Curriculum Innovation Award
Center for the Enhancement of Teaching and Learning, Georgia Tech
Nomination Packet for Dr. Tristan Utschig
February 2015

Table of Contents

Description of the Innovation

Team-Based Learning (TBL) is a pedagogical approach originally developed by Larry Michaelsen in his management and business communication courses. The TBL approach has been widely adapted across a variety of disciplines and is now supported through a non-profit organization called the Team-Based Learning Collaborative which hosts an annual conference and maintains a website with a variety of resources to support the TBL approach. In the standard Team-Based Learning approach a course is structured around the following two component learning cycle which is applied to 5-7 course modules:

1. The Readiness Assurance process - students first complete pre-readings outside of class, then students take an individual quiz on the pre-reading material which is immediately followed by a team quiz using the same questions. Next, students can submit appeals for quiz questions they answered incorrectly but feel they should receive credit for and, finally, the instructor provides a mini-lecture addressing areas where students struggled
2. In-Class activities - a series of questions with increasing complexity are posed for teams to discuss. Each question scenario should address key concepts that students must understand and use to demonstrate achievement of the course learning objectives. Additionally, these question prompts are structured such that the activity follows the "4S" design: a *significant problem* is addressed, the *same problem* is addressed by each team, *specific choices* are presented as potential solutions to the problem, and teams *simultaneously report* their specific choices. These in-class activities may be interspersed with just-in-time lectures addressing areas where teams are struggling or displaying misconceptions.

This two-part process is conducted using teams typically sized from 4-7 students and is supplemented with out-of-class assignments, projects, etc. along with exams that are designed according to the instructor's preference for how best to help students achieve the learning outcomes for the course.

<u>Problem or student learning issue the innovation addresses</u>

I have implemented the TBL approach for NRE 4214 – Reactor Engineering. This is a required course for NRE majors that is part of a set of courses preparing students for their capstone senior design project. Reactor Engineering is a very difficult course building on the combined content of three challenging pre-requisite courses. Historically, students have struggled significantly in this course and the percentage of students who withdrew or performed poorly was quite high shown below in Table 1 (data adapted from the Georgia Tech SGA website: https://critique.gatech.edu/course.php?id=NRE4214).

Table 1: Aggregated Student performance in NRE 4214 from 2001 to 2013*.

	GPA	A%	B%	C%	D%	F%	W%
Average	2.56	23	33	19	15	5	5

*Due to the way this data is made available, the data includes two semesters taught with the TBL format which cannot be disaggregated. As such, this data underrepresents D grades, F grades, and Withdrawals for non-TBL sections.

In addition, the Team-Based Learning approach provides ample opportunity to build student professional skill sets. Students report being less well prepared on these skills than other more traditional areas of engineering training. Table 2 displays results from the 2012 GT Baccalaureate Alumni Survey for several professional skills (n= 23 students who graduated between 2007 and 2009). Means for these skills are all less than 4 (well-prepared) on a scale of 1 to 5 where 1= Not Prepared and 5= Very Well Prepared. Traditional skills all scored at or above 4.0.

Table 2 – BS NRE alumni survey data related to professional skills in ABET accreditation criteria

ABET Outcome	Mean
d. an ability to function on multidisciplinary teams	3.74
f. an understanding of professional and ethical responsibility	3.78
g. an ability to communicate effectively	3.65 (oral)
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	3.65

Objectives of the innovation

The purpose of the TBL innovation in reactor engineering is twofold:

(1) Capitalize on the benefits of social learning present in the TBL approach to help students succeed in mastering the technical course content such that everyone can pass the course and many can do well. My approach also includes frequent feedback in various forms to help students improve over the course of the semester.

(2) Create opportunities for students to develop critical professional skills they will need as working engineers. These professional skills include general problem solving skills, effective teamwork and communication, and the ability to understand how their work fits into broad real-world contexts.

Learning outcomes of the intended audience

The syllabus for NRE 4214 Reactor Engineering includes both technical student learning outcomes specific to the course and general professional student learning outcomes appropriate for most STEM fields.

Technical Learning Objectives (adapted from http://nremp.gatech.edu/files/ug/NRE4214.pdf):

Outcome 1: To familiarize the students with various reactor types and their main design and operational characteristics, including how thermal design principles apply to these reactor types.
Outcome 2: To teach the students how to estimate the volumetric heat generation rate in fission reactor cores under normal operation and shutdown conditions.
Outcome 3: To teach the students how to analyze the thermal performance of nuclear fuel elements (linear heat rate, surface heat flux, volumetric heat generation) including effects such as temperature-dependent conductivity, non-uniform heat generation, gap conductance, and restructuring.
Outcome 4: To teach the students the basic fluid mechanics of single phase reactor cooling systems including application of the shell momentum balance and determination of velocity profiles.
Outcome 5: To teach the students how to calculate pressure drop in reactor systems, including tube bundles, entrance effects, and spacer grids.
Outcome 6: To teach the students how to analyze the heat transfer characteristics of single phase reactor cooling systems including application of shell energy balances to determine temperature distributions and heat transfer coefficients for various coolants and fuel configurations.
Outcome 7: To teach the students the basic fluid mechanics of two-phase systems, including flow regime maps, void-quality-slip relations, pressure drop, and critical flow.
Outcome 8: To teach the students the fundamentals of Boiling heat transfer including physical process and flow regimes, and its implications for reactor design including estimation of critical heat flux.
Outcome 9: To teach the students the fundamentals of core thermal design, with attention to design uncertainty analysis and hot channel factors.

