

UNDERSTANDING DESIGN THINKING AND ITS IMPLEMENTATION IN ENGINEERING SCHOOLS

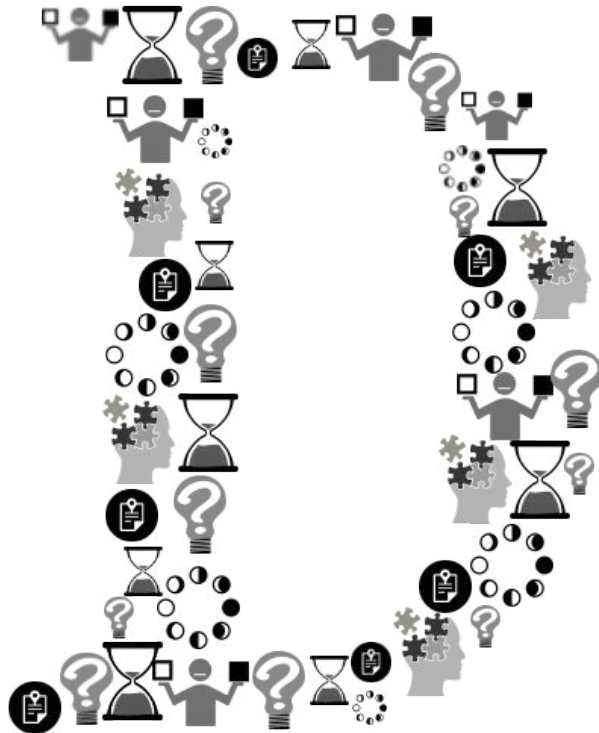
DESIGN RESEARCH SEMINAR PROJECT
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Understanding Design Thinking & its implementation in Engineering Schools

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Special Project report

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Approval sheet

The project titled *Understanding design thinking and its implementation in Engineering schools* by Vasundhara Agrawal, is approved for partial fulfilment of the requirement for the degree of 'Master of Design' in Animation Design.

Guide



Date

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Abstract

Design Methodology as the name suggests has been the standard work process followed by Designers across the world for generations. The effectiveness of this methodology has inspired people from various other fields to incorporate it in their work process. Thus the journey of Design Methodology as a process to Design Thinking as a subject of study. The report intends to help users gain a better understanding of the term Design Thinking and its implementation. It explains the origin of the term and how it can be implemented in fields apart from core-design field like Management, Engineering, Medicine etc.

Introduction

This report is a an attempt to study and understand Design Thinking as a methodology. The report explains the term Design Thinking and its origin. Its journey and evolution over the past 40 years since its first coining and its effective implementation in various fields. Most importantly it is to emphasis on the universal nature of this methodology which makes it useful for people from all professions and backgrounds.

The report is an assimilation of how people across the globe have benefited from this methodology in various fields. This report talks in detail about its implementation in the field of education. A detailed study of Design Thinking as a subject as taught in various engineering schools has also been presented in this report.



What is Design thinking?

People around the world from various fields have their own definitions of “Design Thinking”. While they address a common topic each of them differ in their own way. Below is a collection of few such interpretations of Design thinking and a personal analysis of why it will work or not work.

According to a student at Darmouth Engineering college

“Design thinking is a way of structuring brainstorming and a way of approaching problems such that you open yourself up to every possible avenue and consider everything that could be done.”

When we look closely the above generic statement is not helpful when solving specific problems. Like in animation and film design the first step to represent a story is always storyboarding, but since animation is such an elaborate and lengthy process one cannot try out every possible way to represent each frame. It has to be the film makers perception as to what will work and what not. Hence its not always possible to consider everything that could be done. Therefore design thinking is a tool which can be used as and when required and is not applicable uniformly through all fields.

Tim Brown CEO of IDEO says :

“Definition of Design Thinking according to me is Applying the methodologies and approaches of Design and designers to a broader set of issues and problems like business and society. IDEO is about teaching the world and the clients the perspective about how we solve problems.”

IDEO has helped implement Design thinking in various fields of life from schools to restaurants. However Design thinking as mentioned before is a tool which can be used at its best only over time through experience and practice.

