

Affordable Learning Georgia Textbook Transformation Grants

Final Report

Date: May 18, 2015

Grant Number: 27

Institution Name: Georgia Institute of Technology

Team Members (Name, Title, Department, Institutions if different, and email address for each):

- Young Mi (Christina) Choi, Ph.D., Assistant Professor, School of Industrial Design, christina.choi@gatech.edu
- Cathy Carpenter, Head of Architecture Library, College of Architecture, cathy.carpenter@library.gatech.edu

Project Lead: Young Mi (Christina) Choi, Ph.D.

Course Name and Course Number: ID 2320: Human Factors in Design

Semester Project Began: Fall 2014

Semester of Implementation: Spring 2015

Average Number of Students Per Course Section: 50

Number of Course Sections Affected by Implementation: 1

Total Number of Students Affected by Implementation: 68

1. List of Resources Used in the Textbook Transformation

The open course material that was considered/used is hosted at:

<http://libguides.gatech.edu/ID-2320>

This will be updated as further materials are reviewed and integrated into the course in future semesters. One of the issues with the references linked on the site are that they only cover individual aspects of a topic (or at an inappropriate level of depth) for a class that touches on many different topics.

It was difficult to find completely free resources that gave adequate introductory coverage of many of the topics. The resources ultimately used were a mix of completely free (with links provided), resources that were free to GT students through the library, and a few non-free resources (where one chapter or less than 10% of the book was used).

- 1) The History of Human Factors and Ergonomics. David Meister (available in EBSCO ebooks from GT library)

Book section used:

Ch 4: The Formal History of HFE

- 2) Trochim, William M. The Research Methods Knowledge Base, 2nd Edition. Internet WWW page, at URL: <<http://www.socialresearchmethods.net/kb/>>

<http://www.socialresearchmethods.net/kb/strucres.php>
<http://www.socialresearchmethods.net/kb/desintro.php>
<http://www.socialresearchmethods.net/kb/resques.php>
<http://www.socialresearchmethods.net/kb/destypes.php>
<http://www.socialresearchmethods.net/kb/hypothes.php>
<http://www.socialresearchmethods.net/kb/dedind.php>
<http://www.socialresearchmethods.net/kb/statdesc.php>
<http://www.socialresearchmethods.net/kb/statinf.php>
<http://www.socialresearchmethods.net/kb/measlevl.php>

- 3) Human Factors in System Design, Development and Testing. David Meister. (available in EBSCO ebooks from GT library)

Book section used:

Ch 3: Design Methods

- 4) Psychology as a Biological Science.
<http://nobaproject.com/textbooks/psychology-as-a-biological-science>

Book sections used:

Section 3: Vision

Section 3: Hearing

Section 3: Touch and Pain

Section 3: The Vestibular System

Section 5: Judgment and Decision Making

- 5) Handbook of Human Factors and Ergonomics. Gavriel Salvendy. (available in ProQuest ebrary from GT library)

Book sections used:

Ch 24: Illumination

Ch 25: Occupational Health and Safety Management

Ch 38: Accident and Incident Investigation

Ch 59: Automation

6) Introduction to Ergonomics. R.S. Bridger.

Book section used:

Ch 13: Displays, controls and virtual environments

7) The Rules of Work: A Practical Engineering Guide to Ergonomics. Dan MacLeod.
(available in ProQuest ebrary from GT library)

Sections used:

Part I: The Rules

Review the principles in sections 1-10

Part II: Measurements and Guidelines

14. Anthropometry

15. Exertion and Biomechanics

16. Posture

17. Motions

18. Miscellaneous

19. NIOSH Lifting Guide

19. Pushing, Pulling and Carrying Guides

8) Engineering Psychology and Human Performance. Christopher Wickens and Justin Hollands.

Book sections used:

Ch 11 (last half): Attention, Time-Sharing and Workload

Ch 12: Stress and Human Error

9) The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications. Ed: Andrew Sears and Julie A. Jacko.
(available in ProQuest ebrary from GT library)

Book sections used:

Ch 5: Cognitive Architecture

Ch 17: Visual Design Principles for Usable Interfaces

10) Human-computer Interaction. Alan Dix, Janet Finlay, Gregory D Abowd and Russell Beale.