Professional Learning Objectives:

- Thoroughly visualize reactor engineering concepts through the use of correct, complete, well-labeled diagrams or sketches (visual representations) that aid in understanding problems or ideas and help to connect real world applications to the equations used to model those situations.
- Develop high-level modeling and engineering analysis skills such that (1) appropriate variables, governing equations, and assumptions can be quickly and correctly identified and connected to describe a thermal hydraulic situation and (2) calculations can be performed using appropriate mathematical techniques, inclusion and conversion of units, and validation of results.
- Professionally perform individual and team activities as evidenced by taking personal responsibility for the success of both individual and team efforts through completing tasks in a timely manner; careful documentation of work; the use of quality engineering analysis procedures; and the use of quality teaming techniques such as performing roles as needed, contributing to discussion, listening, compromising, and demonstrating respect for others.
- Exemplify effective communication skills in and out of class as demonstrated through the use of appropriate technical language in class settings and as documented in individual or team work.
- Demonstrate quality reflective practice in learning via the use of such techniques as discussion statements summarizing homework problem issues and performing regular self and/or peer assessment of performance.

Approach taken

The following typical class period facilitation plan was shared with the students on the course syllabus.
Before class:

- Read the assigned textbook sections
- Attempt each HW problem assigned
- Formulate any questions you want to ask

During class you can expect to:

- Periodically display your HW problem solutions on the board
- Add notes *in red pen* to your HW solutions
- Contribute to your team during learning activities
- Add your *own* notes to any handouts, notes on the board, or other materials presented.
- Contribute your questions during class discussions

The course was divided into 8 modules the first time it was taught with approximately one technical course outcome included in each module. The second and third time the course was taught four modules were used with approximately two technical outcomes each. Each module used the organizational structure shown in Table 3.

Table 3: Phases of Team-Based Learning

Activity	Preparation		Practice						Assessment
In-class		-Individual test -Group test -Appeals -Corrective instruction		Group Work (simple)		Group Work (harder)	Continue pattern as long as needed		Exam or other assessment
Out of class	Reading		Homework		Homework			Review	

Approximate level of content understanding (%)

40	50	70-80	80-100

Students worked through the modules supported by the following graded learning activities as described in the syllabus.

Individual Homework Portfolio - graded in two parts:

1. Timely completion of end-of-chapter textbook problems: One or more end-of-chapter textbook problems (sometimes modified by the instructor) will be assigned most days for completion by the next class period. Each problem will be assigned a 0, 1, or 2 to indicate minimal, moderate, or full completion.
2. Problem Solving Rubric: The Problem Solving Rubric will be applied around weeks 3, 5, and 10 to assign *temporary* grades. You may continue to revise your work and, at the end-of-course, receive your permanent grade as determined by the rubric for ALL HW PROBLEMS AS A WHOLE. This grade will replace any previously assigned temporary grades.

iRATs: There will be a multiple-choice in-class "**Individual** Readiness Assurance Tests" at the beginning of each section to evaluate whether basic information and concepts from the assigned readings have been seriously considered before we begin class discussion. RATs will cover: key concepts, major governing equations, and key variables/nomenclature from the reading.
gRATs: Immediately following each iRAT (during the same class period), assigned **teams** will take the exact same test. *Each* member of the team is expected to contribute their thoughts on *each* question.

RAT Appeals regarding specific questions may be made by a *team* by 12pm prior to the next class period. Decisions apply *only* to the appealing team.

Peer Review: Both peer and self contributions to the team will be periodically rated using the CATME.org peer review system, and an explanation of ratings provided must be given. The quality of the explanation and ratings provided will be graded using the Peer Review Rubric.

Team Quizzes: There will be four equally weighted in-class quizzes completed as a team.

Final Team Presentation: Each team will conduct an analysis of one or more reactor components as their final exam. During the final exam one member of the team will be randomly selected to present the team analysis in a 4-6 minute presentation using no more than 3 ppt slides. The team will then join the presenter to answer up to 6 minutes of questions.

Evaluation of the Innovation

Initial implementation involved a partial adoption of the TBL process in the fall of 2010 with 40 students. I next taught the course using the full TBL process in 2013 with 61 students, and most recently in 2014 with 28 students. As described below, evaluation data was collected for each course outcome by mapping exam questions, components of assignments, or other information to each outcome.

<u>Description of how the objectives were met</u>

Technical learning objectives were met through individual homework problems included in the problem-solving portfolio, in-class activities targeting specific content for each objective, and out-of-class preparation for end-of-module exams.

Professional learning objectives were met with a combination of the problem-solving portfolio which utilized the engineering analysis process; daily team activities in class including group readiness assurance tests, in-class team exercises, and end-of-module team exams; and the final oral team presentation.

<u>How outcomes were measured</u>

Table 4 displays how each student learning outcome was measured.