Given that it should also be mentioned that the application of design thinking as in the field of design is very different from that of problem solving. While problem solving almost always has a fixed goal that needs to be met designing something might be related to innovation with variable or flexible goal. There might be cases when one stumbles upon a good design while solving a problem or one might start designing to solve a particular problem it is not necessary that one should include the other. Therefore it can be said that “problem solving and designing are independent events which can be mutually inclusive while using a common tool of design thinking”.

Professor Peter Robbie from Dartmouth Engineering College says

“Design thinking teaches more conscious ways to think about creativity”

This statement focuses on a very important aspect of Design thinking which is Design thinking can be used by anyone and everyone. But when people from other fields like engineering or management use design thinking they have to consciously adapt to the process of design thinking. Therefore Design thinking is also an adaptive process. A person has to consciously practice Design thinking for a period of time before it gets incorporated in his creative thinking.

As we can see people have different interpretations of design thinking none of which are complete in themselves. Therefore the very fundamental question What is Design thinking?

Design thinking is for anyone and everyone who can identify a problem and wants to make a sincere attempt to solve it. It is like a helping hand which an individual should know how to use in the best possible manner. But it needs custom application and is not uniformly applicable in solving all kinds of problems. People and environment form the core of design thinking therefore design thinking is a social skill which becomes better with practice.

This brings us to some of the fundamental elements of design thinking.



Elements of Design thinking

Human-Centered: Design Thinking begins from deep empathy and understanding of needs and motivations of people.

Collaborative: Several great minds are always stronger when solving a challenge than just one. Design Thinking benefits greatly from the views of multiple perspectives, and others' creativity bolstering your own.

Optimistic: Design Thinking is the fundamental belief that we all can create change—no matter how big a problem, how little time or how small a budget. No matter what constraints exist around you, designing can be an enjoyable process

Experimental: Design Thinking gives you permission to fail and to learn from your mistakes, because you come up with new ideas, get feedback on them, then iterate. Given the range of needs your students have, your work will never be finished or “solved.” It is always in progress. Yet there is an underlying expectation that educators must strive for perfection, that they may not make mistakes, that they should always be flawless role models. This kind of expectation makes it hard to take risks. It limits the possibilities to create more radical change. But educators need to experiment, too, and Design Thinking is all about learning by doing.

Now that we have a basic understanding of the concept of Design thinking it would be good to look into its origins.



History of Design thinking

The notion of design as a “way of thinking” in the sciences can be traced to Herbert A. Simon’s 1969 book *The Sciences of the Artificial* in which he says:

“Engineers are not the only professional designers. Everyone designs who devises courses of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artifacts is no different fundamentally from the one that prescribes remedies for a sick patient or the one that devises a new sales plan for a company or a social welfare policy for a state. Design, so construed, is the core of all professional training; it is the principal mark that distinguishes the professions from the sciences. Schools of engineering, as well as schools of architecture, business, education, law, and medicine, are all centrally concerned with the process of design.”

Robert McKim in his book *Experiences in Visual Thinking* published in 1973 talk about “Express, Test, Cycle” (ETC) as an iterative backbone for design processes. He explains and emphasises on the productive thinking. He says:

*“A Major purpose of this book is to encourage a third universal condition that fosters productive thinking: flexibility. The productive thinker can be flexible in his thinking in three ways:
He can have easy access to subconscious as well as conscious levels thinking.
He can be proficient at a variety of mental operations and able to move freely from one operation to another.
He can utilize several vehicles of thought, and readily transfer his thinking from one vehicle to another. “*

Peter Rowe’s 1987 book *Design Thinking*, which described methods and approaches used by architects and urban planners. The book proceeds from detailed observations of designers in action to an examination of the

broad frameworks that appear to shape design theory and inform design thinking.

Rowe seeks to define the intellectual activity of designing both as rational inquiry, governed by guiding principles and constraints, and as a matter of the conviction and impulse by which design principles are invented and applied. The book was a significant early usage of the term in the design research literature

Rolf Faste expanded on McKim's work at Stanford University in the 1980s and 1990s, teaching design thinking as a method of creative action. At Stanford Faste was noted for his contributions to engineering education and design research, developing courses to strengthen students' visual and creative skills such as Aesthetics of Machinery, Ambidextrous Thinking and Expression of Function. He was interested in exploring the way that the body and mind influence technical creativity, understanding needs and cultural meaning in the creation of products, and incorporating functional, aesthetic and humanistic concerns in design.

