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TEACHING AXIOMATIC DESIGN IN THE FRESHMAN YEAR: A CASE STUDY AT KAIST

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ABSTRACT

Axiomatic design theory was once considered the domain of engineering doctoral candidates and industry experts in search of an improved understanding of design. However, an innovative freshman design course at KAIST is using Axiomatic Design Theory, along with traditional product design and TRIZ, to improve the students' ability to think independently, consciously, rationally, and synthetically. This paper discusses the basic format, goals, and philosophy for ED100: Introduction to Design and Communication. Finally, the successes, challenges, and the future implications of the course are also discussed.

Keywords: first year education, design theory

1 INTRODUCTION

Axiomatic design (AD) theory was once considered the sole domain of engineering doctoral candidates and industry experts in search of an improved understanding of design. AD is still offered primarily in graduate engineering subjects [MIT, 2008; WPI, 2008; KAIST, 2008; Tate 2004], as university professional short courses [MITPI, 2008 and Brown, 2008] and through short courses offered by industry [ADS, 2008].

However, as axiomatic design theory has gained acceptance within the larger design community, it has begun to appear in undergraduate classes. AD has been used in capstone design courses in the Mechanical and Electrical Engineering Departments at the University of Idaho [Odom, 2005]. It has been combined with a variety of other design tools and theories in an undergraduate capstone course at Ryerson University in Canada [Salustri, 2003]. It is also compared to other design processes in an undergraduate materials design course at Northwestern University. However, until recently AD was still notably absent from the growing field of freshman design education.

This work describes an innovative freshmen design course at KAIST which uses Axiomatic Design Theory, along with traditional product design and TRIZ, to improve the students' ability to think independently, consciously, rationally, and synthetically.

2 MOTIVATION

The new freshman design course at KAIST is part of a larger initiative to make KAIST one of the best scientific and technological universities in the world.

2.1 KAIST REVOLUTION

During his inaugural address at KAIST, President Nam P. Suh stated three major goals for helping the university to become one of the premiere research institutions in the world: (1) "to produce the next generation of leaders for society, industry, and academia," (2) "to build the knowledge base and create technologies that will shape the future of humankind," and (3) "to provide public service that will change our world for the better." His vision was for KAIST to become "the place where innovative, new ideas and concepts are created that change the way people think and approach challenging issues. It will be where … disruptive technologies are generated. Most of all, it will be the place where our planet's future leaders - in all fields of human endeavor - are groomed through the rich education and varied experiences they receive and the professional and personal relationships they form." [Suh, 2006] To achieve these goals, KAIST is working to create a campus-wide culture of "design thinking."

2.2 DESIGN THINKING

One of the most complete discussions of design thinking can be found in [Dym, 2005]. The paper's definition of good design thinking includes: divergent-convergent thinking; systems thinking; the ability to tolerate ambiguity and uncertainty; the ability to make decisions; the ability to work in teams; and the ability to communicate through various media and in the multiple languages of design.

Stephen Lu [2007] adds the following characteristics of good design thinking: "synthetic (rather than analytical) thinking; functional (rather than physical) thinking;…constructionist (rather than determinist) thinking; solution-neutral (rather than solution-specific) thinking; demand-driven (rather than supply-based) thinking; want-pull (rather than need-push) thinking; price-based (rather than cost-based) thinking; top-down (rather than bottom-up) thinking; [and] socio-technical (rather than pure-technical) thinking."

2.3 DESIGN REVOLUTION

The design revolution at KAIST has three major parts. For undergraduate students, a new mandatory freshman

design class (ED100) has been created to introduce the fundamentals of conceptual design and critical thinking to students. For graduate students, a new joint MS-PhD program is being developed with a special focus on interdisciplinary systems thinking. For faculty and researchers, a new research institute, the KAIST Institute for the Design of Complex Systems (KIDCS), has been created to facilitate interdisciplinary research on design.

2.4 ENGLISH REVOLUTION

During his inaugural address, President Nam P. Suh also said that the "[f]uture graduates of KAIST must have the ability to work in a global economy. They should be trained and exposed to the cultures and customs of other nations so that they can operate globally in technical and managerial fields." As part of the globalization efforts at KAIST, all courses must be offered in English by 2011. Currently all freshman and sophomore courses are taught in English. Junior level classes will be added in 2009 and senior level classes will be added in 2010.

In accordance with these policies, the KAIST freshman design class is taught exclusively in English. It is the only major freshman design course (to the author's knowledge) that is taught in English as a foreign language. The new joint MS-PhD systems thinking program will also be English-based.

3 FRESHMAN DESIGN

The freshman design course at KAIST is formally known as ED100: Introduction to Design and Communication. It is a 3 unit course and required for all incoming freshmen regardless of major. (For the Spring 2009 semester, it will become a 4 unit course consisting of ED100: Introduction to Design and ED101: Communication for Design.) Approximately 400 students (half of the freshman class) register for the course each semester.

The pilot for ED100 was run as a freshman elective in the Fall 2007 semester with 29 students. Prof. G. J. Park from Hanyang University in Korea was the course coordinator for that effort during a sabbatical leave at KAIST. The full scale version was first offered in the Spring 2008 semester and is run by Prof. M. K. Thompson and Prof. T. S. Lee from KAIST.