Outcome	**Measure (% weight)**
Technical course outcomes (each outcome measured separately)	Selected homework problems completion grade (25) Selected homework problems problem-solving rubric (25) Selected exam questions (50)
Visualization of concepts	Problem-solving rubric element- diagrams (100)
High-level modeling and analysis skills	Problem-solving rubric element- governing equations (50) Problem-solving rubric element- solution steps (50)
Professionalism for team activities	CATME Online Peer Review system – ratings elements for: contribution, interaction, expecting quality, using skills (25 each)
Effective communication skills	Norback-Utschig Oral Presentation Scoring Rubric (100)
Quality reflective practice	Problem-solving rubric element- discussion (75) CATME Online Peer Review system – comments rubric (25)

<u>Extent to which the learning outcomes were achieved</u>

Figure 1 displays results for the course technical outcomes shown on pages 2-3. It is clear from the figure that the partial TBL implementation in 2010 was not as successful as the full TBL implementation in 2013 and 2014. The % of students meeting or exceeding expectations come from the combined results of the measures identified in Table 4 using the weighting shown, and then converting those results to a %. Student achieving 70% or greater are considered to meet expectations.

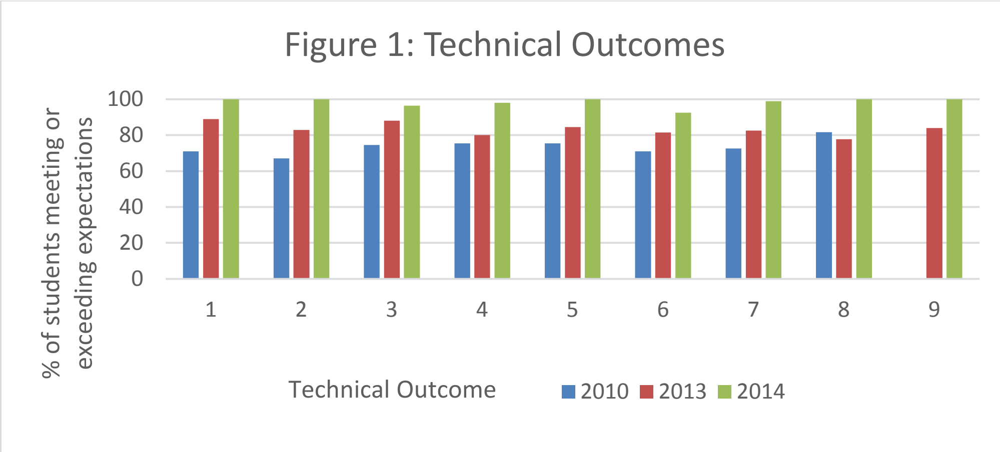
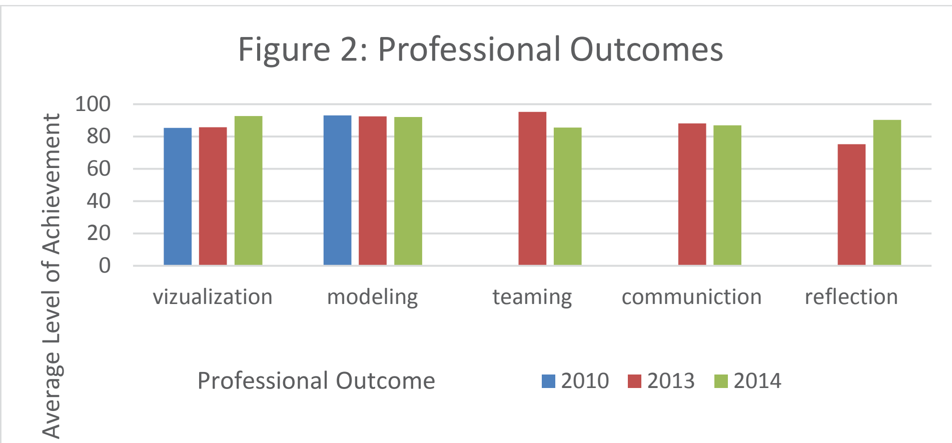


Figure 2 displays results for the course professional outcomes shown on page 3. These results are consistent across all implementations of TBL measured, but team skills, communication skills, and reflection skills were not measured in the first (partial) instantiation of the TBL innovation.



<u>Benefits derived from the innovation</u>

The TBL approach applied in NRE 4214 Reactor Engineering has produced several substantive benefits. First, the DFW rates have dropped significantly using this approach, as shown in Table 5.

Table 5: Aggregated Student performance in TBL versions of NRE 4214 vs all versions

	GPA	A%	B%	C%	D%	F%	W%
All offerings	2.56	23	33	19	15	5	5
TBL only	3.31	33	41	5	2	0	3

Additionally, the TBL approach provides the following general benefits:

- ABET accreditation criteria such as lifelong learning, effective teamwork, effective communication, and understanding professional and ethical responsibilities can be easily addressed by the use of appropriately designed team activities.
- Students appear to find the course format valuable due to its parallels to real-world working environments. This is substantiated by students who have completed internships or coops making anecdotal comments to this effect.
- The use of teams can reduce grading workload.
- Student learning becomes more efficient in the TBL mode. An entire textbook chapter (requested by students at the end of the first implantation of this format) and a team project were added to the course during the second

and third offerings without diminishing performance on the original technical objectives. This result has also been reported in the literature describing the use of TBL is other settings.

Description of the potential for others to adopt or adapt the innovation

The TBL approach has been widely used outside of STEM settings. However, the approach has been employed successfully in a number of settings for science courses. There is a growing literature in this area to support faculty interested in adapting TBL for their own courses. Much of this work is archived on the Team-Based Learning Collaborative website at http://www.teambasedlearning.org/.