Design thinking was adapted for business purposes by Faste's Stanford colleague David M. Kelley. In 1978, he partnered with another Stanford Product Design graduate, Dean Hovey, to form Hovey-Kelley Design. Hovey left to pursue other interests and the firm was renamed "David Kelley Design" (DKD). In 1991, Kelley merged DKD with three other design firms (Mike Nuttall's Matrix Product Design in Palo Alto, ID TWO in San Francisco, and Moggridge Associates in London, the latter two founded by Bill Moggridge) to create IDEO, which he ran as CEO until 2000.

Tim Brown is the current CEO and president of IDEO. He frequently speaks about the value of design thinking and innovation to business people and designers around the world. He takes special interest in the convergence of

technology and the arts, as well as the ways in which design can be used

to promote the well-being of people living in emerging economies. His book on how design thinking transforms organizations, *Change by Design*, was released by HarperBusiness in September 2009. In which he says:

"What we need is an approach to innovation that is powerful, effective, and broadly accessible, that can be integrated into all aspects of business and society, and that individuals and teams can use to generate breakthrough ideas that are implemented and that therefore have an impact. Design thinking... offers just such an approach."

We can see that Design Thinking as a practice has been evolved and nurtured by various great designers and thinkers for more than 40 years now. Each of whom have always emphasised on the versatility of its application in various fields and by people from varied backgrounds. But one might question that even if Design Thinking is an approachable and easy to understand method of working do we really need design thinking? This brings us to the next section of this report which explains Why Design Thinking?



Why Design Thinking?

To understand why design thinking and its influence in our day to day life I conducted a small experiment. The experiment consisted of giving an everyday scenario to a few design students and analysing their approach. Here we are trying to see if design thinking influences their everyday work and how is it helpful.

Question: Describe your process to make a cup of tea when in the following scenario

Case 1: Describe the process if you had to make a cup of tea

Student 1 : Boil water in a container, add tea leaves and sugar. Filter using a sieve, pour and drink. When asked why did he make black tea he said “I assumed I was making tea for myself”.

Student 2: I need to know how many people are there and what kind of tea needs to be made. I will then take boil some water and add sugar and tea leaves to it and filter the decoction. I will boil the milk separately.

Student 3: Take a vessel, pour water and milk in it to boil add cardamom and ginger while its boiling. Add sugar and tea leaves and strain it in two cups. When asked why did you make two cups of tea she says i'll generally make tea for my brother and sister. For myself i'll make black tea.

Case 2: Describe the process if you had to make a cup of tea for your mother

Student 1: I will ask her if she wants tea or coffee. Then ask her if she wants milk tea or black tea. The boil milk put the tea powder, add sugar and pour.

Student 2: Boil a cup of water and add ginger and pepper to it while its boiling. Add tea leaves and filter. Squeeze a lemon and add salt.

Student 3: I'll take half a cup milk and half a cup water rest of the process is same as described above just that at the end i'll add sugar free for mother.

Case 3: Describe the process if you had to make a cup of tea for some guests in the house

Student 1: Will select different nice looking cups. Then the same procedure but will put extra spoons and sugar separately

Student 2: I need to know how many guests are there? Are they familiar guests or non-familiar. I will boil water and add tea leaves to make a decoction. I will boil milk separately. I will not add sugar as I don't know everyone's preferences.

Student 3: I need to count the number of guests. I'll put a little less sugar as mom will drink the same tea.

Case 4: Describe the process if you had to make a cup of tea to sell

Student 1: Boil milk in the container and boil water separately and add tea leaves to it. Take a glass put sugar, put milk and put concentrated tea solution.

Student 2: I need to find the location and time for selling the tea. Says if I have to make a cup of tea then I'll take three fourth cup water and one fourth cup milk.

Student 3: Says "since it's my first tea shop I would want to make a good tea" I'll make a little more than the number of customers presently ordering. Suppose there are 3 orders I'll make 5 such that others don't have to wait.

