User-Based Approach to Teaching and Learning Product Design

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With more than 25 years of combined experience in the high-tech industry, government and academia Dr. Raviv developed fundamentally different approaches to ”out-of-the-box” thinking and a breakthrough methodology known as ”Eight Keys to Innovation.” He has been sharing his contributions with professionals in businesses, academia and institutes nationally and internationally. Most recently he was a visiting professor at the University of Maryland (at Mtech, Maryland Technology Enterprise Institute) and at Johns Hopkins University (at the Center for Leadership Education) where he researched and delivered processes for creative & innovative problem solving.

For his unique contributions he received the prestigious Distinguished Teacher of the Year Award, the Faculty Talon Award, the University Researcher of the Year AEA Abacus Award, and the President’s Leadership Award. Dr. Raviv has published in the areas of vision-based driverless cars, green innovation, and innovative thinking. He is a co-holder of a Guinness World Record. His new book is titled: ”Everyone Loves Speed Bumps, Don’t You? A Guide to Innovative Thinking.”

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Abstract

This paper reports on a senior-level multidisciplinary course titled Innovative Product Design at Florida Atlantic University aimed at teaching and learning one aspect of innovative thinking: Design of products or services from the user viewpoint, i.e., focusing on benefits and ease of use, rather than on product features.

Specific objectives of the course are:
- To study well-known principles in design interaction, i.e., basic rules that allow design from the user point of view.
- To enhance innovative problem solving skills.
- To explore creative and innovative processes in product design.
- To practice methodologies for design of products and services.
- To engage student teams in the design of assistive technologies.

This course introduces students from engineering, computer science and business majors to methodologies in design of products and services. Lectures, discussions, and problem solving exercises are used to explore the creative/innovative process in product design. Student teams design assistive technology products based on their knowledge and enhanced innovative skills. For a project to be approved, each team had to interview at least five potential users.

The paper focuses mainly on engaging activities, some of which are new. It describes hands-on interactive class exercises, teaming activities, homework assignments, presentations, and projects, most of which relate to the user’s point of view. The paper shares some available formal and informal preliminary feedback/evaluation of class topics, material and activities.

In order to engage students in more real-life experiences, design experts and specialists in assistive technologies visited the class to teach and mentor students. Among the visitors were the chief product designer of Motorola, and the director of Stand Among Friends, a non-profit organization that helps people with disabilities.

The paper shares students’ feedback. They liked the fact that the course teaches design from a totally different perspective, i.e., the user – an unfamiliar aspect to most of them. For some, the concept of design with the user in mind was an “eye opening” experience. They enjoyed prototyping activities (and asked for more) and hands-on experiences that led to prototyping. Open environment and openness to new, simple and absurd ideas were highly appreciated. They have asked for smaller scale projects and for more class time to work on them.
Introduction

This paper details engaging activities in an introductory multidisciplinary course titled *Innovative Product Design* at Florida Atlantic University. The main goal of this course is to enhance the student’s mindset and awareness as it relates to product design, from a user’s point of view.

In this course, students learn principles and methodologies in design interaction, and explore and practice relevant innovative processes (see syllabus in Appendix C). The course is very interactive: students are engaged in many hands-on activities, discussions, lecturing and sharing information. They teach others about specific design books that they have read, and work in teams on assistive technology projects. The course targets several skills, in particular, those that are related to innovative problem solving and entrepreneurial thinking, understanding the “big picture,” as well as personal and social skills.

The paper focuses mainly on engaging activities. It describes hands-on interactive class exercises, homework assignments, projects, book and project presentations, and teaming activities. Projects deal with the whole process of user based design, from observation to advanced prototyping. The paper shares some available formal and informal preliminary feedback/evaluation methods (and results) of class topics, material and activities. Course grading is based on attendance and participation in class activities, homework assignments, off-class activities, and projects. Peer evaluation (three types, see Appendix B) and presentations play an important role in grading as well. Resources for class material are all the books and all Raviv’s papers that are listed in the Reference section. A sample of Power Point slides is shown in Appendix A.

The course attracted experts in the design and assistive technologies areas. Franco Lodato, chief product designer of Motorola has led several design sessions, Shawn Friedkin, the president and CEO of *Stand Among Friends*, a non-profit organization, mentored students and gave them very helpful feedback, regarding designing products that can help people with disabilities.

At the end of the course, students commented that they liked prototyping (and would like to have more) and hands-on experiences that led to prototyping. They liked the fact that the course teaches design from a totally different perspective, i.e., the user – an unfamiliar aspect to most of them. Open environment and openness to new, simple and absurd ideas were highly appreciated. They have asked for smaller scale projects and for more class time to work on them. Most students were engineering and computer science students, and only few from other colleges. This paper shares some of the specific comments (please see Appendix D).

Special thanks to NCIIA for supporting activities and projects.
Details of activities

This section details activities that have been used to enhance the understanding of, and engagement with, user-based design. The underlying goal of the activities is to change the traditional point of view of students when designing products or services, i.e., always keep the user in mind. The activities are grouped in a way that they are easy to explain and rationalize.

Before each activity or assignment, the type of design is introduced to be either a general discussion, or by showing a few visual examples. The different activities are meant to lead to useful (or useless), ornamental, artistic, expressive, etc. designs, in an attempt to increase awareness of the importance of user-based design, to change students point of view and mind-set, to make them more observant, not to take things for granted, and to experience principles in user-based design.

The section starts with a story to elucidate the meaning of “user-based design.”

The activities are divided as follows:

A. Warm-up and mind-set activities
B. You are the user: observing experiences
C. You are the user: mapping experiences
D. Activities to experience the meaning of simplicity
E. Resourcefulness-based design: Making something from (almost) nothing
F. Blue Collar designs
G. “What’s in it for me” designs
H. “Be there:” Empathy-based designs
I. Designs that solve or re-solve existing problems
J. Design Quickies
K. Use-based design
L. Rethinking existing designs (“do not get used to…”)

The meaning of user-based design

The following story epitomizes one of many that are being shared with the students. It is about designing a solution to an “unsolvable” problem. The story emphasizes the need to look at problems and solutions from the customer’s point of view (web-ref 1).

The plot deals with young gang members. The disobedient teenagers regularly damage private and public property. Initial police response was to arrest them for a short period of time. However, the unintended and unexpected response was that the number of offences increased.