Discussion of how the innovation might be used in other settings

Dr. Utschig has offered two workshops to largely STEM audiences on the TBL approach and both have been well received. The first of these was at the Process Education Conference in June 2014, while the second occurred during the CETL fall Kickoff event in August of 2014. Chrissy Spencer (see letter below) was able to successfully implement TBL in a biology course based on her experience in the workshop. Additionally, other faculty in NRE have begun to implement certain pedagogical approaches in their courses which could lead to eventual use of TBL.

Resources required

A full implementation of Team-Based Learning approach used for NRE 4214 requires a few resources to be fully effective.

1. A TBL handbook (several options are available here: http://www.teambasedlearning.org/NewBooks. In particular, a good general resource is Team-Based Learning: A Transformative Use of Small Groups in College Teaching by Michaelsen, Bauman-Knight, and Fink (Stylus, 2003).
2. The group Readiness Assurance Tests require a special format to create the multiple choice test questions which can be repeatedly attempted. Two options are available for this, both of which have been used on the GT campus.
    a. IF-AT scratch off forms available from Epstein Educational Enterprises. Multiple lengths and versions of the form are available along with a simple “Test-Maker” web application to match question choices to the forms.
    b. Learning Catalytics from Pearson Education can be used to produce questions which students complete on their electronic devices.
3. The CATME system (www.catme.org) is an online tool that can be used to form teams and provide opportunities for online peer review using a research-based instrument.
4. To facilitate logistics of teamwork during class, a simple manila folder for each team makes handouts and collection very simple. Simply place the folders at the front of class when you arrive and collect them when you leave.
5. Finally, designing effective in-class activities for teams takes PRACTICE. Dr. Utschig, CETL staff, or others with significant experience using teams in class can be very helpful in getting started, but it often takes a few tries before a effective and significant problem that clearly addresses key course learning outcomes and has appropriate simple choice solution options can be produced.

Georgia Tech Nuclear & Radiological Engineering & Medical Physics
The George W. Woodruff School of Mechanical Engineering
Farzad Rahnema
Georgia Power Company Distinguished Professor and Chair

March 4, 2015

GT Curriculum Innovation Award Committee

Dear Committee Members:

I write to strongly support Dr. Tris Utschig for the Georgia Tech Curriculum Innovation Award. Dr. Utschig has been teaching one or two courses each year for Nuclear and Radiological Engineering since 2007 when he requested a meeting with myself and the former chair of the School of Mechanical Engineering Dr. Ward Winer to volunteer his services. My program has been very fortunate that we took Dr. Utschig up on his offer. In particular, this letter is to support Dr. Utschig's implementation of the Team-Based Learning (TBL) approach which he first used in our senior level Reactor Engineering course. He has also adapted the TBL approach into his already highly innovative teaching approach for our freshman course.

Dr. Utschig began teaching our freshman course, Introduction to Nuclear Engineering, the semester after we met. This was a course which our department struggled to deliver effectively. As a staff member in the Center for the Enhancement of Teaching and Learning Dr. Utschig brought many new and innovative ideas to the teaching of this course. At first students were skeptical about some of Dr. Utschig's techniques and a few brought their concerns to me. I raised these concerns to Dr. Utschig and found that he was already thinking about adapting what he was doing to better fit our students. He quickly began revising his approach and has continued to do so ever since. Dr. Utschig has done a truly tremendous job in turning the course into a motivating freshman experience that not only firmly embeds basic knowledge and skills in nuclear engineering but also sparks significant interest in our students to continue in the major, based on the feedback I have received from students.

More recently, in 2010 I asked Dr. Utschig if he would be willing to teach our senior level reactor engineering course. This course is notoriously challenging. Traditionally, many students struggle with the content, but the TBL approach employed by Dr. Utschig has been highly successful. The TBL approach has significantly reduced the number of students who fail or withdraw from the course and has raised student achievement on course outcomes we measure for ABET. A number of students have commented to me about how valuable Dr. Utschig's course was, how much they learned, and how much they enjoyed it.

Specifically because of Dr. Utschig's use of teams as part of a general focus on building professional skills our students will need as working engineers or researchers, we use both of the courses he teaches as part of the six course set we use for assessment efforts in our ABET accreditation. Team-Based Learning has been important to our program as it helps us assess the following ABET criteria which are often difficult to assess:

- an ability to function on a multi-disciplinary team
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global and societal context
- a recognition of the need for, and be able to engage in, life-long learning
- a knowledge of contemporary issues

farzad@gatech.edu
http://www.nremp.gatech.edu
770 State St., Boggs Building, 3-39S
Atlanta, Georgia 30332-0745 USA
Phone: 404-894-3731 or 3718
Fax: 404-894-3733

Finally, I want to point out that a number of my faculty have worked with Dr. Utschig to utilize aspects of the TBL approach. With guidance from Dr. Utschig, Dr. Deo has used the team formation and peer review software to strengthen the use of teams in his course. Dr. Dubose, after listening to students rave about their experience in Reactor Engineering during his lab class, has also met with Dr. Utschig to adapt some of the strategies that are a part of Dr. Utschig's Team-Based Learning approach.

To sum up, I strongly and wholeheartedly support Dr. Utschig's nomination for the Curriculum Innovation Award. His TBL approach has made a significant positive impact on my program and has great potential for similar results when adapted by others.