Conclusion:

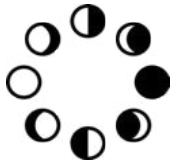
In Case 1 we can see that most of the students have narrated the tea making act as they would do in their everyday life and when no user is specified the assumed users are the ones they best understand which is either themselves or their immediate family members. This brings us to the

first phase of Design Thinking namely user understanding.

In Case 2 we see how the students adapt from the earlier definition of the task which was "making tea" to "making tea for your mother". We can see the changed focus of the task from their concern towards the user. This act also reflects the first and second phase of design thinking which is user understanding and defining the problem and adapting with the changes.

In Case 3 we see that when the user group is not very well defined the students ideate on what might work best in those conditions. Here since the users are guests the students chose nice crockery, serve the tea decoction and milk separately or even make tea with a little less sugar to meet everyone's preferences. This also shows the presence of the third phase of design thinking which is ideation apart from the first and second phase

In Case 4 where the students are not very well versed with the act of selling tea which is entirely different from making tea for anyone they already know. We see that they take an approach to prototype by making small numbers of the servings like 3-5 cups initially or to prepare and store the milk and decoction separately. Here we see presence of all the four phases of design thinking namely, user understanding, problem definition, ideation, prototyping and testing.



Phases of Design Thinking

Design thinking consists of primarily five phases. Lets take a look at each of them in detail as below:

User Understanding: It is important to be able to get a clear idea of the user. What does the user want? How does the solution help? How can he self improve the solution if needed? these are important questions which needs to be asked not only in the beginning of the design process but throughout the process.

Defining the problem statement: The problem definition is important as it helps one establish the premise to start working. The problem definition might undergo variations over the working period and it need not be rigid. But a well articulated problem statement helps everyone in the team to be on the same page.

Ideation: Once the problem statement has been defined the next obvious step seems to be working towards the solution. However this is exactly where design thinking plays the strongest role. Ideate, this step involves thinking and representing all possibles solutions in the form of notes sketches, mind maps etc. An ideation book is a resource which can be referred to at any step during the development of a solution.

Prototype: The ideation stage may lead us to more than one possibilities in which case it becomes difficult to decide. An easy and simple solution to a confusion like this is to prototype, a prototype is quick and cheap way to try out more ideas.

Given that a fundamental question arises How does one prototype intangibles? Intangibles like business plans and management problems are not only huge in space and impact but are also lengthy and time consuming to implement. This question has been very well answered by Tim Brown in his book Change by Design. He calls it 'Prototyping things you can't pick':

"The movie industry has long used this practice. The storyboard emerged as a way of mapping out the movie before it was shot to make sure that all the scenes were thought through..."

Techniques borrowed from film and other creative industries suggest how we might prototype

nonphysical experiences. These include scenarios, a form of storytelling in which some potential future situation or state is described using words and pictures."

"A simple scenario structure useful in the development of new services is the 'customer journey'. This structure charts the stages through which an imagined customer passes from the beginning of a service experience to the end. ...the value of describing a customer journey is that it clarifies where the customer and the service or brand interact. Every one of these 'touchpoints' points to an opportunity to provide value to a firm's intended customers – or to derail them for good. "

"Acting out...Our most reliable consultants...are kids. As soon as two or three children get together, they start to role-play: they become doctors and nurses, pirates, aliens, or Disney characters. Without prompting, they begin to perform lengthy enactments full of complex plots and subplots.

Research suggests that this form of play is not only fun but also helps establish internal scripts by which we navigate as adults.

Learning to feel comfortable acting out potential ideas is obviously important for anyone

contemplating an experiential approach to prototyping... Knowing some of the basics, such as how to build on the ideas of one's fellow actors and being willing to defer judgment to them, increases the likelihood

that collaborative, real-time prototyping will be successful. The amateur theatrics of an experiential prototype can look foolish. It takes a certain confidence for individuals to loosen their ties, slip off their heels, and explore an idea through improvisation. "

Besides one should always remember the purpose of prototypes which is to test or examine a particular idea, hence a prototype should never be finished enough that its hard to discard it and build a new one.

Testing: Testing and prototyping always go hand in hand. Any changes made in the prototype needs to be tested. Testing leads to feedback which further needs to be incorporated in the prototype and this needs to be tested again. Hence testing and prototyping are a very iterative process.

