on the item about getting help from the teacher than 7th grade ELL students, $F(3, 161) = 3.70$, $p < .05$.

At time 4, non-ELL 6th grade students had lower average ratings than 7th grade non-ELL students on the self-regulation for learning item regarding their ability to concentrate during class, $F(3, 162) = 3.42$, $p < .05$ and the enlisting social resources item about their ability to get help from other students, $F(3, 163) = 2.68$, $p < .05$

Please see Table 8 for a summary of significant differences between ELL and non-ELL students. In Table 9, average change from Time 1 to Time 4 are compared for ELL and not-ELL students.

Taken together, these patterns indicate that ELL students are quite similar to their grade level peers. As described in the previous section, 6th grade students showed less average growth and occasional declines in their self-

efficacy from time 1 to time 4 than did 7th grade students regardless of their ELL status. Although there were a few significant group differences**,** none of them were between ELL and non-ELL students within grade level. It is important to note that small group sizes may have played a role in the lack of detectible group differences, e.g., there were only 33 ELL students in 7th grade, so differences between ELL and non-ELL students should be explored in future work.

Table 8 Self-efficacy rating changes for ELL vs non-ELL students

	Time 1				Time 2				Time 3				Time 4			
	6th grade		7th grade		6th grade		7th grade		6th grade		7th grade		6th grade		7th grade	
How confident are you that you can…	**Not ELL**	**ELL**	**Not ELL**	**ELL**	**Not ELL**	**ELL**	**Not ELL**	**ELL**	**Not ELL**	**ELL**	**Not ELL**	**ELL**	**Not ELL**	**ELL**	**Not ELL**	**ELL**
finish assignments on time	76.4	81.7	76.9	72.6	84.1	84.5	83.0	75.5	78.3	89.7	84.7	84.2	78.7	84.5	88.9	82.4
always concentrate on school subjects during class	80.4	82.3	80.2	77.1	85.0	90.3	82.6	89.9	82.3	91.2	85.2	82.8	74.9	84.4	88.3	82.3
remember information presented in class	70.0	74.0	72.1	68.9	81.0	79.0	80.5	79.2	74.2	88.0	79.2	79.6	79.0	77.8	84.4	77.9
can figure out new things about editing the wiki	78.4	78.6	76.8	70.6	80.6	71.8	81.0	79.1	75.7	79.9	82.2	83.2	76.0	81.5	85.9	82.3
get help from another student when you get stuck on something	84.0	86.5	83.0	77.2	82.7	78.6	86.0	91.7	82.8	86.0	85.4	88.0	77.5	87.5	88.7	83.4
get help from a teacher when you get stuck on something	90.4	89.6	87.1	75.4	87.6	88.9	88.8	88.3	81.5	86.2	88.3	86.4	80.9	85.8	87.6	89.0
help other students who are stuck on something	83.4	84.4	74.3	73.0	81.1	77.6	81.8	82.9	78.2	81.1	80.3	85.1	79.2	81.0	81.7	83.5
can participate in class discussions	85.2	78.6	81.0	75.2	85.8	77.2	84.1	81.9	81.3	82.5	82.6	85.7	78.5	79.3	85.8	85.3
can put your thoughts and ideas into words that are easy for people to understand on your blog	77.2	80.0	78.3	71.0	84.3	81.8	82.0	75.4	82.8	81.2	82.6	78.6	81.6	82.0	85.5	82.8
figure out what to do when you get stuck on something doing Flash	70.8	74.0	63.8	66.8	80.3	64.5	83.3	72.5	71.0	73.5	68.1	66.2	80.4	78.9	81.4	81.0
search on the Internet to find help when you get stuck on something	76.2	82.8	77.8	72.4	81.6	64.0	80.7	75.5	82.2	77.4	82.4	88.0	79.5	82.5	83.1	85.4
Overall	**79.3**	**81.1**	**77.4**	**72.7**	**83.1**	**78.0**	**83.1**	**81.1**	**79.7**	**83.8**	**83.1**	**84.1**	**78.7**	**82.3**	**85.6**	**83.2**

Table 9: Average Change in Self-efficacy from Time 1 to Time for for ELL and not-ELL students, with Significant Differences