Following some brief undercover investigation it appeared that the reason for the increase in offences was the gang’s perception of a 'macho image'. Those who were jailed actually were highly respected among their peers.
The police chief came out with a totally ingenious solution: by observing the customers (i.e., the gang members) he treated the jailed offenders like babies. They were fed baby food, given drink in baby milk bottles. In a short period of time news of this "baby food treatment" spread out, and the offences disappeared.

By being able to think like the “consumer/customer” a simple solution was designed and successfully implemented.

A. **Warm-up and mind-set activities**

The following activities are meant to encourage sketching and prototyping, and engage students in fun, team-based activities.

**Drawing**
The following is based on Betty Edwards book (Edwards 1999). The approach, also known as upside down drawings, allows students to be creative, view problems from different, atypical, perspective, and express themselves by drawing, sketching, and discussing expressively using their hands.

**Activity:** Draw (upside down) Stravinsky by Picasso (see below).

*Upside-Down Drawings*

**Stravinsky by Picasso**

The following are two examples of students’ drawings.
Activity: Re-invent name tag.

I was introduced to this activity by Tina Seelig from Stanford University. After a brief discussion of what’s wrong with existing name tags, small teams of students are asked to reinvent a futuristic energy-free name tags, and share their ideas with their peers.

B. You are the user: observing experiences

These activities encourage observation (including active questioning of “what’s wrong with…”) that can later help in designing/redesigning from the user’s point of view.

Prior to the first observation activity, students are introduced to a product that is based on Seinfeld observation, i.e., that most people eat only the top portion of the muffin. The statement by Seinfeld “Top of the Muffin to You” has led to Muffin Top products.
**Activity: “What bothers you”**
List what bothers you and need to be fixed

Sample responses by students:
Car gets too hot when parked even with visor; Red light too long; Speed bumps are annoying; Dependency on cell phones; Losing cell signal in building; TV gets louder at commercial break; Slippery plastic coat hangers; Blind spots in cars; Banks’ hours are inconvenient; Taking hands off steering wheel to adjust the radio; Waiting for hot water in a shower; Driving and texting; Ignoring and denying history; Finding lost wallet; Automated intelligent voice machines that do not understand you.

**Activity: Observe elevator experience**
Observe your elevator experience, map it, and come up with suggestions for user-centered improvements.

Before assigning the activity, students are shown sample of elevator buttons (see below). Obviously there is a problem: The “Lobby” button looks the same as the other buttons. A more user-focused approach would be to have a bigger, stronger, more visible and possibly duplicated button due to the fact that it is the button that is most used.

Students’ ideas for ways to improve elevator experience:
Have a/c; Be quicker and more spacious; TV instead of music; Air freshener; Info on each floor (room locations, maps, etc.); Increasing room size by having an elevator on opposite side; Have smoother feel; Improve aesthetics; Improve button interface; Talk to elevator not press button; Glass mirrors; Safety sensors; Put footprints on floor; Greater capacity; Bright lighting; No
vibration; Cell phone signal; “De” select button (Undo buttons); Sound dampening; Fold in seats; Round, only up or only down elevator; Greetings; Talking elevators.

C. You are the user: mapping experiences

From *Design of Everyday Things* (Norman 2002):

Natural mapping is desired in design: it leads to immediate understanding. For example, to control an array of lights, arrange the control in the same pattern as the lights.

Or: Make the control look and feel different

Activity: “In case of Fire”: Improve evacuation system in hotels

Students’ ideas:
- Show the better direction – as far as possible from the fire
- Battery-backed Make it visual: LED that directs to the stairs that are relevant
- Color coding for specific directions: desired path
- Voice activated instructions
- Cell phone based directions
- Arrows on floor and at eye level
- Expanded pathways towards exits
- Auto window opener
- Explosives that open new paths and exits wider
- Slides outdoor
- Detachable roof escape
- Inflatable slide connected to windows – with unambiguous ways to approach them
Other mapping activities:
- Shower mapping
- Air travel: from home to final hotel destination
- Websites Phone message systems
- Treadmill panel
- Remote control (TV, VCR, DVD, CD, etc.). In this exercise participants are given photos of the remotes

Activity: Explore the word innovation:
List 10 places where the word “innovation” or “innovative” is, in your opinion, appropriately or inappropriately used.

Students’ ideas:
Proper use:
- Independent innovative village: village that runs completely clean and separate from all conventional ways
- Innovative motorsports: offers leading edge technologies for the motorsport world with new and better products

Improper use:
- In Innovative: an office supply company name
- Innovative mounts: web company that sells motor mount parts

Activity: Find irrelevant information in a middle school mathematics book
Look at middle school book find 5 irrelevant pieces of info

Students’ ideas:
- An explanation how to use a basic calculator
- Career choice mentions which are non-math related
Chapters that depict photos that are irrelevant to the material (photo of a child skating)
Irrelevant stories to make certain points (ex: a long story about dogs in order to introduce an example of percentage graphics)
Homework does not compare to topics in same sections
Using puzzles to solve math problems; Self-explanatory or useless tips

Activity: Explain what is wrong with speed limit signs:
From the user’s point of view: What’s wrong with speed limit sign/driving/enforcement (for example, we don’t feel “guilty” by driving above it). Suggest ideas to solve the problem.

Students’ responses:
Right:
- Max speed limit required by law
- Higher speed limits in Highways
- Safe way not to get a speeding ticket
- People can agree that the octagonal shape of a stop sign is an unmistakable symbol
- Reflective properties of signs and reflectors make it easier to drive during the night

Wrong:
- People do not follow the speed limit
- Speed limit signs are hard to see when changing from one lane to another - brighter colors/funky shapes/ bigger signs can help them stand out; Cops do not follow speed limit
- Should have different speed limit for different lanes
- Speed limits should be lower, and speeding tickets higher
- Give speed limit signs 0.5 miles before the construction site
- Can’t be easily enforced

D. Activities to experience the meaning of simplicity

We start with a set of presentations and discussions on Occam Razor, Made to Stick (Heath 2007), Brand Simple Adamson 2007), KISS principle (and Einstein’s point of view), and examples of simple, brilliant designs.