When dealing with testing on intangible prototypes it is often helpful to test in smaller scale but in real time situations. Like installing a walk through experience for the customer or laying out the roadmap for the entire journey for clients and others in the company to explore.

Given that one might ask How can design Thinking make a difference?



How can Design Thinking make a difference?

The importance and need for design thinking has been well explained in Tim Brown's book *Change by Design*. In which he mentions:

"We are at a critical point where rapid change is forcing us to look not just at new ways of solving problems but to new problems to solve. A purely technocentric view of innovation is less sustainable now than ever, and a management philosophy based only on selecting from existing strategies is likely to be overwhelmed by new developments at home or abroad".

"What we need are new choices – new products that balance the needs of individuals and of society as a whole; new ideas that tackle the global challenges of health, poverty, and education; new strategies that result in differences that matter and a sense of purpose that engages everyone affected by them. It is hard to imagine a time when the challenges we faced so vastly exceeded the creative resources we have brought to bear on them".

"What we need is an approach to innovation that is powerful, effective, and broadly accessible, that can be integrated into all aspects of business and society, and that individuals and teams can use to generate breakthrough ideas that are implemented and that therefore have an impact. Design thinking offers just such an approach".

"...By integrating what is desirable from a human point of view with what is technologically feasible and economically viable, designers have been able to create the products we enjoy today. Design thinking takes the next step, which is to put these tools into the hands of people who may have never thought of themselves as designers and apply them to a vastly greater range of problems"

"The term "design thinking"...I now use it as a way of describing a set of principles that can be applied by diverse people to a wide range of problems. I have become a convert and an evangelist of design thinking. And I am not alone. Today, rather than enlist designers to make an already developed idea more attractive, the most progressive companies are challenging them to create ideas at the outset of the development process.

The former role is tactical; it builds on what exists and usually moves it one step further. The latter is strategic; it pulls “design” out of the studio and unleashes its disruptive, game changing potential.

“As the center of economic activity in the developing world shifts inexorably from industrial manufacturing to knowledge creation and service delivery, innovation has become nothing less than a survival strategy. It is, moreover, no longer limited to the introduction of new physical products but includes new sorts of processes, services, interactions, entertainment forms, and ways of communicating and collaborating. ...The natural evolution from design doing to design thinking reflects the growing recognition on the part of today’s business leaders that design has become too important to be left to designers”.

As explained and mentioned by Tim Brown that there is an urgent need for products that balance the needs of individuals and the society as a whole. That there is a need for an approach like Design Thinking that can be taken up by individuals and teams to generate ideas and implement them to have an impact. But to generate bigger impact the reach for the correct approach needs to be broadened. Design Thinking is a tool in the hands of people who many have never thought themselves as designers yet solve problems as efficiently and creatively as them.

We now understand how can design thinking make a difference. In the next section we further explain the why is design thinking important through examples from real life implementations of the process.



Why is Design Thinking important?

The importance of Design Thinking can be very well explained through examples is the “Design Thinking for Educators” program run at the Riverdale school by IDEO (a global design firm that takes a human-centered approach to helping organizations in the public and private sectors innovate and grow) . It states that “Design Thinking for Educators is a creative process that helps you design meaningful solutions in the classroom, at your school, and in your community. The toolkit provides you with instructions to explore Design Thinking”. Under this program various design initiatives were taken at the school level at the districts level and even at the community level. Some of the examples are as below:

Teacher-designed: How might my classroom be redesigned to better meet my students’ needs?

“Michael Schurr, a 2nd grade teacher in New York, realized that he never asked his students what would make them comfortable in the classroom. He decided to talk directly with his students to figure out the best design for their environment.

Based on his student’s input, he was able to redesign his classroom to better address the needs and desires of his students. He lowered the bulletin boards so that his students could actually see the content he’d spent hours assembling, and created a more comfortable semi-private space for the students to study by rethinking the student cubby space. His students are more engaged, and move more fluidly in the classroom space. Now Michael consistently engages his students in helping him more effectively shape their learning experience.”

The effect of teachers using humancentered design techniques to understand their students is that it makes students feel more engaged in the changing learning environment. The fact that the teacher is becoming the designer of his or her own classroom experience professionalizes the role

of the teacher and allows for the most valuable change—authentic change driven by the students’ needs rather than a school or district mandate.