Book section used:

Ch 7: Design Rules

2. Narrative

The overall impact of this project has been positive. From student comments, most appreciated the cost saving and seemed to take advantage of the flexibility of the electronic materials. The biggest drawback to delivering the materials this way is that some students don't really like consuming them this way. Several commented about eye strain and fatigue from reading (especially longer materials) from computer screens/tablets/phones.

The key metrics viewed were the performance on exams, final course averages and student responses on end of semester Course Instructor Opinion Survey (CIOS). The course has been offered following the same curriculum 3 times in the past (Spring 2011, Spring 2014 and Fall 2014). The material covered for Spring 2015 was the same but the textbook was replaced with materials free to GT students. The midterm and final course grades were largely the same. There was a drop in the final exam grade this semester though. As the lectures and exams were the same as in previous classes, this may indicate that some of the materials covering the latter half of the semester need some updates. The CIOS scores related to the survey questions:

- How prepared were you to take the subject
- How much did you learn
- Overall effectiveness of the course

were examined. The scores were nearly identical to the previous semester and much improved from Spring 2014. This improvement was encouraging. The Spring semester offering of the class has tended to be much larger than the Fall offering and student opinion scores in the larger classes tend to be lower than with smaller classes. Despite the final drop in final exam scores, students' feeling about the class is that they are learning more and feel the class is more effective. These results indicate that with continued improvement the course can continue to improve, both in student performance as well as effectiveness of the course from students' perspective.

Some of the student comments highlighted some interesting trends. Many students do not seem to read textbooks if they have to buy them for a class. Several comments indicated disappointment with other courses where a textbook just didn't seem to be needed. Still there were some comments that indicated that even with the free materials, many students didn't read the free materials either. Instead they relied only on notes taken during lectures or activities. In the future I anticipate integrating the materials more closely into the course, such as introducing quizzes based on them, to encourage closer reading.

Another interesting set of comments were that some students felt like the free materials from different sources gave them more 'perspective' than they would get from a textbook. This was curious since the lectures and topics covered were not changed between the class

that used a textbook and the one that did not. This opinion seemed to encourage some students to explore different topics more than they might with a textbook (even if it was a very well referenced textbook). Keeping in mind that a lot of students may not be reading the materials anyway, I don't know how much additional exploring of topics actually happened. The fact that students seemed more motivated or open to seeking different resources is encouraging, especially for a topic like Human Factors where the ability to research, locate and use many different resources is important.

Finally, related to the course development, the most difficult aspect was identifying free materials that would give good introductory coverage to a multidisciplinary topic like Human Factors. If I were to do it again, I would allow for more time. This task might not be such a problem with a more advanced course or one more focused within a particular discipline. Covering topics ranging from psychology, anatomy, mechanics, biology, computer science and research methods and others that make up human factors at an appropriate level in an introductory class is very challenging. For future work, along with refining the material selections I am considering how they might be pulled together into a more uniform, open textbook type format.

3. Quotes

The “no cost learning material” or supplemented weakly reading I presume, were in my experience more preferred over a traditional textbook. To start, cost savings alone and not having to carry back and forth a book is a positive. Also the accessibility of all the readings is more convenient, since most people carry computers anyway, it can always be accessed and it makes one less thing to carry. And finally the quality of all the reading were pretty good not the typical low-resolution pdf. scans in most classes. However, reading large amounts of information on a computer screen for long periods of time is somewhat discomforting and not my preference. Either more condensed information, or usually I have to take breaks. Overall though its much more convenient id say to each student and I myself prefer to use such “no cost learning” rather than the more traditional way.

--Alex Hochfelder

I come from a background where money is tight, and any aspect where money can be saved makes a big difference for me. I always try to find books online or see if my friends have them to avoid paying for them. On top of that, there are often times where I get a book for a class, and it is only used a couple of times. I think it is silly to ask students to pay \$100 or more for something that is not very useful. For this class I think the text was really a reference and something that can be used to facilitate learning, so I wouldn't really deem it absolutely necessary, especially if it is \$100 or more. It's hard to measure something that does not

happen, but I can say that not having to pay for the books for this class definitely helped me out.