The goal is understand the meaning of simplicity. After introducing some simple and elegant designs, students are exposed to some approaches to explore/obtain simple designs. The first approach is the “Complicate-to-simplify” approach: it deals with complicating things before simplifying them. The second approach is about what and how “not to design,” from which students better understand the art of simplification. The third is about condensing information without losing the core ideas. It shows students how difficult it is to simplify. The fourth engages students with finding simple solutions to problems.
Sticky Ideas
From Made to stick (Heath 2007).

The book discusses principles behind “sticky” ideas, one of which is simplicity. According to the author: “A sticky idea is one that people understand when they hear it, that they remember later on, and that it changes the way they think or act.”

They show a great example of a sticky idea:
“…put a man on the moon and return him safely by the end of the decade.”
… JFK’s speech from 1961 that “Challenged the nation to put a man on the moon and return him safely within the decade. It’s a sticky idea that motivated a nation.”

The example captures perfectly the 6 principles of sticky ideas: it’s simple, unexpected, concrete, credible, emotional, and it’s a story.

The book’s outline follows the acronym “SUCCES.”

Simple — find the core of any idea
Unexpected — grab people's attention by surprising them
Concrete — make sure an idea can be grasped and remembered later
Credibility — give an idea believability
Emotion — help people see the importance of an idea
Stories — empower people to use an idea through narrative

Activity: Find a sticky idea

Occam's razor
A principle attributed to the 24th century English logician William of Ockham. It states that the explanation of phenomena should make as few assumptions as possible. The principle used to distinguish between equally explanatory theories: it states that theories should be supported according to their practical value of simplicity. Simplicity is practical.

The KISS principle
Acronym for “Keep It Simple, Stupid,” “Keep It Sweet & Simple,” or “Keep It Short & Simple.” It states that design simplicity should play a key role. Unnecessary complexity must be avoided.

Albert Einstein’s view on simplicity
“Any fool can make things bigger, more complex, and more violent. It takes a touch of genius -- and a lot of courage -- to move in the opposite direction.”

“Make everything as simple as possible, but not simpler.”

Brand simple (Adamson 2007) states that the most powerful brands are Based on clear, gut-simple ideas that address Needs, Uniqueness (address a gap), and Audience. It must be different, Relevant, Clear, Simple.
D1. Complicate-to-simplify

The purpose of the next several approaches is to share that one way of coming up with an idea to a simple design, is to start with the opposite, i.e., by first complicating the idea.

Activity: Make life more difficult
Suggest 10 ways to make life more difficult - suggest regulations (Think about things that you do regularly, and then...). I heard this idea on the “Car Talk” radio program.

Students’ ideas:
• Restricting the use of electricity from the hours of 6-8 am and 5-9 pm
• Making the sale of ownership of firearms legal but outlawing the sale of bullets
• Before you fill your vehicle with gas, you have to check all the fluids and tire pressure
• You can only buy $5 worth of gas every time
• Have only one supermarket per city
• Every other parking space must be left open, just in case
• All alarm clocks will go off +/- 1 hr from the set time
• You must change your password to everything every week
• You cannot use your car if you live less than 5 miles away from your work
• Border crossings at all state lines
• No buttons is. Elevator stops at all floors
• You are not allowed to speak to more than 5 people per day
• Restrict the amount of items you are allowed to buy from a store in one day
• You must call 5 people that you like before 10 pm to greet them with “good night”
• Cars must stay within 1 mile/hour range of speed limit

Rube Goldberg Machine

Is an apparatus that performs a simple task in a very complicated and indirect fashion. By thinking of a complicated machine such as a Rube Goldberg, a user-friendly based solution may come up (Wolfe 2011).
An Automatic Back Scratcher

Flame from lamp (A) catches on curtain (B) and fire department sends stream of water (C) through window. Dwarf (D) thinks it is raining and reaches for umbrella (E), pulling string (F) and lifting end of platform (G). Iron ball (H) falls and pulls string (I), causing hammer (J) to hit plate of glass (K). Crash of glass wakes up pup (L) and mother dog (M) rocks him to sleep in cradle (N), causing attached wooden hand (O) to move up and down along your back.

Activity: Sketch a Rube Goldberg Machine that can cut bread into 2 pieces

Answering Machine

Most answering machine message sound like: “Hi… You have reached… I am not away from my desk or on another line… your call is important to me… please leave a message after the beep” … Almost useless words.

“You have reached… Please leave a message (then beep)” is a more direct way to leave a message in a time-saving manner.

The following are examples for actual answer machine messages:

- Hello. I am David's answering machine. What are you?
- Hi. John's answering machine is broken
- This is the refrigerator. Please speak very slowly, and I'll stick your message to myself with one of these magnets
- If you are a burglar, then we're probably home cleaning our weapons right now and can't come to the phone. Otherwise, we probably aren't home and it's safe to leave a message
- Hi. I am probably home. I'm just avoiding someone I don't like. Leave me a message, and if I don't call back, it's you
- Hello, you are talking to a machine. I am capable of receiving messages. My owners do not need siding, windows, or a hot tub, and their carpets are clean. They give to charity
through their office and do not need their picture taken. If you're still with me, leave your name and number and they will get back to you

- Please leave a message. However, you have the right to remain silent. Everything you say will be recorded and will be used by us

**Activity: Prepare 3 answering machine greetings**

Students’ ideas:

- Hey man *wait two seconds* I’m actually pretty busy, can you call me later? *wait 3 seconds* Cool, leave a message after the beep! Gotcha!*beep*
- Hi I’m unavailable to answer the phone but here is my secretary Edna who will tell you what to do.. Edna! * proceed to play automated voicemail
- I’m sure you know what to do at the beep, so I’ll talk to you later
- You know more than 95% of the human population is available at this moment, unfortunately I’m not, so please leave your message after the tone. Thanks
- You have reached Armando’s voicemail; please leave your message after the tone. English and Spanish messages are welcome! Thanks
- Hi….Hello? I can’t hear you, can you speak up? This is Eric’s voicemail playing tricks on you. Leave a message!
- I didn’t answer for a reason, leave a message maybe I’ll call you back
- If it’s important leave a message, if it is really important text me, but if it’s really really important call 911
- Hey! How’ve you been? That’s cool, my days going alright, it’s been a long day, What are you up to this weekend? Hey, I apologize, I can’t get to the phone at the moment, please leave a message and I’ll get you back
- If you leave a message I’ll call you back later, if you text, you’ll probably get better results

**D2. What and how “not to design”**

**Chindogu: Un-use-less designs**

My way of explaining an un-use-less invention: An invention that at first looks great, but no-one would want to use it. This fun activity has been used as a basis to create a great user-based simple design.