	Average self-efficacy rating change from Time 1 to Time 4				
How confident are you that you can…	**6th grade Not ELL (n = 56)**	**6th grade ELL (n = 41)**	**7th grade Not ELL (n = 60)**	**7th grade ELL (n = 33)**	**F-tests**
finish assignments on time	0.9	2.8	12.0	9.9	$F(3, 149) = 1.97$, *ns*
always concentrate on school subjects during class	5.3	2.1	8.1	5.2	$F(3, 148) = 2.43$, *ns*
remember information presented in class	9.4	3.8	12.3	9.1	$F(3, 149) = .68$, *ns*
can figure out new things about editing the wiki	3.8	2.9	9.0	11.7	$F(3, 149) = 2.29$, *ns*
get help from another student when you get stuck on something	-6.0	1.1	5.8	6.2	$F(3, 149) = 1.43$, *ns*
get help from a teacher when you get stuck on something	-9.5[a]	-3.8	0.5	13.6[b]	$F(3,150) = 4.16$, $p < .01$
help other students who are stuck on something	-6.0	-3.4	7.3	10.5	$F(3, 149) = 1.43$, *ns*
can participate in class discussions	-7.8 [a]	0.8	4.8	10.0[b]	$F(3, 149) = 3.01$, $p < .05$
can put your thoughts and ideas into words that are easy for people to understand on your blog	4.8	2.0	7.2	11.8	$F(3, 149) = 1.43$, *ns*
figure out what to do when you get stuck on something doing Flash	7.8	4.9	17.7	14.2	$F(3, 149) = 1.18$, *ns*
search on the Internet to find help when you get stuck on something	3.7	-0.3	5.3	13.0	$F(3, 149) = .92$, *ns*
Overall	**-1.2[a]**	**1.2**	**8.2**	**10.5[b]**	$F(3, 149) = 3.59$, $p < .05$

Discussion

The present paper began the process of validating the self-efficacy for learning engineering survey by examining (a) the item descriptive statistics for all students and for grade level, gender, and English language learner subgroups and (b) the internal consistency of the scale for all students and grade level subgroups. The major findings for these analyses offer early support for the validity of the measure, show some interesting patterns in student performance, and suggest avenues for future analysis and revision of the instrument.

Moderately high item and total score means

One interesting trend that emerged in the descriptive analyses was that, on average, students gave moderately high self-efficacy ratings at all time points. Because our goal is to develop a measure that accurately measures self-efficacy for learning engineering over the course of individual school years and over the course of secondary school, it is important that the instrument allow students to accurately report a wide range of levels of self-confidence, and that the items accurately reflect the challenges of the curriculum. Also, because the survey must be sensitive to changes in self-efficacy that are the result of succeeding in the face of real engineering challenges in the Globaloria classroom, we recommend the following revisions for consideration, based on Bandura (2006).

First, we recommend ensuring that each item requires students to rate their confidence that they can accomplish each task *in the face of challenging circumstances*, for example, if they are frustrated or have competing school demands. Second, we recommend revising the rating scale from 1 to 100, which is very similar to the school grading scale, to a 1 to 10 scale. The 100 point scale may encourage students to inflate their scores to match "good grades" in school (i.e. As and Bs). Introducing a midpoint anchor of "somewhat confident" also may prevent students from overinflating their scores.

Measuring growth in self-efficacy over time

The 6th grade respondents to the survey appear to be like other novice raters in that they have little to basis to rate their efficacy and therefore may not make accurate assessments (Pajares, 1997). Before engaging in new activities, task-specific self-efficacy beliefs are either lacking or must be inferred from past attainments in situations perceived as similar to the new one. It is possible that the 6th grade students were using prior experiences in educational settings or experiences they have had playing games or using the computer for fun as a basis for their efficacy ratings. However, as they proceeded through the course, students' understanding of the challenges involved in the course led them to assess their efficacy differently. It is possibly due to this lack of experience and its effect on rating ability at the beginning of the study that we saw little detectable growth in self-efficacy from the beginning of the year to the end of the year.

The instrument appears to have been sensitive to growth in self-efficacy among 7th grade students who had previous experience in the course. As presented above, 7th grade students showed significantly greater gains on their total scores and on 6 of the 11 items on the survey in comparison to 6th graders. This offers some confirmation that the mastery experiences within the student-centered Globaloria classroom and self-led learning experiences that students have in the classroom are reflected in growth in student self-efficacy. This finding was further confirmed by the student reflections on blogs and in interviews, where students described a change in the way they think about themselves as learners.