Sincerely,

Farzad Rahnema
Georgia Power Company Distinguished Professor and Chair

farzad@gatech.edu
http://www.nremp.gatech.edu

770 State St., Boggs Building, 3-39S
Atlanta, Georgia 30332-0745 USA

Phone: 404-894-3731 or 3718
Fax: 404-894-3733

A Unit of the University System of Georgia An Equal Education and Employment Opportunity Institution

To Whom It May Concern,

I write to enthusiastically support Tris Utschig for the Curriculum Innovation Award for his work in the Nuclear and Radiological Engineering department. Tris deeply cares about his students, and employs novel, evidence based teaching methods to maximize their success. His team-based-learning (TBL) is an innovative approach that encourages student engagement and promotes learning.

I observed Tris's NRE 2110 class in spring 2014. At the time, I worked with Tris in CETL as his GRA, so we were considered colleagues. I was immediately struck by how uniquely he mediated the classroom. Students partially prepared for the lesson before class, and individually took a readiness assurance test. In class, students formed into pre-defined groups to take the same test again. Each group could only submit one answer, so students had to debate and settle on a single answer. In standard group work in which several students are assigned a new problem, typically one student takes charge and others are passive. By contrast, Tris's design ensures every student has already worked through the problem, so each has an answer they believe is correct. This engages students to debate and defend their decision. Indeed when I observed, every student was actively participating. Because both individual and group components are counted towards the grade, students are motivated to learn the material before class and actively participate within the group.

Tris's TBL design succeeds in promoting teamwork skills, a critically important facet of engineering in a professional environment. Tris automatically forms student groups at the beginning of the semester using software designed to maximize diversity, as supported by educational literature (see for example [1]). Students within these groups grow to feel responsibility to fellow members. For example, in my observation I overheard one student telling his group members "Sorry for letting you down, I didn't complete the assignment". In contrast, typical class group projects involve friends with already cemented previously social dynamics grouping together. Tris's TBL approach mimics a professional engineering workplace environment and causes students to learn collaboration and team work over the semester, skills neglected in many GaTech engineering programs.

Tris's TBL design is an approach unlike any I have seen in an engineering classroom at GaTech or other institutions. I was inspired by my observation of his class and have attempted to adopt his methods into my classroom. In particular, I've had great success implementing his readiness assurance tests as a pre-class exercise, demonstrating his methods would be applicable across domains. Tris has taken a technically dense course that is typically taught in lecture format and innovated it to engage students, improve student learning, and develop frequently neglected teamwork skills. It is for these reasons I highly recommend Tris for the Curriculum Innovation Award.
Please feel free to contact me if you have additional questions.

Sincerely,

Anthony Bonifonte
Ph.D. candidate in Industrial and Systems Engineering
ABonifon@gatech.edu

1. Hurtado, Sylvia. "Linking Diversity and Educational Purpose: How Diversity Affects the Classroom Environment and Student Development." (2001).

School of Biology
Atlanta, Georgia 30332-0230 USA
Phone: (404) 385-0539
Email: chrissy.spencer@biology.gatech.edu

March 4, 2015

Dear Esther and the nominating committee,

I write in support of Dr. Tris Utschig's nomination for Georgia Tech's Center for the Enhancement of Teaching & Learning Curriculum Innovation Award. Tris presented his work with Team-Based Learning in his nuclear engineering courses in a CETL Fall 2014 Kick-Off workshop, and the idea was transformative for my own teaching the following semester. Tris' Team-Based Learning approach is highly innovative and perfect training for future engineers, it is highly engaging for students as well as for the instructor, and it transfers well to other courses, as evidenced by my use of a modified form in a sophomore-level science course. Tris' application of the TBL approach at Georgia Tech should be held up as an example of how student learning can be transformed by an innovative and applied teaching approach.

While I have not directly observed Tris teach a nuclear engineering course, I participated in a CETL Fall 2014 Kick-Off workshop that Tris ran like a class. In the workshop he mimicked the course format by reenacting the first day of class. He laid out course materials, put us in groups of 5-6, and then taught us as he does his own students for the first 30 minutes of class. We worked through the cycle of pre-reading, individual test, team test, and subsequent facilitated discussion. The pre-reading alone was completely over my head; at the workshop we did this "in-class" while Tris' students would have done it beforehand. However, even without the pre-reading step some of my teammates had engineering background and were able to help the team reason through it. We wrestled with a large amount of complex content, while navigating team work interactions that involved personalities and tensions we needed to resolve to teach each other the content. The experience was exhilarating and highly engaging.

I was completely inspired by the concept and the approach. I was so taken with the process that before the session ended, I had ordered a TBL reference book on-line. From a workshop on 4000 level nuclear engineering, I had gained enough confidence in my understanding of TBL and the experience it might produce for my students that I felt ready to try it out in a sophomore-level science course—and I did! In the week between the workshop and the start of classes, I reworked my General Ecology course to incorporate TBL elements. If I'd had more time, I would have converted the entire course. Tris was able to provide support to address questions that I had along the way, which also demonstrates his ability and willingness to support other faculty in curriculum innovation.

Sincerely,

Chrissy Spencer

Chrissy Spencer, PhD
Academic Professional

To whom this may concern,

It is a sincere privilege to write this letter of support for Dr. Utschig, the most influential professor I have had the pleasure of learning from at Georgia Tech. I had the opportunity to complete two classes with Dr. Utschig, Introduction to Nuclear Engineering and Reactor Engineering. When I began Introduction to Nuclear Engineering, it was immediately evident that Dr. Utschig had more passion for his job and the material he taught than any other professor I had, or any I encountered during my time at Georgia Tech. The true brilliance of his teaching "team based learning" method was revealed in the Reactor Engineering course I took in the senior year of my undergraduate degree.