Examples (Kawakami 2005):

Mopping cloths
Beerbrella invention (patented) #6637447

Banana protector

Eye drop funnel glasses
Activity:
1. Invent a Chindogu
2. Improve your invention to make it more useful and simple

Students’ ideas:
• Recliner bench press: allows you to work out while relaxing
• A bed with arms and legs that move while you sleep
• Eyeglasses with wipers for working in the rain and for self cleaning
• Parabolic shaped house that collects rain for later home use
• Magic marker with eraser
• Dress socks that clip to your pants, so they don’t slide down
• TV remote control with solar panel. Your home lights charge it
• A “cooling down fan” that is activated while riding a bike
• Umbrella to protect your mobile phone
• Automatic tire cleaner: Brushes activated while driving
• A handle funnel that stops ice cream from dripping onto hands

(Note: It is sometimes tough to judge whether or not an idea is a Chidogu.)

Learning how “not to” design

Learning from “Not good” designs. Examples:

Confusing 2000 Florida ballots:
Confusing road signs:

Strange sign:

Kendall Sq. Cambridge Storrow WB Left Lane Only

Chelmsford (A 414) Chipping Ongar A 128
Brentwood Kelvedon Hatch A 128 Industrial Estates
Secret Nuclear Bunker
Emergency Exit Instructions: “If you cannot read and understand the information on this form, please advise the Northwest agent or flight attendant.”

No-sense road sign:
Double meaning sign:

Conflicting instructions:

D3. Get to the core
This is used to let students experience the challenge of simplification.

Activity: Read a high tech article. Summarize it in 50 words or less

Activity: Invent a simple method to identify reckless drivers

Here students have to first identify the problem.)
Ideas: merging too fast; no turn signal; fast changing lanes; acceleration /deceleration too extreme; too close to car in front; too many distractions (phone, texting, radio, talking, dui, etc.); driving too slow, especially in left lane; inconsiderable driving: cutting off; shining high beams at opposing traffic.
Students’ ideas:
- Equip cars with motion and cameras; develop algorithms to find drivers
- Stay in lane for at least 5 seconds before switching lane
- Mandatory in car device (GPS, acceleration, gyro) that measures behavior…
- Measure engine changed noise – as an indication
- Assign negative point systems. If drivers get too many – then - reckless

Activity: Invent a simple, safe and effective method for cars to cross intersections when traffic lights malfunction (due to, for example, power failure or hurricane)

- Build a roundabout in each intersection
- Install mandatory 4 way stop @ each intersection
- Left turn NOT allowed. Only right turns
- Only clockwise turns allowed
- Place decoy cop cars at intersections
- Add a new battery operated light that switches (rotates) to green for 30 seconds out of 2 minutes (the rest of the cycle, 90 seconds, red)
- Have volunteers and high schools students to help
- Use cameras in intersection to monitor behaviors and later assign tickets
- At even minutes allow east west traffic, on even minutes north south
- Secondary light should be installed for emergency use only
- Send instructions to mobile devices
- Add controlled speed bump or barrier to block/slow traffic
- Do not allow private cars on roads, only ambulances, law enforcement, fire trucks, etc.
- Short range speakers to announce order and instructions

D4. Finding a simple solution to a problem

This approach starts with evolution of designs towards simplicity and clarity, e.g., by showing some IBM innovation commercials, LOGO evolutionary designs, and artistic/ornamental designs.

Students are shown LOGO, ads and commercials that are simple, as well as Some IBM “Keep it simple” commercials.

LOGOs of companies that aren't seeking to reinvent themselves tend to become simplified.
(Web-ref 2, web-ref 3)
Examples: Nike and Starbucks, along with many other companies, evolved their logos to become simpler:

Activity: Design a new LOGO for...

Activity: Design a simple commercial for...

Activity: Design and act out a commercial (team activity)

**Simple and elegant designs**

Parents struggle to teach their young children to ride a bike. Existing solutions are relatively not optimal and sometimes not user-friendly. The **Trike-Bike** is a bike where no training wheels are needed. The Tri-Bike slowly transforms from a tricycle to bicycle configuration as the rider pedals faster, then back to tricycle configuration as the rider slows down. Lead designer: Scott Shim. AP Photo.
Clear Road division:

Traffic light for bikes:
Activity: book Shelf
You put many books in a certain order on a shelf.
What can you do to (easily) find out if one or more are missing or moved?

A solution:
Draw a diagonal line from one extreme end to the other. Discontinuity will show up immediately –meaning: missing book(s). If a book is missing on either side of the shelf (the extreme location), the line will not end at the corner.

Activity: Design a very simple language (look at bacteria/ bees communication methods, as well as Morse and Morse “accent” as a start).

E. Resourcefulness-based design: Making something from (almost) nothing

These are activities that relate to designing with limited available resources, yet they can lead to designs that add value.

Activity: “What can you do with coat hanger?”
Design is introduced as a form of art, where imagination and exploration lead to multiple user-centered “right” solutions.
Activity: “What can you do with bottled water?”

Alternative uses to bottled water (e.g., a flotation device) are shown to students. Following that spirit, they are asked to invent new user-focused uses for bottled water. Here is an example for student’s idea.

Activity: Add value to pencils

F. Blue Collar designs

This approach is intended to make sure that participants do NOT underestimate their abilities (despite getting other “experts”’ advice)

Examples:
Source: The following is a quote from (web-ref 4)

Low level employee suggests simple yet brilliant innovation that increases the profits of a successful company many times over...
Sandpaper on a matchbox

An employee of Swan Vesta, the match company, went to senior management and told them that he could think of a way they could save themselves millions of pounds in production costs. He would reveal this to them if they agreed to give him some large share of the savings they made. They got the whole thing agreed with a solicitor, so that if they indeed were able to save millions, he'd make his cash. He then told them to put the sandpaper on only one side of the matchbox. They saved millions and he got his share. This is why Swan matches have sandpaper on only one side of the box.

The Colgate story

I started working at an upscale department store and during orientation they told us this story about a marketing meeting at Colgate (or Crest??). They were trying to come up with ideas of how to sell more of their product. The cleaning lady was in the room and suggested that they make the hole bigger so more toothpaste will come out. I just thought that was interesting... I don't know if it is true or not, but I wouldn't doubt it.