--Alex Panter

My experience with this course was actually great because there was no required textbook that is needed to be bought. The reasoning behind this is that it provides us students with the possibility to actually explore other material that can basically provide the same material. A textbook is great but it only provides us with one perspective of material; it does not let us see other examples of problems in human factors that are available to us. This also opens the door for us to explore different material because we are exposed to stories, reports, and actual occurrences that would only be filtered in a textbook. This new idea of not having to buy a textbook is great; it really helps us as students to learn to not reference only the textbook because not everything there is true; there can exist bias in the textbook so if we are exposed to many forms of bias we ourselves can learn to use this information and extract the most important parts so we can help design a better place for society.

-- Alfonso Soldevilla

My experience during this class felt more rewarding using no cost materials compared to using the books. I felt like the reading material that we were assigned was more significant because it was specifically picked out and assigned to us by the professor. It was easier to understand the reasoning and significance of the material. The reading also seemed to be a bit more informative and entertaining than what a book would have provided. The readings were specialized and specific to a certain topic, while I feel like books are less in-depth in content. The only negative I feel with the no cost material is that it is very disjointed compared to a book. Books are better at connecting concepts and explaining the significance of certain topics relative to each other, but separate articles are more disjointed so it is more difficult to see the relation of different topics that are assigned.

-- Chantal LaPointe

As an industrial design student, for the most part, I don't have to buy textbooks. Rather, I end up spending "textbook money" on supplies for studio. So right off the bat, learning that I wouldn't have to buy a textbook for 2320 was a relief because that I meant I could spend the money that I would have spent on a textbook on additional supplies.

In the past I have found that a good deal of the material in textbooks aren't relevant to the class being taught so a majority of the book is wasted. This always bothered me because I never saw the point in using the book. Even worse is when textbooks are hardly utilized. With 2320, the

material was well integrated into the course. This meant that we were able to learn the pertinent information without feeling like we're trying to fish out the important bits from a large amount of source material. Overall, it just felt like a more efficient way of learning.

--Hareen Godthi

4. Quantitative and Qualitative Measures

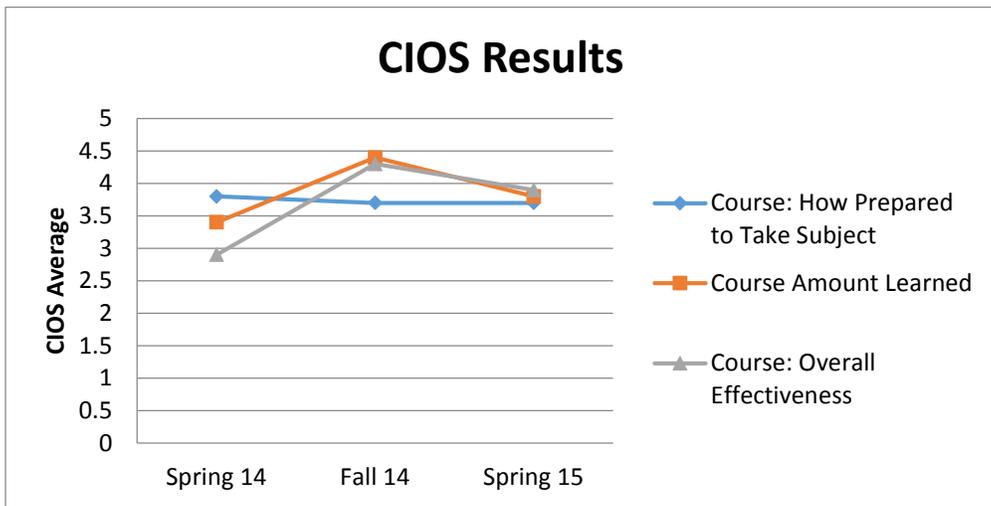
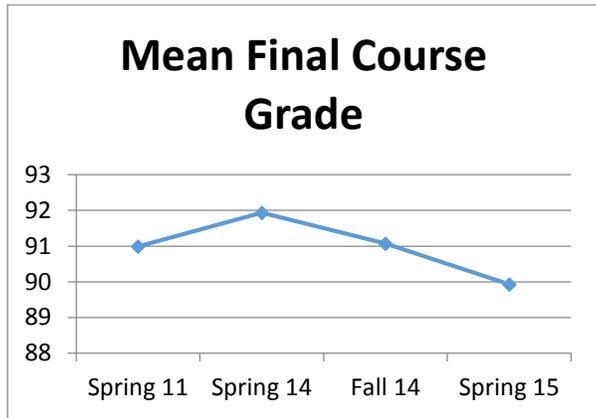
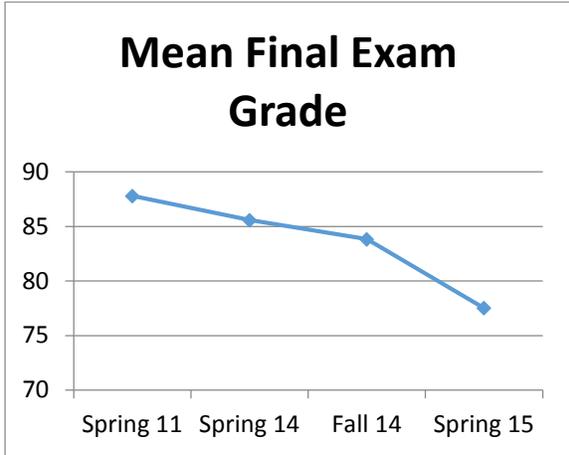
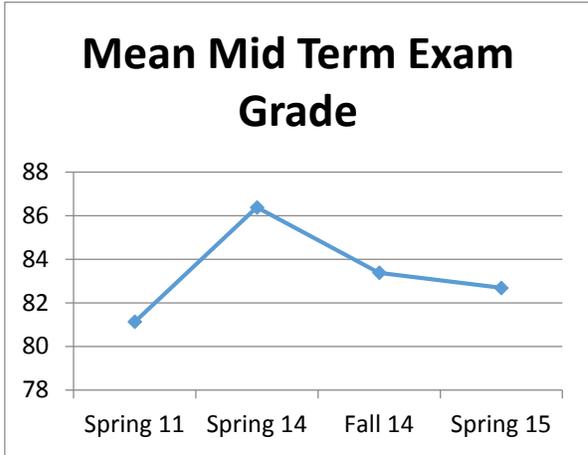
Two main sets of measurements were examined. One set are the grades (exams, assignments, etc) from all of the times this particular course has been offered. The other set are student opinions collected from the end of semester Course Instructor Opinion Survey (CIOS).