Detecting differences between subgroups

The current version of the instrument detected, some, but not many differences in self-efficacy between boys and girls and between ELL and non-ELL students. Other research has shown that boys are more likely than girls to report high self-efficacy, and that pattern also emerged from these data. There were very few differences between the ratings of ELL and non-ELL students; in fact, these students tended to respond very much like their grade level peers. It may be the case that with larger sample sizes and revised items that reflect bigger challenges, particularly in the areas of oral and written communication, that this measure will become more sensitive to differences between ELLs and non-ELLs.

Other recommendations

These results are an early indication that the survey is a valid measure of the latent construct, self-efficacy for learning engineering; however, validation efforts should continue. Next steps include associating self-efficacy survey scores with performance in the Globaloria course and with game design quality ratings to determine if students with higher confidence in their abilities to learn engineering also have higher levels of engineering achievement. It also will be valuable to conduct confirmatory factor analysis to determine if the instrument measures the hypothesized underlying factors, efficacy for self-regulation of learning, enlisting social resources, and learning new game design and social media skills.

Further research: Social engagement and self-efficacy

Research shows that feedback and encouragement, as forms of social persuasion, support development of students' self-efficacy. For all students, regardless of age, the social media component of the program, and the subsequent opportunities to receive feedback from a wide variety of sources, may be a source of support for self-efficacy for learning engineering. Examples of this include the competition organized by the school and World Wide Workshop (the Globey Awards), other game and digital art contests, virtual feedback from mentors or experts, and showing work to the technologically savvy visitors who frequently come to the Globaloria classrooms to talk with the students and give them feedback.

The Globaloria program in East Austin also provides special activities such as staying late into the evening in the computer lab, special work sessions at lunch, and coming to school on weekends and vacations to work on games. By simulating the experience of working in a technology-related career, these sessions also provide opportunity for mastery experience and development of efficacy.

Classroom observation also indicates that game design programs and the Globaloria curriculum correspond with best practices for supporting the development of self-efficacy. Because coding is an iterative process that involves a lot of failure, it provides an opportunity for students to see a mistake as part of a process, rather than a final verdict. Educators in Globaloria are encouraged, through professional development, to act more as a resource than a judge. In fact, many of the educators are learning simultaneously, alongside the students, sharing the process. Most Globaloria teachers also model effort, rather than ability, as novice engineers themselves. All of these factors may support their ability to communicate personal, rather than normative, standards for student achievement.

In interviews, students, a majority of whom are Hispanic and high levels of Spanish speakers, report a high level of identification with the Globaloria teachers, both of whom are very proficient with design and engineering, young, and dynamic. Both are Latina and fluent in Spanish. These teachers serve as mentors, and as Zeldin and Pajares write, provide 'verbal persuasion and vicarious experiences necessary likely to nourish the self-efficacy beliefs of girls and women as they set out to meet the challenges required to succeed in male-dominated academic domain.' (Zeldin & Pajares, 2000). Further

research will explore and define the role of teachers and other mentors in development of self-efficacy in Globaloria programs.

Conclusion

Students with two years of Globaloria experience showed significantly higher confidence in self-regulation for learning within the Globaloria classroom than those with one year of experience. We also saw significant gender differences in self-efficacy in problem solving in programming, with young women showing strong promise in this area. Self-efficacy scholars (Pajares, 2003) have found that women tend to report much lower efficacy in math and science; further research will attempt to explore specific practices in Globaloria classrooms that may support women in self-efficacy development.

Using a refined instrument, research will continue in the areas above, with a focus on supporting and improving student self-efficacy in engineering and design.

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Appendix A. The Self-efficacy for Learning Engineering Instrument

Table A-1. Components and item text of the Self-efficacy for Learning Engineering Instrument