"If the hole in the tube were bigger, folks would squish out more of the product for each brushing and so would have to buy toothpaste more often,"

Elevator in El Cortez Hotel in San Die

It was the janitor's idea. The famous El Cortez Hotel in San Diego provides an excellent example of the advantage of listening intently to employees at every level. The hotel management decided to install an additional elevator to better serve their guests. Engineers drew up plans cutting holes through each floor of the hotel. A janitor, who was concerned with this, made the comment that this would make a great deal of mess. The janitor was told not to worry because the hotel would be closed to guests during the construction. The janitor suggested, "You could build the elevator on the outside of the hotel." At the time, this architectural concept had never been done before, but after investigation by the engineers, it proved an idea that was worth developing, and is now commonplace in buildings today worldwide. The janitor's idea saved the El Cortez thousands of dollars in guest revenue, employees from losing salary, and major clean-up costs related to the construction of the new elevator.

G. "What’s in it for me" designs

Incentive based designs

These are about user-centered economy-based incentive methods that influence behavior.

Question: How would you convince people to use less plastic bags? Since official requests do not make a big difference, here is an idea:
When a 5 cent charge was instituted (by Loblaws, Canada) customers reduced use of plastic bags by 55%. A similar experience reported (by Metro, Canada) this time with a 70% reduction. Montgomery County, MD, adapted the same strategy with great success as well.

**Activity: How would you convince people to “go paperless?”**

**H. “Be there:” Empathy-based designs**

Activities that encourage experiential design thinking. Example:

**Activity: Join the following event:**

**Lights out**
Don't miss your chance to register now for Lights Out in your city!
Time is running out so be sure to click the image below and register for this unique Visually Impaired Dining Experience at some of South Florida's hottest restaurants!

… as far as we know no one showed up (…it was not mandatory and not free)

**Autistic-based design (extreme empathy)**

This approach is based on Temple Grandin book “*Animals in Translation*” where she describes her own experience designing slaughter houses. (Grandin 2006). We have not yet done an activity in Autistic-based design.
I. Designs that solve or re-solve existing problems

Activity: Convince college students to read the paper version of the NYTimes

Students’ ideas:
- Every Wednesday pay students 25 cents for picking up the paper. Hopefully they will read it, get use to it and buy it on other days
- Free home delivery
- Receive free things when purchasing a copy
- Make back side blank so paper can be reused
- Argue that an old fashion newspaper is better for the eyes
- Explain that reading the paper increases knowledge of foreign affairs
- Offer extra credit for students who read the paper
- Get a digital subscription for your mobile device
- Make the online version annoying
- Have a quiz on every paper. Send in your answers and you are eligible to win something (e.g., sweepstakes)

J. Design Quickies

Activities that encourage user’s reaction. They are quick exercises that stimulate the minds.

Activity: Generate user centered attractive ads for dating, for car, and for bike

Students’ ideas:

**Dating**
- I’ll pay for the drinks
- Your other half is waiting for you.
- Tired of always needing beer goggles when going out? Come over to our new dating place, we have the sexiest people around, no need for beer goggles here
- Date with confidence
- Just admit it, you want me
- Lonely? Think that girl is cute? Try dating!
- I wish you knew me
- Real people looking for real love
- Find your needle in the haystack
- There is a person waiting for you just one click away
• Love begins with your other half

Car
• Feelings, Fast, Fun
• Just picture yourself driving this
• Conquer all terrain
• Attract women
• Think small and go far

Bike
• Now in your local store
• Climbing mountains are more fun with Bike
• Exercise, be good to the environment, and skip bad parking!
• Ride a bike for a strike!
• Speed and balance like no other

Activity: Prepare license plate messages.

An example for ads that focuses on potential users:
Other license plates shown to students to stimulate their minds:

students’ ideas:
AV-8R, TECREP, IPDLVR, BACK UP, 2 CLOSE, CR8ART, ROCKON, HAPPY, FLYIN, U ROCK, W8 4ME, 2BAD4U, LANDFA11, UR2FAT, LIS10, AN TIQ, H8 2 B L8, LV2EAT, 4MYLUV, NO TOY, HIT IT, U2FAST, GOHELL, UMAD, TOO SLO, LOOK OUT, PSY-K1K, Y3S-S1R, LOL NOW, CALL 911, 2FST4U, IMSOL8, U CAN, AIM HI, ICU, 100 MPG, UR2CLS, BIGSXY, GAS GZLR, ILUVCOPS, R3VO 3VOM (Note: This means MOVE OVER when viewed in a mirror).

Activity: Create a bumper sticker with a message

Students’ ideas:

- Don’t text and drive
- Warning: this car may cut you off
- Stop reading and drive
- Caution! I drive at the speed limit
- I brake for tailgaters
- Honk for brakes
- Wanna honk? I’m deaf
- I drive S L O W
- Fresh paint do not touch
Activity: Prepare presidential slogans for both Obama and Romney
Just before the 2012 elections students were asked to prepare presidential slogans, both positive and negative for both candidates. Shown here are the positive only…

Students’ ideas for positive presidential slogans:

Obama
- I got rid of Osama, support me Barack Obama
- Barack Obama, helping the working class
- We laid the foundation, now let’s build this nation together
- Tomorrow never looked so good
- Education, hard work, family, determination, and good results

Romney
- Let’s make a real change- Vote Mitt Romney
- More jobs, more take home pay; Believe in America
- Believe in America- We all want to believe in ourselves and this gives us hope
- Building a stronger military, makes this country stronger
- Romney he can make it better

Activity: Design a method to judge art (e.g., paintings)
This activity is about an objective measure that stems from multiple subjective responses.

Students’ ideas:
- Observe collective sensing and feelings (touching, hearing, tasting, and smelling) and what collective emotion do they invoke.
- Observe how many people stopped by and how much time they spend next to each piece of art. Compare to other art pieces in the exhibition
- Hand each of exhibition visitors a certain amount of fake $$$. Ask them to distribute among the artists. See who gets the most $$
- Ask people to judge on a scale of 1 to 10 with no explanation. Collect and decide

K. Use-based design

Activity: Design a path for students to walk between buildings
Students are asked to report on designs that resulted from users’ behavior.