Design thinking is a creative act and lets teachers understand that the act of creating a really effective learning environment is an art that is both reflective and intentional. It is important for everyone to realise that schools and colleges are setups designed for education but if they are not serving their primary purpose of ‘effective learning’ it should be customised and redesigned as per the requirements of the audience.

Therefore if we want to change education and learning to make it more relevant, more effective and more enjoyable for all involved, teachers need to be the entrepreneurial designers and redesigners of the “systems” of schools and of the schools themselves.

School-designed: How might we create a 21st century learning experience at our school?

“The faculty at Ormondale Elementary School in California wondered if they were preparing their students well for the future. They decided it was time to corroboratively design an approach to teaching and learning that they felt was updated and relevant for the 21st century.

Collectively, they embarked on a design journey and came to an approach they call “Investigative Learning”, which addresses students not as receivers of information, but as contributors to knowledge. The faculty continues to evolve and share this approach with new teachers through the creation of a Manual of Investigative Learning to keep track of their philosophy and methods. They have gained support from their school board, and have become recognized as a California Distinguished School.

The faculty at Ormondale Elementary School uses design to address the needs of their evolving student body.”

This example concentrates on looking at improvements that can be made in the education process rather than just the environment which

ensures the problem is addressed at the root level.

District-designed: How might we redesign our approach to curriculum development and delivery to center around the needs and desires of our teachers and students?

“With a movement toward student-centered and personalized instruction, the Howard County Public School System in Maryland is using Design Thinking to tackle next generation curriculum redesign incorporating 21st Century skills. Currently, there is a disconnect between the existing paper-based curriculum and the interactive digital resources that are now available anytime, anywhere for teachers and students.

Tapping into teacher, parent, and student behaviors in and outside of school, the design team collected inspiration around the ways that people engage with information and interact with curricular materials. Understanding the desires of teachers, students, parents, and administrators has helped the team rethink curriculum delivery as well as develop resources to replace, augment, and enhance current curriculum documents.

Howard County is using design to re-conceptualize curriculum creation and delivery to meet the needs of all learners.”

Community-designed: How might we redesign our high school to elevate student engagement and academic outcomes?

“Consistent low student achievement results at Castle High School in Hawaii demonstrated the need for a redesign and restructure of the school. Design Thinking Hawaii, a non-profit organization that engages volunteers to apply Design Thinking to big challenges, partnered with the Hawaii Department of Education to reimagine the Castle High experience.

Through a series of mini-charettes, Design Thinking Hawaii has collected the needs and interests of learners, teachers, and families and engaged the larger community to imagine new solutions that could help the school be more effective. The adopted plan captured the community's priorities in new content and structures, and Complex Area Superintendent Lea Albert is enabling the school and community to prototype and iterate core curriculum, character education, and support services. This is the first public-school model in Hawaii to co-design its offerings with community, targeting systemic educational problems.

Design Thinking Hawaii is using design to provide the state with input that will shape the redesign of Castle High and other schools in the community.”



Design Thinking in existing and potential Engineering Schools

ESD 051 Engineering innovation and Design at MIT

Course Description:

Learn to produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact. This project based course gives students the ability to understand, contextualize, and analyze engineering designs and systems. By learning and applying design thinking, students will more effectively solve problems in the required domain. Lectures focus on teaching a tested, iterative design process as well as techniques to sharpen creative analysis. Guest lectures from all disciplines illustrate different approaches to design thinking. This course develops students' skills to conceive, organize, lead, implement, and evaluate successful projects in any engineering discipline. Additionally, students learn how to give compelling in-person presentations. Open to all majors, all years.

Course information:

Class session: The course is open all year around. The class is broken up into two sessions, a Monday and a Wednesday class. Each class is two hours long. There are more classes at the beginning of the semester, than towards the end.

About the teaching faculty:

Professor Joel Schindall is a graduate from MIT, and has an industry experience of 35 years in aerospace and telecommunications.
Professor Blade Kotelly: Comes from an interdisciplinary background.

Purpose of the course: The course represents one of four courses as part of the Gordon Leadership Program. The course was established after consultation with a lot of industry leaders. They explained what was engineering leadership and what were they looking for in the successful engineers within their companies. About 3/4 of the topics had to do with leadership, decision-making, advocacy, cross-cultural communication-- but about a quarter of the topics that they really were looking for had to do with good engineering designers.