The only other freshman design course which is required for all students regardless of major (that the author is familiar with) is EPICS 151 at the Colorado School of Mines. The majority of the other required freshmen design programs are limited to the School of Engineering, to a specific department, or are offered as first year elective courses.

4 COURSE PHILOSOPHY

The intent of ED100 is to use design and design thinking to produce a paradigm shift in the way that the students think, view education, view the world, and view their role in the world.

4.1 NEED FOR ED100

At KAIST, 85 – 90% of the students in the incoming freshman class have never participated in a design project before. Their education before entering university has focused more on memorization and calculation than on analysis and synthesis. Evaluation of their work has been done with more tests than projects. These students have little experience with open-ended poorly-defined questions and assignment. They are used to working with specific instructions, rather than independently evaluating the situation and choosing the best path for their work. Finally, they are used to relatively little freedom of choice in academic subjects and take courses that are required (or suggested) rather than choosing courses which will help them achieve their future goals.

Because of the choices made in the course development and the very nature of design projects in general, ED100 changes all of the previous rules of education and starts students down the road towards personal and professional independent thinking. It is, understandably, not always an easy road to take.

4.2 EMPHASIS ON DESIGN THEORY

There has long been an assumption that design cannot be taught. Designers are often said to be "born, not made". Design is often described as an "art" or a "trade." It is not uncommon to hear someone say that students must develop their "designer's intuition" through experience. Design is, by definition, a human activity. Aspects of it are intangible, inexplicable, and improved with time and experience. However, these adages do little to help students learn design or help professionals improve their efficiency or techniques.

In ED100, we assume that design can be taught scientifically. As a result, the course materials focus heavily on design theory, process, and methodologies. The students are required to approach design from a creative, but conscious, rational, and systematic perspective. Trial-and-error and intuitive design are not permitted. All design decisions must be explained and justified. Success is evaluated not just based on the quality of the resulting design from the viewpoint of the faculty members doing the grading, but based on the students' ability to understand, explain, and substantiate their work.

4.3 SUBJECT-SPECIFIC TOPICS

Because the course is mandatory for all incoming students, appropriate subject-specific design topics, including principles of design, design of / design for, and design tools and technology, would be different for each student. As a result, subject-specific design topics are not covered in the course.

Design projects are scoped to minimize subject- or domain-specific knowledge and skills. Required subject- or domain-specific knowledge is provided by project advisers and teaching assistants, or obtained through background research and expert interviews. It is expected that students will acquire subject specific design knowledge, skills, and experiences in upper-level design courses offered within their respective departments.

4.4 TO BUILD OR NOT TO BUILD

Many undergraduate design courses strongly emphasize design realization (building). Hands-on experiences can enhance confidence, increase excitement, and result in an improved sense of achievement at the end of the course. However, there is a risk that students will focus on "doing" at the expensive of "thinking" when faced with the pressure of impending deadlines (Students sometimes refer to this as "hacking things together.")

Design implementation in ED100 is not required for all projects. However, individual project advisers may choose to require a prototype. All students are encouraged to create some kind of visual aid to help communicate their final design. Some projects will have full working prototypes. But the majority will rely on sketches, sketch models, movies, dioramas, or other media to communicate their ideas.

It is expected that students will have additional opportunities to do detailed design and build-and-test in upper-level design courses offered within their departments.

4.5 BREAKING THE RULES

Novices in all fields, including design and communication, tend to seek "the rules", while experts tend to ask "what are we trying to do?" In ED100, there are no "rules" which students must obey. Instead, students are exposed to different ideas, opinions, tools, and guidelines. The students, then, choose which aspects of the lecture materials to apply to their design projects and how to apply it based on their needs. The emphasis is on whether or not the students' decisions make sense, and whether or not they can explain and defend those choices.

4.6 GRADING PHILOSOPHY

Discussions of grading philosophy in freshman design classes are frequently heated affairs. Many faculty members argue that these courses are intended to be fun and motivational, and thus grading is either unnecessary or should be very lenient.

In ED100, grading is a difficult issue. All aspects of the course repeatedly emphasize that the course exists to help the students with their education, their lives, and their careers. The rewards in the course are not grades, but the opportunities that students have to write papers; file patents; start companies; and produce ideas and designs that could make a real difference in the world. The course faculty work very hard to ensure that students are not learning design simply because they were told to.

However, there is also a major concern that if grading is not taken seriously in the course, the students will not take the course seriously. Thus, evaluations in ED100 are done as rigorously as the grading in other subjects. Grading is done on a straight scale and there is no curve. Students are given the grade they earn. Grading instructions and criteria are published for all assignments and final deliverables. In addition, discussion forums are posted for all assignments and final deliverables. These steps are taken to make the grading process as fair as possible and to allow students to focus on their work instead of their grades.

5 COURSE OVERVIEW

ED100 is a project (problem) based course that has been heavily influenced by the Northwestern University freshman Engineering Design Course. The course format changes slightly each semester, but in general students attend 1 - 2 hours of design lecture per week, 3 hours of design laboratory, 1 hour of communication lecture, and 1 hour of communication laboratory.