The following are images of designs that are the result of observing human behavior. The crosswalk is curved to mimic people walking patterns, and the missing grass is the result of actual paths taken by pedestrians (probably to be paved accordingly).
L.  **Rethinking existing designs (“do not get used to…””)**

Activity: List steps to make a phone call using your Mobile device (e.g., iPhone). Explore ways to make it better

Initial condition of phone: Phone sleeping + held in hand.
Steps:
1. Wake up phone
2. Swipe to unlock
3. Switch to the home screen
4. Tap contacts icon
5. Scroll to contact
6. Swipe to dial
7. Hit talk

Suggestions for improvements focused mostly on ideas from less smart phones.
Projects

The theme for the class projects is assistive technologies, i.e., products that can help people with physical disabilities.

Teams of 2-3 students each design and build prototypes in about 10 weeks. Note: One of the requirements for choosing and approving projects was to interview at least 5 potential users.

Here are some examples for available products that help users with disability.
Sample of students’ projects (sponsored in part by NCIIA)

Keyless and Automatic Door Entry System
This project uses mobile device to automatically open a door. Implemented on Android platform and using Bluetooth technology, it activates the door by (i) pushing a button on the mobile device, (ii) talking to the device, and (iii) automatically open the door with no command. The latter is accomplished by automatically identifying the user. The following are pictures of the device and of the door (only the top part is used for the project. Another project used the same door to automatically unlock the door using similar communication ideas.
Stand-Up Assistant
This apparatus helps people to get in and out cars by shifting and tilting the seat.
RFID Sensor-based cane
A cane that allows visually impaired people to locate themselves in an environment.
**Sensor-based cane**
A cane for detecting obstacles. Presence of obstacle translates to audio signals of different frequencies depends on the proximity of the obstacle.

**Head tilt device for controlling RC toy cars**
Picture of the device is not shown, since it looks like a collection of wires.

**Vertically lifted chair**
A chair that can lift the user by a foot.
Monitor-based visualize of audio signals
Allows messages to interrupt the normal flow of TV programming whenever there is an important audio signal (e.g., bell ring signal).

Auto mail box opener
Mail box that opens and pushes mail forward based on user command.
Car auto-shading system
This auto-shading system allows keeping heat out of the car while parking, with a push a button.

Auto flushing
This is an auto flushing unit that allows touch less flushing.
**Bike assist**
A chargeable device that helps riding in difficult terrains.

**Auto can opener**
This device helps opening “stubborn” cans. (The actual device will be by far smaller…).
**Books**

Students present ideas and concepts from user-based designs books. Each book presentation is followed by a relevant activity (from the book or made up by the presenter).

Most Books were chosen from the following recommended list:

- *Brand Simple*, by Allen Adamson
- *Design of Everyday Things*, by Donald Norman
- *Thinking in Systems: A Primer*, by Donella H. Meadows
- *Design is the Problem: The future of design must be sustainable*, by Nathan Shedroff
- *Experimental Eco-Design: Product, Architecture, Fashion*, by Cara Brower
- *Product Design In The Sustainable Era*, by Dalcacio Reis and Julius Wiedemann
- *Creativity in Product Innovation*, by Jacob. Goldenberg and David. Mazursky
- *Biomimicry: Innovation Inspired by Nature*, by Janine M. Benyus
- *Cradle to Cradle: Remaking the Way We Make Things*, by Michael Braungart
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- *The Designful Company: How to Build a Culture of Nonstop Innovation*, by Marty Neumeier
- *I Miss My Pencil*, by Martin Bone
- *Deconstructing Product Design: Exploring the Form, Function, Usability, Sustainability, and Commercial Success of 100 Amazing Products*, by William Lidwell
- *IDEO’s Toolkit for Human Centered Design*, by IDEO
- *Don’t Make Me Think*, by Steve Krug
- *Sketching User Experiences*, by Bill Buxton
• Made to Stick – Why Some Ideas Survive and Others Die, by Chip Heath and Dan Heath
• Designing Interactions, by Bill Moggridge
• Designing for interaction: Creating innovative Applications and Devices, by Dan Saffer
• The Creative Code – The Wonderful World of Creative Advertising Thinking, by Noam Manella
• Everyone Loves Speed Bumps, don’t You? A Guide to Innovative Thinking, by Daniel Raviv and Tal Raviv
• Animals in Translation: Using the Mysterious of Autism to Decode animal Behavior, by Temple Grandin and Catherine Johnson
• A Whole New Mind: Why Right-Brainers Will rule the Future, by Daniel H. Fink
• The Back of the Napkin: solving Problems and Selling Ideas with Pictures, by Dan Roam
• 100 Things Every Designer Needs to Know About People (Voices That Matter), by Susan Weinschenk
• Simple and Usable Web, Mobile, and Interaction Design, by Giles Colborne
• Undercover User Experience Design, by Cennydd Bowles and James Box
Sample of book related activities

Activity: Have the students redesign the University Home Page

Activity: What added design feature would make these products more efficient?

Activity: Given a photo of a DVD remote: design a new simple and usable DVD remote

Activity: Think of a line of the worst thing to say or do of the chosen scene.

1. World's Worst: Thing to say or do on a Romantic Date
2. World's Worst: Thing to say or do during a divorce
3. World's Worst: Thing to say or do on a first date
4. World's Worst: Thing to say to your wife/husband

Activity: Observe the 4 sets of different figures and vote for the more appealing ones.
(It turned out the more aesthetically appealing are those with geometry closer to closer golden ratio.)
References


IDEO’s Toolkit for Human Centered Design (2011). IDEO.


(REF web 1 XXXX)
http://www.mindbloom.net/index.php?option=com_content&view=article&id=32&Itemid=25

(REF WEB 2 XXXX)
http://www.logodesign.com/logo-design-article-display/13/Logo-Evolution/

(REF WEB 3 XXXX)
http://weburbanist.com/2011/02/09/rad-rebranding-how-10-famous-logos-have-changed-over-time/

Source: (REF WEB 4 XXXX) The following is a quote from http://www.snopes.com/business/genius/innovate.asp
Appendix A: Sample of PowerPoint slides on design laws

Sources: (Moggridge 2007, Saffer 2009, Norman 2002)

**Designing for Interaction**

The Unbreakable Law in Interaction Design

Design for the User

---

**Designing for Interaction**

The "Laws and Principles" of Interaction Design

- Moore's Law
- Fitts' Law
- Hick's Law
- Tesler's Law
- The Poka-Yoke Principle
- Direct and Indirect Manipulation
- Feedback and Feed-forward

---

**Moore's Law**

In 1965 Gordon Moore, a co-founder of Intel, predicted that every two years, the number of transistors on integrated circuits will double. 