The course offered in the Spring 2011, Spring 2014 and Fall 2014 semesters was largely the same and utilized a commercial textbook. The no-cost materials were introduced in the Spring 2015 semester. The gap between 2011 and 2014 represented a change in curriculum. Prior to Spring 2014, the Human Factors in Design class was an elective and only offered infrequently during the Spring semester. Starting in Spring 2014, the course became a requirement for all students completing a major or minor in Industrial Design.

	Mid Term Exam Grade			
	<i>Spring 11</i>	<i>Spring 14</i>	<i>Fall 14</i>	<i>Spring 15</i>
Mean	77.24	85.19512	80.375	82.68657
Standard Error	1.419249	0.922704	1.885722	0.963187
Median	78	87	82	85
Mode	78	91	88	86
Standard Deviation	7.096243	8.355436	10.66725	7.884025
Sample Variance	50.35667	69.81331	113.7903	62.15785
Kurtosis	-1.03374	1.631215	-0.25097	0.359317
Skewness	-0.08295	-1.09858	-0.44965	-0.85172
Range	23	44	46	35
Minimum	65	55	53	61
Maximum	88	99	99	96
Sum	1931	6986	2572	5540
Count	25	82	32	67
Confidence Level(95%)	2.929185	1.835891	3.845955	1.923065

Final Exam Grade				
	<i>Spring 11</i>	<i>Spring 14</i>	<i>Fall 14</i>	<i>Spring 15</i>
Mean	83.88	84.43902	80.90625	77.51493
Standard Error	1.359314	0.638779	1.747902	1.205903
Median	86	85	83.5	79
Mode	86	90	90	82
Standard Deviation	6.796568	5.784393	9.887625	9.870744
Sample Variance	46.19333	33.4592	97.76512	97.43159
Kurtosis	0.401596	-0.41077	1.473516	-0.63234
Skewness	-0.78934	-0.44411	-1.34132	-0.32727
Range	28	26	41	40.5
Minimum	67	70	51	54.5
Maximum	95	96	92	95
Sum	2097	6924	2589	5193.5
Count	25	82	32	67
Confidence Level(95%)	2.805485	1.27097	3.564869	2.407664