		Instructions
Component of self-efficacy for learning engineering	**Item number**	**For each of the following questions, we are going to use a scale of 1-100. Numbers close to 1 are connected with a low confidence and numbers close to one hundred are connected with complete confidence. Numbers around 50 are connected with a medium level of confidence. (Please choose a number from 1-100)**
Self-regulation of learning	Item 1	How confident are you that you can finish assignments on time in Globaloria?
Self-regulation of learning	Item 2	How confident are you that you can always concentrate on school subjects during Globaloria class?
Self-regulation of learning	Item 3	How confident are you that you can remember information presented in Globaloria class?
Learning new engineering skills	Item 4	How confident are you that you can figure out new things about editing the wiki?
Enlisting social resources for learning	Item 5	How confident are you that you can get help from another student when you get stuck on something in Globaloria?
Enlisting social resources for learning	Item 6	How confident are you that you can get help from a teacher when you get stuck on something in Globaloria?
Enlisting social resources for learning	Item 7	How confident are you that you can help other students who are stuck on something in Globaloria?
Self-regulation of learning	Item 8	How confident are you that you can participate in class discussions in Globaloria?
Learning new engineering skills	Item 9	How confident are you that you can put your thoughts and ideas into words that are easy for people to understand on your blog?
Learning new engineering skills	Item 10	How confident are you that you can figure out what to do when you get stuck on something doing Flash?
Learning new	Item 11	How confident are you that you can search on the Internet

engineering skills to find help when you get stuck on something?

Note. The instrument was designed to measure three components of self-efficacy for learning engineering: self-regulation of learning, enlisting social resources for learning, and learning new engineering skills.

Table A-2. Changes to the Self-efficacy for Learning Engineering Survey Instrument during the 2010-2011 school year

Original items	**Final items**
Used at time points 1 and 2	*Used at time points 3 and 4*
Item 5. How confident are you that you can get another student to help you when you get stuck on something in Globaloria?	Item 5. How confident are you that you can get help from another student when you get stuck on something in Globaloria?
Item 6. How confident are you that you can get a teacher to help you when you get stuck on something in Globaloria?	Item 6. How confident are you that you can get help from a teacher when you get stuck on something in Globaloria?
Item 9. How confident are you that you can share your thoughts clearly on a blog?	Item 9. How confident are you that you can put your thoughts and ideas into words that are easy for people to understand on your blog?
Original open-ended item	**Final open-ended items**
What ideas do you have about future careers or study for yourself	What ideas do you have about what you want to study in college? Do you know what career you would like?

Table A-3. Results of an internal consistency analysis of the Self-efficacy for Learning Engineering, 6th grade cohort

		Time 1 (n = 86)		Time 2 (n = 70)		Time 3 (n = 85)		Time 4 (n = 87)	
	Cronbach's alpha for the full scale	.868		.868		.892		.924	
	How confident are you that you can…	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted
Item 1	finish assignments on time	.672	.851	.603	.855	.481	.890	.769	.914
Item 2	always concentrate on school subjects during class	.604	.855	.373	.868	.370	.895	.653	.919
Item 3	remember information presented in class	.731	.844	.419	.867	.527	.888	.759	.915
Item 4	can figure out new things about editing the wiki	.577	.856	.492	.863	.494	.890	.777	.914
Item 5	get help from another student when you get stuck on something	.309	.875	.607	.854	.669	.879	.663	.919
Item 6	get help from a teacher when you get stuck on something	.442	.865	.574	.856	.717	.876	.506	.927
Item 7	help other students who are stuck on something	.487	.862	.718	.845	.765	.873	.725	.916
Item 8	can participate in class discussions	.532	.860	.790	.841	.740	.875	.782	.913
Item 9	can put your thoughts and ideas into words that are easy for people to understand on your blog	.595	.855	.450	.864	.600	.884	.769	.914
Item 10	figure out what to do when you get stuck on something doing Flash	.646	.851	.694	.847	.757	.874	.724	.916
Item 11	search on the Internet to find help when you get stuck on something	.674	.849	.533	.860	.625	.882	.557	.924

Table A-4: Internal Consistency Statistics for all items

		Time 1 (n = 79)		Time 2 (n = 62)		Time 3 (n = 80)		Time 4 (n = 79)	
	Cronbach's alpha for the full scale	.917		.784		.686		.888	
	How confident are you that you can…	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted
Item 1	finish assignments on time	.739	.907	.427	.769	.382	.669	.559	.881
Item 2	always concentrate on school subjects during class	.575	.914	.442	.768	.404	.667	.644	.877
Item 3	remember information presented in class	.649	.911	.476	.763	.560	.645	.679	.874
Item 4	can figure out new things about editing the wiki	.715	.907	.480	.763	.507	.653	.624	.877
Item 5	get help from another student when you get stuck on something	.589	.913	.365	.775	.480	.658	.536	.882
Item 6	get help from a teacher when you get stuck on something	.629	.911	.436	.768	.250	.878	.579	.880
Item 7	help other students who are stuck on something	.793	.903	.334	.779	.601	.643	.683	.873
Item 8	can participate in class discussions	.685	.909	.542	.756	.586	.641	.626	.877
Item 9	can put your thoughts and ideas into words that are easy for people to understand on your blog	.702	.908	.313	.782	.473	.656	.682	.875
Item 10	figure out what to do when you get stuck on something doing Flash	.741	.906	.642	.740	.683	.639	.631	.877
Item 11	search on the Internet to find help when you get stuck on something	.620	.912	.400	.772	.561	.650	.513	.887