Amazingly accurate!

---

**Fitts’ Law**

Psychologist Paul Fitts, 1954:

The time it takes to move from a starting position to a final target is determined by two factors: the distance to the target and the size of the target.

... when pointing with a mouse or with a finger; the larger the target the faster it can be pointed to!
**Hick's Law**

The time it takes for users to make decisions is determined by the number of possible choices they have. People subdivide the choices into categories, eliminating about half of the remaining choices with each step.

Thus, Hick's law claims that users will more easily make choices from one menu of ten items than from two menus of five items each.

Controversial... would you prefer one menu with 50 items over 5 menus with 10 items each?

---

**The Magical Number Seven**

- Miller, 1956, a psychology professor, determined that the human mind is best able to remember information in chunks of seven items, “plus or minus two.”

---

**Tesler’s Law of the Conservation of Complexity**

States some complexity is inherent to every process. There is a point beyond which you cannot simplify a process any further; you can only move the inherent complexity from one place to another.

---

**Morse Code Transmitter**

The Telegraph was the first technology system for communicating over long distances that required complex assembly and training to use.

---

**The punch cards:**

The first interface with computers.

---

**A thermostat compares “what temp you want” (you set it) with the “available temp” (measured) to produce a control signal for the heating system.**
The Poka-Yoke Principle by Shigeo Shingo, 1961
Avoiding (yokemu) inadvertent errors (poka)
Preventing problems from occurring in the first place
USB, power, printer, etc. cards are intentionally different (size, shape, color, # of pins, etc.)

Show a picture of back of a pc with all the different color and shape connections

Direct Manipulation
Ben Shneiderman, U-MD, 1980
By selecting a digital object we can do something to it: move it, turn it, drag it, change its color, etc.
In indirect manipulation we use commands to alter an object (menu, Ctrl-)

Designing for Interaction
Characteristics of Good Design Interaction
- Trustworthy
- Appropriate
- Smart/elegant/simple
- Responsive
- Pleasurable/Playful

Switch - a simple control
Dial provides more control than just a switch.

Netflix mailer introduced in 2005
5 million subscribers in less than 3 years.

User friendly systems here

Feedback and Feed-forward
Feedback, as used in design, means some indication that something happened.

E.g. Pushing a button on a phone results in a display of a number, a tone, or a "click."

Feedback and Feed-forward
Feed-forward, as used in design, refers to knowing what will happen before you perform an action.

E.g. “Pushing this button will submit your order,” or “click here to learn more.”
Ease of use
- with no ambiguity -
Appendix B: Evaluation forms

Innovative Product Design - Project

YOUR Team: Peer and Self Evaluation

Date: __________________________________
Your Name: ____________________________
Last 2 digits of your Z number: __________
Project name: ___________________________

Your team gets overall 100 points (total).

Share the points between the members of your team (according to effort, hard work, smart work, success, teaming, communication, peer help, etc.)

Your name: ____________________________Points: ___________
Team Member name: ____________________Points: ___________
Team Member name: ____________________Points: ___________
Team Member name: ____________________Points: ___________
Team Member name: ____________________Points: ___________

If you had to choose the “team champion” who would he/she it be?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

How would you rank your project relative to other projects?
Explain
_____________________________________________________________________________________
_____________________________________________________________________________________

What could have been done differently?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Comments (Please specify any special circumstances/events/problems):
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Any suggestions for future Projects?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

## Criteria to judge book presentations

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<th>Presenter: ________________________________________</th>
<th>Book title: ________________________________________</th>
<th>Evaluator's name: optional</th>
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### Judging Peers

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<th>Knowledge of subject</th>
<th>Quality/clarity/effectiveness of slides</th>
<th>Organization and flow of presentation</th>
<th>Clear examples</th>
<th>Visualization</th>
<th>Timing</th>
<th>EFFORT</th>
<th>Handling Q and A</th>
<th>ACTIVITY</th>
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### Comments:

- **Criteria to judge book presentations**
- **Date:** ____________________________
- **Presenter:** _______________________
- **Book title:** ______________________
- **Evaluator's name:** optional
- **Innovative Product Design**
- **Judging Peers**
  - Knowledge of subject
  - Quality/clarity/effectiveness of slides
  - Organization and flow of presentation
  - Clear examples
  - Visualization
  - Timing
  - EFFORT
  - Handling Q and A
- **ACTIVITY**
- **Comments:**
**Criteria to judge projects**

**INNOVATIVE PRODUCT DESIGN -- Evaluating Other teams**

Date: ____________________

Presenters: ____________________

Project title: ____________________

Evaluator's name: (optional)

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<td>Usefulness</td>
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**EFFORT**

**WORKABILITY and demonstration**

Comments:

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Appendix C: Syllabus

Innovative Product Design

Course description

This course introduces students to methodologies in design of products and services. Lectures, discussions, and problem solving exercises are used to explore the creative/innovative process in product design. Students learn to design based on the user/customer point of view, and student teams design assistive technology products based on their knowledge and enhanced innovative skills.

Course objectives

- To study well known principles in design interaction, i.e., basic rules that allow design from the user point of view.
- To enhance innovative problem solving skills.
- To explore creative and innovative processes in product design.
- To practice methodologies in design of products and services.
- To engage student teams in the design of assistive technologies.