Course content and expectation: So a course was put together which is a combination of 10 design principles, Socratic inquiry, and the students themselves being engaged in design projects, while being supported by some student teaching assistants.

The purpose of the course is to enable students bring about a change in their thought process. To enable them to question the way a particular thing exists.

For example: When they're walking down the street and they pass a door handle, they think, why is the door handle designed that way? Does it communicate effectively to me to know how to use it? What about other people? Would they understand how to use it? What's the material made of, which material's involved in that door handle? How has it been used? Is it smudged? Is it clear? Is it clear against the background? Hopefully, they see everything differently in the vast interconnectedness of everything in the world

The aim is to enable student's to open their thinking process to start connecting and analysing everything else they do in life. Design thinking finds application almost everywhere hence it can be started with something as simple as planning a birthday party to something more complicated, like making a mechanical system or designing a phone etc.

Teaching style:

The lectures are interspersed with activities. Students will do some hands-on activities every half hour or an hour through, This helps retain student attention.

The classes are a mix of lecture based as well as hands on experience classes. In classes where students are working continuously they are often interrupted and asked questions, and given ideas on improving their projects and evaluating them.

Some classes need a continuous flow like a class on ethics where the students need to become engaged with the material.

The evaluation and feedback session is equally open to students as well as teachers. One thing that facilitates a more accepting feedback session is that all students have name cards on the front and the back. This way when a student calls another by his/her name to give a feedback it becomes more personal and acceptable. Basically they can see each other. So it connects a class to be able to start learning together.

During the duration of the course speakers from outside are also invited for some of the talks. And the outside speakers are an eclectic mix. They can be an Engineering faculty who is particularly gifted at communicating mechanical engineering design skills or electrical or chemical, at others someone who seems rather off-the-wall is also called. Like someone who has started two or three restaurants in the Boston Area. The obvious question is a restaurateur? What does that have to do with engineering?

The students come to the class, but don't really expect to get anything of value until they find out that designing a restaurant is a really significant design process. You have to look at what do the users want? How do you greet them at the restaurant? What type of food do you have? How do you design the space? How do you make the patron in the restaurant feel welcome? How do you make the staff function effectively?

There are many, many aspects and to see someone in front of the room who is not an engineer, and yet who is using some of the same engineer

thinking that you use to solve a problem opens a whole new set of questions and queries. There is a realisation that there are many more dimensions in the world that you're interacting with than you pay attention to.

Prodding Thought-Process : As part of the class students are often asked questions like why? what? how? Students end up giving normal answer to the questions. On further prodding students often tend to get a little irritated. However it turns out that it's not the only way to look at the problem and they simply haven't challenged that way of looking at it. But the fact is, the irritation provokes the expanded exploration, the sensitivity to things around them, which is what the ultimate goal of the class is.

Quizzes and Assistance: Quizzes are all administered, swapped and reviewed. Multiple quizzes are taken and a lot of the questions are repeated intentionally such that if a student skips or misses a question in the first attempt they will solve it the second or the third time. All quizzes are review in the class itself for the benefit of all.

The teaching assistants take notes of everything that is discussed in the class. This helps in incorporating topics that get left out or might be triggered during some discussion. The involvement of the teaching assistants has brought a whole new perspective to the whole course. The course was taught in a more conventional manner until some students volunteered to be teaching assistant after the first term.

The students and the teaching assistants also share an online camaraderie where they can post questions or doubts anytime of the day or night and appropriate TA's can answer it. Three or four teaching assistants monitor the website literally 24 by 7

This system is not only more productive and helpful but also very satisfying. Students benefit and appreciate this kind of dialogue.

Hence it isn't surprising that when it comes to giving scores the Teaching Assistants almost always end up with a full score of 7 given by the students.

Grading System:

The grading system is different from an ordinary course. In an ordinary course, there's a specific body of material, and so you can grade on proficiency. However in a course like this students are being taught of way of thinking and being innovative so they are given exercises and presentations, and then are graded on the passion of their engagement. Although some of them have better presentation skills than others its not an absolute mark that is being looked at, but a keenness to go outside the box? Try something new? Given where a person was at the start of the course, was there an increase in their skill set effectively and energetically?