Table A-5. Item means from the Self-efficacy for Globaloria survey by grade level and gender

	Time 1				Time 2				Time 3				Time 4			
	6th grade		7th grade		6th grade		7th grade		6th grade		7th grade		6th grade		7th grade	
How confident are you that you can…	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
finish assignments on time	75.5	82.8	74.4	73.4	82.0	84.2	77.0	76.6	80.8	83.8	82.8	83.9	80.4	80.2	87.9	82.0
always concentrate on school subjects during class	77.7	85.6	76.0	79.2	84.5	87.5	84.4	82.9	82.9	87.4	84.8	85.2	79.2	80.3	85.8	86.7
remember information presented in class	70.6	73.2	70.9	69.8	76.0	81.6	78.0	78.4	76.2	83.9	76.9	78.7	78.1	79.4	82.1	80.9
can figure out new things about editing the wiki	75.3	82.4	72.8	74.6	71.1	84.6	82.0	74.6	77.8	77.7	83.9	79.4	78.1	77.6	87.4	80.6
get help from another student when you get stuck on something	84.0	86.4	76.9	82.8	84.4	76.1	90.9	85.3	81.6	87.8	84.4	86.2	84.5	81.6	89.2	85.3
get help from a teacher when you get stuck on something	90.0	90.1	78.4	84.2	89.3	87.2	85.2	86.5	80.7	88.1	79.9	91.1	81.8	82.1	91.7	86.0
help other students who are stuck on something	86.3	80.9	74.9	71.5	78.8	79.6	80.4	83.0	75.4	84.3	79.6	83.6	81.0	77.9	85.7	79.3
can participate in class discussions	86.5	77.0	75.4	79.9	78.9	80.8	82.0	79.6	80.4	85.5	81.1	84.1	81.9	73.8	84.7	85.6
can put your thoughts and ideas into words that are easy for people to understand on your blog	83.5	72.3	72.7	75.8	82.1	82.7	82.4	80.1	79.3	85.7	80.6	83.0	84.0	79.7	84.8	84.0
figure out what to do when you get stuck on something doing Flash	71.4	73.3	61.5	65.0	78.2	69.5	81.6	71.5	74.5	81.8	80.1	82.3	79.1	77.0	83.8	80.6
search on the Internet to find help when you get stuck on something	77.0	81.8	74.9	75.7	77.2	68.4	78.0	76.5	77.8	84.1	80.5	88.0	74.9	87.3	84.8	84.0
Overall Average	79.8	80.5	73.5	75.6	80.3	80.6	82.0	78.9	79.1	83.6	81.3	84.2	79.8	79.9	86.2	83.2

Table A-6 Descriptive Statistics for each item:

Item number	How confident are you that you can…	Time point	N	Min	Max	Mean	SD	Skewness	Kurtosis
Item 1	finish assignments on time?	1	165	6	100	76.7	23.0	-0.95	0.23
		2	149	10	100	80.3	21.9	-1.08	0.16
		3	173	5	100	83.1	21.9	-1.75	2.73
		4	167	1	100	82.2	21.3	-1.82	3.63
Item 2	always concentrate on school subjects during class?	1	165	10	100	79.9	21.7	-1.33	1.16
		2	147	23	100	84.8	17.3	-1.43	1.65
		3	174	5	100	85.0	19.9	-1.96	4.12
		4	166	1	100	82.9	19.9	-1.88	4.17
Item 3	remember information presented in class?	1	165	0	100	71.3	27.5	-0.92	-0.13
		2	149	6	100	78.6	21.5	-1.09	0.56
		3	174	5	100	79.1	24.7	-1.40	1.16
		4	167	0	100	79.9	20.8	-1.54	2.50
Item 4	can figure out new things about editing the wiki?	1	165	0	100	76.3	26.4	-1.09	0.26
		2	149	1	100	77.6	24.8	-1.24	0.74
		3	174	5	100	79.7	24.2	-1.37	1.27
		4	167	0	100	80.5	23.7	-1.73	2.61
Item 5	get help from another student when you get stuck on something?	1	165	1	100	82.2	26.3	-1.58	1.48
		2	150	0	100	84.4	22.7	-1.79	3.01
		3	174	3	100	84.6	22.5	-1.79	2.69
		4	167	0	100	84.1	22.1	-1.99	3.86
Item 6	get help from a teacher when you get stuck on something?	1	165	0	100	85.6	22.0	-1.80	2.75
		2	150	10	100	87.3	21.6	-2.05	3.67
		3	174	1	100	90.4	24.0	-2.06	3.52
		4	167	0	100	85.0	22.9	-1.89	3.15