Course material

(No textbook)

- Instructor’s notes
- Handouts
- Reference Books
- Papers

Reference books

- Brand Simple, by Allen Adamson
- Design of Everyday Things, by Donald Norman
- Thinking in Systems: A Primer, by Donella H. Meadows
- Design is the Problem: The future of design must be sustainable, by Nathan Shedroff
- Experimental Eco-Design: Product, Architecture, Fashion, by Cara Brower
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• Design Driven Innovation: Changing the Rules of Competition by Radically Innovating What Things Mean, by Roberto Verganti
• The Designful Company: How to Build a Culture of Nonstop Innovation, by Marty Neumeier
• I Miss My Pencil, by Martin Bone
• Deconstructing Product Design: Exploring the Form, Function, Usability, Sustainability, and Commercial Success of 100 Amazing Products, by William Lidwell
• The Fundamentals of Product Design, by Richard Morris
• IDEO’s Toolkit for Human Centered Design, by IDEO
• Don’t Make Me Think, by Steve Krug
• Sketching User Experiences, by Bill Buxton
• The Plenitude: Creativity, Innovation, and Making Stuff (Simplicity: Design, Technology, Business, Life), by Rich Gold and John Maeda
• Made to Stick – Why Some Ideas Survive and Others Die, by Chip Heath and Dan Heath
• Designing Interactions, by Bill Moggridge
• Designing for interaction: Creating innovative Applications and Devices, by Dan Saffer
• The Creative Code – The Wonderful World of Creative Advertising Thinking, by Noam Manella
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• A Whole New Mind: Why Right-Brainers Will rule the Future, by Daniel H. Fink
• The Back of the Napkin: solving Problems and Selling Ideas with Pictures, by Dan Roam
• 100 Things Every Designer Needs to Know About People (Voices That Matter) by Susan Weinschenk
• Rocket Surgery Made Easy: The Do-It-Yourself Guide to Finding and Fixing Usability Problems by Steve Krug
• Simple and Usable Web, Mobile, and Interaction Design by Giles Colborne
• Undercover User Experience Design by Cennydd Bowles and James Box
• Blink, by Malcom Gladwell
• How to think like Leonardo De Vinci, by Michael Gelb.
• The Art of Innovation, by Tom Kelley
The Ten Faces of Innovation. Tom Kelley

**Grading**
- Attendance and participation in class activities 20%
  Missing class (or part of) = - 4% (up to max of - 20%)
- Homework assignments, off-class activities, and projects 40%
- Peer evaluation 20%
- Books and other Presentations 20%
- Note: It may be possible to receive additional 8% for extra credit (depends on work with design scholars)

**Final grades** will be based on the following scale:
- A 95-100
- A- 90-94
- B+ 85-89
- B 80-84
- B- 75-79
- C+ 70-74
- C 65-69
- C- 60-64
- D+ 55-59
- D 50-54
- F below 50

**Topics**
- Useful designs
- Useless designs
- “Un-use-less” designs (the “Chindogu” concept)
- Complicated “Rube Goldberg” designs
- Simplicity and simplification
- Occam’s Razor
- Use-based design
- Nature-based design - Biomimickry
- Meaning of Innovative/creative design
- Experiencing the user’s experience
- Observation
- Design for interaction
- Design rules
- Universal design principles
- “Made to Stick” SUCCESS principles and BrandSimple concepts
- Stanford’s design process: Empathy, synthesis, inspiration, ideation, prototyping, iterating, and storytelling
- Design strategies and sustainable design
- Visualization
- Autistic-thinking-based design

**Detailed Topics**

**Introduction**

**Your team**
- Personal and teaming skills
- Who’s on your team? Team personalities, types, and qualities
- Ten faces of innovation
- Enneagram

**Becoming an innovative individual**
- What does it mean?

**Innovative problem solving: concepts, skills, techniques and methodologies**

**Engaging both sides of the brain**
- Pattern breaking
- Sketching and drawing techniques
  - Drawing on the right side of the brain
  - The “draw first then tell me” approach
  - Basic elements of graphic design

**How not to design - examples**
- Chindogu: The concept of Un-useless inventions
- Rube Goldberg approach to “design”
- Other Complication approaches

**The missing links**
- Between cognitive science and industrial design
- Between information technology and industrial design

**Visualization**
Surprising studies of visual awareness
Information visualization for understanding
Principles: Overview, context, detail on demand

**Inspiration by nature and art**
- Biomimicry
- The Golden Ratio

**Innovative product design: idea to prototype to product**

**Design for unique customers: firsthand experience**
- From empathy, inspiration, ideation to Prototyping, iterating and reiterating, and story/demo-telling

**Observe**
**What bother you?**
- Opportunity identification and problem exploration

**Put your thought together: Mind mapping**
**What are you talking about? Keep it simple!**
- Find a focal and differentiating point
  - Simplicity and Occam’s Razor
  - Opportunity pitch and elevator pitch for your design
  - From storytelling to design

**The concept of prototyping**
- The effect of prototyping on design results

**Usability**
**Design thinking**
- What is it and how to use it?

**IDEO’s principles of human centered design**
- Desirability, Feasibility, Viability
- HCD Process: Hear, Create, Deliver

**Design for interaction / for the user**
- Function, need, context, timing, added value

**The IDEO process and Deep Dive** + IDEO cards concept

**IDEO’s Art of Innovation**
**Design aesthetic**
**Design rules**
**Design tools**
**Design strategies**
**Autism approach to design**
Ref: Temple Grandin books and movie

**Use-based design**
Main concept: Look for most wear and tear and design accordingly
Early version known as “Desire path desire line”

**Expectation/Anticipation based design (look ahead).**

**The process - summary:** From customer needs to products

**Applications in advertising/marketing**

**Evolution of products and services**
- Aircraft evolution, innovation and design,
- Evolution of LOGOs
- Money and trading
- Clocks/watches

**Other considerations**
- Energy savings
- Design for reliability, sustainability, safety, cost
- Design for extreme affordability

**Evaluation**

**Note:**
Some topics may not be covered due to time constraints.
Appendix D: Students’ feedback

What did you like most about this course?
- The creative process. The course pushes you to think, to question, to find answers to those questions and possibly find more questions in the process
- Only the prototype is necessary. No real design
- To be able to do a project that’s paid for
- Homework assignments
- When he actually lectured
- Presentations that involved students
- The students read different books and had presentations for each book. By the end of the class I felt that I had read all the books
- It’s openness to simple and absurd ideas
- The ability to think and to leverage my innovative skills
- Teach me to look engineering from different perspective to come up with good ideas
- Good introduction to innovation
- Project involved use of knowledge learned, hands on experience

How could this course be improved?
- I enjoyed the mini projects and the homework, they made me think a lot and try to come up with new ideas
- Less homework, no limits on the design
- Allotting more time for projects
- More smaller projects may lead to more creativity than one main project, as it turns into an Engineering Design 2 type project
- Few more in-class activities
- Have projects related to school so it can improve the problems facing in school
- Great course as is

Additional comments and suggestions:
- Rather than have us do one big project, have us do multiple small ones in many different areas
- Some projects require more time for large scale designs
- Good job
- Good work