Before Dr. Utschig began teaching the course, enough students had failed Reactor Engineering that an extra class had to be added to allow those students to graduate. It would be fair to say many of us were apprehensive about what lay ahead, even with the change of professor. From the very first day, however, those worries diminished as Dr. Utschig explained his challenging but thorough team based learning curriculum. We were immediately placed into teams, and as a class we collaborated to determine how each assignment would be factored into our grade. We were also quickly challenged in both group and individual quizzes, and began to learn the material more efficiently than ever before, in large part due to the group expectations for all members to participate equally. In addition, it was refreshing to have a professor adapt his lesson plans based on the results from our assessments, and it was especially helpful having team members as a learning resource. We concluded the semester with a final group presentation which portrayed how well the teams had bonded.

This team based learning method could not carry on successfully without a dedicated professor such as Dr. Utschig. Dr. Utschig showed up to every class with a passion for the material, and began each day with a short nuclear news segment to keep us informed about the real-world applications of our coursework. His lectures were always concise to keep the students captivated, and usually include an example of the material covered during class. I cannot overstate how beneficial it was to practice these examples with the help of a team. During these work periods, Dr. Utschig would also take the time to interact with all the groups to personally ensure that we were comprehending the material, and offered aid if need be. Even when work became challenging, I knew if my first attempt was incorrect I could easily ask for help to improve my work.

Reactor engineering has historically been one of the toughest courses for the nuclear engineering degree. Due to its extreme difficulty, many "A" students such as myself would be content with a "B" or less in this course. The semester that Dr. Utschig began teaching, not a single person failed the course, and the enthusiasm that Dr. Utschig brought to this course persuaded many of my colleagues to pursue similar reactor engineering careers. Aside from the material learned, the most significant advantage gained from this course was the preparation for future group work which we would encounter in senior design the following semester. Our curriculum has very few courses that include collaborative work, and this course was instrumental in preparing me for the final stages of my undergraduate degree.

Dr. Utschig is an excellent candidate for the curriculum innovation award. He has already made large strides to improve the university's educational environment to keep up with the ever changing aspects of higher education. I know of no one else more deserving of this award than Dr. Utschig. If I can be of further support, please feel free to contact me.

Sincerely,

Martin Zavala
1st Year Graduate Nuclear and Radiological Engineering
Georgia Institute of Technology
Areva Fellow
martin.zavala@gatech.edu

Dear Selection Committee, Curriculum Innovation Award;

As a senior Nuclear and Radiological Engineering major at Georgia Tech, it can oftentimes be daunting to take an array of courses across the colleges of engineering and discern how everything links together, how these subjects fit into this integrated, comprehensive puzzle of a degree. Perhaps this is no longer the correct phrasing, though. As an NRE student, it used to be formidable to attempt to piece this vast array of classes together to find their underlying link, but that was before enrolling in Professor Utschig's Reactor Engineering course, NRE 4214.

Walking into Professor Utschig's Reactor Engineering class was intimidating. Upon arrival, students received sheets of paper shaded in various stand-out colors for the different facets of the course; acronyms were called upon in an intentional, nonchalant manner; the class was divided into groups—teams, really—based on personalities and work ethic; and soon enough, each team was interacting with one another, facilitated by this professor. We were not being lectured—we were being included. And from the buzz in the atmosphere leaving class the first day, each student could tell: this class may seem difficult, but it would be worth it.

Professor Utschig adopted a method to teaching his class that individually engaged and challenged each student by specifically tailoring the course to the students. In order to explain this, a brief description of the course is necessary. Professor Utschig divided the semester into four sections: each section consisted of an initial quiz set, problem sets and in-depth analysis during class, and a team test. The initial quiz set contained an individual and team quiz, one after the other, based on given chapters in the text; these were unique in that students could receive credit for "incorrect" answers if they could successfully defend their answer through the text. Each subsequent lecture period brimmed with group activities and opportunities for students to both demonstrate their understanding of the material and receive clarification on the assignments due each class period. Every phase concluded with a team test over the material, which caused teams to recognize the strengths of each member and plan accordingly.

This course was entirely group-based, yet this very aspect allowed the course to cater so well to the individual learning styles of the students. For the first time in all the courses we NRE students had waged war upon at Tech, the professor introduced the class with the premise that there would be no grade quota: everyone could obtain an A if earned. These powerful words, coupled with the inherent group dynamic of the class, transformed the entire semester. Classmates were working as a unit, helping one another, countering one person's confusion of the material with another's understanding, filling the holes of weakness with strength. This teamwork spread into other courses, and Professor Utschig's Reactor Engineering class was causing the entire undergraduate nuclear engineering senior class to better understand the material in every class; students were not concerned with receiving higher grades than each other, they were concerned with sharing learning strategies. Through this class, we learned how every subject we had been previously taught the past six semesters is integrated into nuclear reactors, yet we simultaneously learned to work long-term as a team.