Item number	How confident are you that you can…	Time point	N	Min	Max	Mean	SD	Skewness	Kurtosis
Item 7	help other students who are stuck on something in Globaloria?	1	165	1	100	78.6	26.7	-1.32	0.83
		2	149	1	100	80.8	24.4	-1.50	1.62
		3	174	5	100	80.9	24.9	-1.65	1.89
		4	167	0	100	80.7	22.9	-1.69	2.71
Item 8	participate in class discussions in Globaloria class?	1	165	0	100	80.5	25.3	-1.47	1.36
		2	150	1	100	80.6	23.8	-1.41	1.45
		3	174	5	100	82.7	24.5	-1.77	2.43
		4	167	0	100	81.6	22.8	-1.52	1.83
Item 9	put your thoughts and ideas into words that are easy for people to understand on your blog?	1	165	0	100	76.5	28.6	-1.15	0.10
		2	150	10	100	82.2	21.6	-1.58	2.04
		3	174	4	100	82.1	23.3	-1.56	1.96
		4	167	1	100	83.1	20.1	-1.78	3.68
Item 10	figure out what to do when you are stuck on something doing Flash in Globaloria?	1	165	0	100	68.4	30.1	-0.78	-0.54
		2	150	0	100	75.4	24.6	-0.98	0.13
		3	174	1	100	79.8	23.6	-1.60	2.20
		4	167	0	100	79.9	24.2	-1.66	2.29
Item 11	search on the internet to find help when you get stuck on something in Globaloria	1	165	0	100	77.7	27.3	-1.25	0.61
		2	150	0	100	75.4	25.8	-1.04	0.44
		3	174	0	100	82.7	23.7	-1.74	2.55
		4	167	1	100	82.3	24.3	-1.75	2.38
	Total score	1	165	20	100	77.6	18.3	-0.95	0.23
		2	164	32	100	80.6	14.5	-0.96	0.42
		3	182	5	100	82.6	18.3	-0.76	7.85
		4	167	7	100	82.0	16.3	-1.90	5.02

Table A-7. Results of an internal consistency analysis of the Self-efficacy for Globaloria, all students

		Time 1 (n = 165)		Time 2 (n = 150)		Time 3 (n = 174)		Time 4 (n = 167)	
	Cronbach's alpha for the full scale	.898		.843		.891		.913	
	How confident are you that you can…	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted
Item 1	finish assignments on time	.712	.885	.616	.831	.597	.889	.766	.903
Item 2	always concentrate on school subjects during class	.591	.892	.545	.836	.534	.892	.718	.906
Item 3	remember information presented in class	.679	.886	.602	.833	.689	.883	.765	.903
Item 4	can figure out new things about editing the wiki	.654	.888	.580	.835	.654	.885	.792	.901
Item 5	get help from another student when you get stuck on something	.463	.899	.623	.829	.699	.881	.688	.907
Item 6	get help from a teacher when you get stuck on something	.558	.893	.626	.830	.731	.879	.624	.912
Item 7	help other students who are stuck on something	.673	.887	.662	.827	.799	.873	.767	.903
Item 8	can participate in class discussions	.623	.890	.782	.815	.782	.875	.800	.901
Item 9	can put your thoughts and ideas into words that are easy for people to understand on your blog	.651	.888	.514	.839	.666	.883	.774	.902
Item 10	figure out what to do when you get stuck on something doing Flash	.705	.885	.729	.818	.812	.872	.760	.904
Item 11	search on the Internet to find help when you get stuck on something	.644	.889	.638	.830	.714	.880	.619	.913