Those who do are the ones that end up with a good grade in the course. Its not surprising that many do end up getting excellent grades as they make an active effort in the course because they've elected to take a course to enhance their capabilities. Those who don't are the ones who simply haven't participated as fully.

ENG12 Design Thinking in Dartmouth Engineering school

Course Description:

A foundation course on the cognitive strategies and methodologies that form the basis of creative design practice. Design thinking applies to innovation across the built environment, including the design of products, services, interactive technology, environments, and experiences. Topics include design principles, human need-finding, formal methodologies, brainstorming, heuristics, thinking by analogy, scenario building, visual

thinking, and study of experienced thinkers. Weekly projects and exercises in a variety of media provide practice and development of students' personal creative abilities. Enrolment is limited to 20 students.

Course information:

About the course: Design thinking is taught as the course ENG12 Design Thinking in Dartmouth Engineering school. The course is taught by Peter Robbie '69, Associate Professor of Engineering. The course is offered three times a year with an enrolment cap of 20 students. It is a multidisciplinary course and students from all branches are free to take up the course.

About the Professor: Peter Robbie '69 graduated from Dartmouth with a major in English, completed an M.F.A. in sculpture at Cornell and spent several years exhibiting in New York City as a studio artist. In 1972 he returned to Dartmouth to teach visual studies and then design.

Purpose of the course: The purpose of the course is to solve a problem in the campus using the methodology of Design Thinking. Students in the past have taken up and solved several issues based in the camps like fixing the Dartmouth alumni network, design a way to reduce clutter in college dorm rooms and an advertising campaign to change a social behaviour such as excessive drinking

Course content and expectation: Design thinking is the foundation course for creative strategies in innovation and includes methods of creativity including lateral thinking, ethnographic research for need finding and various creative strategies including brainstorming and improvisation. The expectation of the course is to look at the products and services and design them innovatively.

Teaching style: The focus of the course is problem solving rather than product design. Hence the most technical assignment is to build a portable, collapsible chair out of foam board. Other assignments tend to be more conceptual and involve tasks such as coming up with a way to reduce clutter in college dorm rooms and designing an advertising campaign to change a social behaviour such as excessive drinking. Although Robbie urges students to not overlook the obvious, he also encourages them to experiment with surprise solutions. He tells students about 20th-century Maltese inventor Edward de Bono, who conceived of “lateral thinking” and coined the term “PO” (provocative operation) to refer to the kind of outlandish idea that can free us from the rut of habitual thinking. Some clever examples of PO: How to limit parking time in free parking spaces? Require drivers to leave their headlights on. How to discourage factories from polluting a river? Have them use water-intake pipes downstream from waste output.

Grading System: For the final project, students work in teams to address campus challenges, including sexual assault, social discrimination and irresponsible and disrespectful party behavior. After several weeks of research and planning, the teams present their solutions to a panel of faculty and deans. In previous terms “Design Thinking” presentations have resulted in new College policies such as changes to first-year orientation and the undergraduate advisor program, the creation of a Dartmouth admissions virtual visit website and the establishment of Dartmouth Food Connection, a program that allows students to donate unused funds from their dining-plan accounts to local charities.

Parameters of a Design thinking Course

As part of my study an observation was a common pattern in all schools implementing Design Thinking as a separate subject or as part of another course. Below is a summary of the common parameters followed while teaching such a course.

1. Since Design thinking is a methodology it cannot be successfully understood just through theoretical knowledge and hence all courses pertaining to Design thinking are project based. Students are mostly divided into groups and where they need to solve problems in the required domain.
2. The courses are taught by mostly interdisciplinary faculty who bring a variety of experiences.
3. The course timings are mostly flexible with more classes during the beginning of the course than the end where more time is given for project completion than lectures.
4. The course includes lectures from external visitors which helps students get a variety of experience.
5. The lectures are interlaced with activities such that the students get time to implement what they learn then and there
6. All courses deal with teaching techniques to sharpen creative analysis skills which then finds implementation in their projects.
7. Over the course of time students develop skills to conceive, organise, lead, implement and evaluate successful projects.
8. The evaluation of the course is more based on the passion and engagement of the student rather than a material measure of their knowledge.

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