The praises for Professor Utschig are endless because, at the end of the day, he took a chance in how he taught this class; in doing so, he was able to take a group of nuclear engineering students and turned them into a senior class prepared to tackle the problems they will face in their field. I can personally attest to the effectiveness of this class in integrating one's studies into a cohesive comprehension of the nuclear major: at the end of the semester, I underwent a series of rigorous technical interviews in an attempt to work for the US Navy as a Naval Reactor Engineer through the NUPOC program. Of all the different classes I completed and all the ways I studied for these interviews, I credit a large portion of my success in attaining this job to Professor Utschig and his class. Professor Utschig is a teacher who challenged my limits, who dared to integrate teamwork into a difficult subject, who took a 50 minute period where most teachers will simply lecture and transformed it into a period where he facilitated a learning environment. I cannot think of a teacher more deserving of the Curriculum Innovation Award than Professor Utschig.

Sincerely,
Rebecca Cottrill

Rebecca Cottrill

Nuclear and Radiological Engineering
Georgia Institute of Technology, 2015

Max Carlson
Graduate Student

Massachusetts Institute of Technology
77 Massachusetts Avenue, Building X00–000
Cambridge, Massachusetts 02139–4307

Phone 301-275-9687
Email mc7@mit.edu

March 4, 2015
To: GT CETL Curriculum Innovation Award Committee

I am writing this letter to strongly support the nomination of Dr. Utschig for the CETL Curriculum Innovation Award. I have taken Dr. Utschig's NRE4214 Reactor Engineering class in Fall 2013. The goal of this course was to teach about thermal cycles and heat transfer in nuclear reactors, which involved presenting highly technical content to the students. Dr. Utschig taught this class in an innovative manner, which included sustained teamwork, class participation, and feedback on student performance. It was clear that the progression of the course was well thought out, and for students this resulted in a much fuller understanding of the content.

Within the first few days, Dr. Utschig described the intended plan for the course as largely based on teamwork and class participation. The students took a survey that was used to form random groups of 6-8 students, such that each group would benefit from a variety of individual perspectives including teamwork style and background knowledge. The students were also able to directly affect the operation of the class by voting on the percentage by which each assignment category (homework, quiz, test, presentation) would affect the class grade. In this way, from the first day of class the students were more involved and had a clear understanding of the way the class would operate.

Unlike conventional group projects assigned in many classes, the teamwork aspect of Dr. Utschig's class encouraged groups to work together to develop an understanding of the different members' strengths, and to develop solutions in a cooperative way rather than splitting responsibilities. This was helped by the survey and by establishing teams early in the semester, along with ample opportunities for teamwork throughout the semester as opposed to a single group assignment.

An outcome of this approach that I found particularly useful to aiding learning was the rapid feedback on one's understanding provided through various means. First, Dr. Utschig's attention to students led to constructive criticism of homework assignments and detailed explanations of lingering questions students had after class. Second, the team quiz, taken after the individual quiz and containing the same questions, was in a scratch-off format - the team members, having taken the quiz individually, had incentive to collaborate to determine the correct solution, and if it was found that the solution was incorrect the team could continue the discussion and make another attempt for partial credit. This interaction led to better understanding of content as required to explain and defend one's answer choice to the team, and encouraged many students to explore resources outside of required readings, including technical papers and articles. A third instance of feedback was in the homework assignments, which contained a final numerical answer for each question and required students to explain how to arrive at this answer. For me this significantly changed the nature of homework problems from a rigid search for the correct answer to an exploration of different methods' efficacy for obtaining the given answer, thus greatly expanding the impact of the assignment. Fourth, in the team test it was possible to earn partial credit for a logical and justifiable approach even if the correct answer was not obtained, once again encouraging understanding rather than memorization.

Looking back on my experience in this class, it is evident that the method used by Dr. Utschig is effective in aiding student learning and understanding of the material, as the knowledge gained from this class has helped greatly in my graduate studies. Perhaps even more importantly, I now have a much better understanding of how to work in a team setting that a professional engineer will likely encounter, where answers are not always found in textbooks. While traditional lecture classes are still a necessary component with highly technical material, if this innovation is applied to more classes by professors with a great understanding of teamwork dynamics, I believe that the students will benefit unequivocally.

Sincerely,
Max Carlson

Max Carlson
Graduate Student

Selection Committee, Curriculum Innovation Award,

I am more than happy to support the nomination of Dr. Utschig for the GT Curriculum Innovation Award. I had Dr. Utschig as a professor my senior year for one of the most dreaded classes in the Nuclear Engineering program: Reactor Engineering. This rigorous course teaches the students to apply thermodynamics, fluid mechanics, heat transfer, neutronics, and general engineering knowledge to nuclear reactor analysis. The difference for my graduating class, however, was the newly implemented team-learning approach to this class.

Using a survey of personality traits and other information about ourselves, we were separated into teams. The idea was that each of us on a team would individually read and prepare for class, but the majority of assignments were completed as a team (though some individually). We would start each unit by each having to read the material individually. In class, there was an individual reading quiz, followed by a group reading quiz. This allowed us to work the problems separately, but more importantly, come together as a team, bounce ideas back and forth to converge to a final answer. I found this method to be very effective for two reasons. First, I felt highly encouraged the students to prepare well for the quizzes in order to contribute to the group setting. Secondly, my team-working ability became almost natural due to the pressure to do well on the quiz. We were focused and worked hard.