Final Course Grade				
	<i>Spring 11</i>	<i>Spring 14</i>	<i>Fall 14</i>	<i>Spring 15</i>
Mean	90.99	90.44939	88.08125	88.53582
Standard Error	0.611638	0.385456	0.739179	0.536865
Median	91.67	90.83	89.235	89.15
Mode	90	93.83	89.5	89
Standard Deviation	3.05819	3.490452	4.181426	4.394431
Sample Variance	9.352525	12.18326	17.48433	19.31102
Kurtosis	2.460923	10.52127	1.079115	0.852054
Skewness	-1.55357	-2.16986	-1.12731	-0.90906
Range	12.13	26.44	17.35	21
Minimum	82.65	71.33	76.24	74.49
Maximum	94.78	97.77	93.59	95.49
Sum	2274.75	7416.85	2818.6	5931.9
Count	25	82	32	67
Confidence Level(95%)	1.262359	0.766936	1.507565	1.071886



Results from the end of semester Course Instructor Opinion Survey (CIOS). The trend for larger classes (more than 35 students) in previous semesters has been lower CIOS scores.

These improved significantly from the previous large class in Spring 2014. The CIOS survey changed after Spring 2011 and contained different questions, so there is no data from that semester to compare directly with later courses.

5. Sustainability Plan

The course will continue to be offered in the fall and spring semesters in the School of Industrial Design at Georgia Tech. The goal of future class offerings will be to iteratively revise and add to the materials offered around two main goals:

- 1) Continue seeking materials that provide comprehensive overviews related to topics of focus. This is particularly true of materials used that were free to GT students through the library, but not fully free to anyone. There are few open materials that give good introductory coverage of the range of topics covered in this course and the initial period before implementing the class in Spring 2015 was not enough to locate completely free references or to generate all that was needed.
- 2) Revise the course to potentially introduce new topics and/or reorganize the ordering of existing topics. The current organization of the course topics closely follows how they were presented in the previously used textbook. This provided a good structure for the initial offering but the use of free materials in the future will allow the course to be more finely tuned to topics of greater interest to designers.

Course materials will continue to be offered in future years through GT's Sakai system (t-square) which allows materials, assignments, communications and grades to be centrally managed.

6. Future Plans

My first thought in designing course materials for future classes will be centered on free materials. These do take more time to locate, review and organize but given time it seems well worth the effort for giving a class a very specific focus.

7. Description of Photograph

[ProjectTeam.jpg](#)

Left to Right:

Cathy Carpenter, team member, head of the Georgia Tech Architecture Library
Dr. Young Mi (Christina) Choi, team lead and instructor of record

Instructor and Class.jpg

Photo of the class before the final exam giving a thumbs up to ALG.

Standing - back and far right: Dr. Young Mi (Christina) Choi, team lead and instructor of record

Seated - students:

Alcock, Peter
Alemayehu, Wengelawit
Allen, Sara
Amole, Oluwaseyi
Andujar, Grant
Assini, Nicole
Barton, Alexandra
Bertschi, Ellen
Blackstad, Logan
Brooks, Julia
Camick, Florence
Carlson, Brett
Cheyne, Eleanor
Corbin, Macy
Daigle, Matthew
Del Toro, Israel
Facius, Milos
Farr, William
Goacher, Louise
Godthi, Hareen
Gooden, Dimond
Han, Mengyang
Hanon, Rosario
Harvey, Samuel
Heffner, Jonathan
Hested, Johnni
Hochfelder, Alexander
Jarecki, Elizabeth
Johnson, Nora
Kemper, Jackson
Kuklennyik, Andrea
Kurth, Rachel
Lal, Arshiya
LaPointe, Chantal
Lee, Hee Su
Lee, Hyun Joo

Lee, Kyle
Li, Sebastian
Lieberman, Joshua
Mannan, Simrun
McCord, Hannah
Mellett, Alyssa
Middleton, Andrew
Muhit, Al-Abdullah
Neiswander, Jane
Niegmann, Kaj
O'Connell, Regan
Oliver, Lena
Oran, Sena
Padgham, Charles
Paek, Woohyun
Panter, Van
Patel, Bindi
Perez Gomez, Diego
Radcliffe, Erin
Silberglied, Chelsea
Smith, Scott
Soldevilla, Alfonso
Stapleton, Michael
Tan, Isabelle
Trollsas, Malin
Tsai, Tung Hung
Wang, Kimberly
Ward, Matthew
Williams, Cheree
Wong Sala, Maria
Zhang, Xueting