Throughout each unit, we worked on problems during class, frequently competing with other groups to answer first and with the best responses. At the end of the unit was a group test. We were given a test as a group that comprised the main ideas of the unit. However, the test was focused on critical thinking and application, not just regurgitation. Everything was open-book, open-notes, though they were not simple problems. Some problems required multiple members, sometimes all the members to contribute. These tests were truly demonstrative of the vast amount of information that we had learned in that unit as well as the cohesive teams that we had formed. I feel they were the closest situation to real life I have felt at Georgia Tech. We were given a certain amount of time to tackle an obstacle as a group. We learned to allocate time and people to problems of different difficulty. We also learned to evaluate our own and each other's strengths and weaknesses. This end of the unit test was the perfect conclusion to tie together everything we learned in a seemingly real-life situation.

The semester ended with a final project. As a class, our teams were to design the components to two separate reactor systems. Since the semester covered the fundamentals of a broad range of these concepts, the teams were easily divided to analyze different components that comprise a reactor. It was a wonderful sense of accomplishment, knowing that the group of students I was with was able to design such a complex task. This was the first time at Georgia Tech that I felt like a true engineer.

Dr. Utschig's class was both creative and innovative. Never have I before worked so hard in a class while being so engaged. With Dr. Utschig's guidance, innovation, and teaching abilities, I felt he led the class to be better critical thinkers, team workers, and engineers. I can sincerely say this is the best class I've ever taken.

Sincerely,
Wesley Gillis
Wesley Gillis

Michael R. Baldwin
391 17th St NW Unit 3053
Atlanta, Ga. 30363

March 4, 2015

To the Selection Committee:

I am both excited and honored to recommend Professor Tristan Utschig for the Georgia Tech Curriculum Innovation Award. It is a privilege to write this letter in recognition of a professor who has had a profound impact on me and whose innovative Team-Based-Learning (TBL) approach is worthy of recognition and deserving of an award.

TBL is an effective approach because it encourages active learning. In the first week of classes, students are grouped into semester-long teams. The team of students is responsible for collectively working together to complete in-class activities as well as scheduled quizzes and tests. Students are instructed to pre-read the chapters in the upcoming unit before class, and upon entering the classroom on the first day of a new unit, each student takes a rather difficult multiple choice unit quiz to assess his/her individual understanding. Directly after the quiz, the teams gather together and retake the same quiz cooperatively. Students are expected to work together to agree on the correct answer to each problem and then to utilize a uniquely designed scratch-off answer sheet to see if their response is correct. In the event of an incorrect response, the teams discuss their thoughts and make another attempt at the correct answer. Scoring of the group quiz is determined by the total number of scratches on the answer sheet. On every other class day, Dr. Utschig spends about half of the class lecturing in detail on the material covered in the pre-unit quiz. The rest of the class time is devoted to a hands-on team activity which directly aligned with the lecture. Short homework assignments pertaining to the lectures were due each class, and problem-based tests were administered at the end of each unit to each group.

The student experience in the TBL learning environment is remarkable. TBL allows for students to learn both collectively as a team as well as individually from their teammates, and although it primarily encourages team work and collaboration, a critical aspect of this approach is that it still awards strong individual performance. Motivating individuals to learn the required material in order to be helpful in the group quizzes is one of the major outcomes of this learning strategy, and I will attest to this from personal experience. Ultimately, students buy into the idea that success is achieved through a team effort, and the amount of learning that results from this team work is unmatched to any other course I have taken at Georgia Tech. It should be noted that this teaching strategy incorporates many different learning styles due to the wide range of ways Dr. Utschig presents the same material; reading, visual, auditory and kinesthetic learning styles are all used for each unit. Apart from the academic advantages, the TBL strategy fosters better relationships among peers and helps develop vital social and communication skills.

It is difficult not to be engaged when the TBL approach is in effect! Dr. Utschig takes the time to create group activities unique to each lecture. As teams are bouncing ideas off of one another and working together to compete the activities, Dr. Utschig moves from group to group in order to: 1) identify any potential confusion about the activity and address questions; and 2) push teams deeper into the activity by asking questions intended to stimulate more group conversation. He also utilizes many tutoring strategies throughout the lecture, such as a Think-Pair-Share when he senses the class is confused. He is good about redirecting questions when students directly ask him how to do a problem in order to develop critical thinking. Active learning is the key to Dr. Utchig's TBL, and he employs many strategies throughout the class period in order to ensure everyone is involved and engaged in learning the course material.

Above all, the most important factor in Dr. Utchig's TBL approach is that it is fun! My friends and I genuinely looked forward to going to his class, and I must admit that is a rare occurrence. I did not even realize how successful his method was until after the semester was over. The wealth of knowledge I gained from his class had nothing to do with the difficulty of the class (in fact Reactor Engineering was probably one of the hardest classes I took at Georgia Tech) but had everything to do with how the information was presented. I was actively engaged on a daily basis, and the group activities were often fun and exciting. This strategy is needed in more classes at Georgia Tech; it is perfect for engineering students. If students are looking forward to class and learning course material, then the implementation of this TBL approach in other classes has the potential to revolutionize the way in which students learn.

It is obvious that Dr. Utschig has dedicated a copious amount of time to creating a cohesive method aimed at improving student learning. His methods are effective, enjoyable, and successful. Professor Utschig has been one of the most inspirational and influential professor I have had so far at Georgia Tech, and I would not hesitate to take another class under his direction. He has been an encouragement to me to keep striving to better my education and become an excellent engineer. I enthusiastically recommend Professor Tristan Utschig for the Georgia Tech Curriculum Innovation Award, a well-deserved honor.

Sincerely,

Michael Baldwin

Michael Baldwin