5.1 DESIGN LECTURE

There are 11 lectures during the 16 week semester. The remaining weeks in the semester are unscheduled to give students more time to work on their projects.

Design lectures are primarily based on material from Axiomatic Design Theory [Suh, 2001] and traditional product design [Ulrich, 2008]. Classical AD assumes that the student is already familiar with design and that they will use AD to supplement and modify their design thinking, rather than building it from scratch. The material from product design is used to create a more holistic course for novice designers. The lectures are also supplemented with materials from Altshuller [2005], Pahl and Beitz [2005], Simon [1996], Suh [2005], and others.

The lectures introduce various definitions of design, design methods vs. design methodologies, and design thinking. Problem identification, problem clarification, and background research are discussed. Different design processes are introduced and compared. Customer needs and customer research are addressed. Functional thinking, functional requirements, and the independence axiom are introduced. Strategies, concepts, and design parameters are explored and compared.

Concept refinement techniques from AD, TRIZ, and other areas are introduced. Students are encouraged to locate and fulfil hidden needs; eliminate coupling, conflict and bias; consider physical integration; introduce flexibility and modularity in their designs; use hidden or free resources; recognize and increase the level of innovation in their concepts; and to increase the overall ideality of their designs.

Students learn about concept testing, concept selection, customer testing, and prototyping. A guest lecture on intellectual property in the US and in Korea is offered. The process domain and design implementation are discussed. Finally, the design matrix is discussed in more detail and advanced techniques for identifying coupling in the matrix are presented. Bonus lecture materials are available on complexity and the information axiom but are not presented in class.

5.2 DESIGN PROJECTS

Each semester, approximately 20 different design projects are offered. Each design project has one faculty project adviser and two graduate student project teaching assistants. Together, they advise four to five project teams which are composed of four or five students each. Project

advisers come from all departments at KAIST and are welcome to offer any project topic. Internal and external clients who bring their own design project topics to the course may be introduced in the Spring 2009 semester.

Projects are required to be unsolved, real world problems. They should encourage the students to further refine the problem definition and choose the specific aspect of the problem that they will work on. Project should provide a large solution space so students can explore a variety of ideas, however the projects themselves should be solution neutral. (This makes the course more problem-based than project-based.) The projects should not require strong domain-specific knowledge, but should encourage students to use fundamental science. Finally, the projects should be scoped to allow students to build or specify a tangible solution if possible.

During the Fall 2008 semester, a professor from the School of Humanities and Social Sciences offered a very successful project on policy design to bridge the digital divide. Other common themes include eco-friendly buildings or products, alterative fuels, futuristic cellular phones and IT products, a wide variety of robots, international development, design for the disabled, and consumer products and toys.

5.3 HOMEWORK ASSIGNMENTS

Weekly project homework assignments are given to all students in the course. These are open-ended assignments which require the students to apply the lecture material to their specific projects. These assignments are graded by the project adviser or the project teaching assistants. Additional assignments may be given by the project adviser if desired.

5.4 COMMUNICATION COMPONENT

Design is fundamentally a communication intensive activity. Communication skills are needed both for the successful delivery of design outcomes and for the effective management of design projects. This is particularly true for design projects which are focused on conceptual design and design thinking, instead of on design realization. The communication component in ED100 was introduced to help and support the students with the communication aspects of their design projects and their final deliverables.

ED100 communication lectures cover teamwork, professional communication, performing and documenting background and customer research, oral presentations, visual communication, and written communication. Communication laboratory sessions provide an opportunity for students to work with their teammates, other teams and their communication adviser to draft, revise, and refine their project-specific communication assignments.

The communication component in ED100 places particular emphasis on learning communication skills in a technical context rather than learning general English communication skills. This is intended to provide a more authentic and need-based setting for applying and practicing the types of communication needed for students of science and engineering.

5.5 COURSE DELIVERABLES

The course has three final deliverables. Each team is required to give an oral presentation as part of their mid-term design review. They are required to produce a technical poster which is displayed during the end-of-term poster fair. Finally, each team is required to write a technical report explaining their design problem, design process, and design solution.

5.6 LOGISTICS

To help run the course, Moodle online course management software is used. Announcements, lecture notes, assignments, and discussion forums are posted in the course main page. Project-specific announcements and discussions are posted on the project pages. All assignments are submitted and graded electronically on the project pages.

6 RESULTS

The success of the course is evaluated through a variety of metrics including the quality of the final projects and final grades; survey results; unsolicited feedback from students, faculty, and visitors; and continuing work.

6.1 FINAL PROJECTS

Overall, the final projects in ED100 are very good. Most teams have strong statistics or customer data to demonstrate the need for their design and substantiate their customer needs and functional requirements. Designs tend to be uncoupled or decoupled. The level of innovation for most of the projects is high and almost no projects rely on incremental improvements. Many projects have calculations, experiments, or customer testing data to support the viability of their designs. And all projects use formal design theories and processes to produce their final design (although some do so more successful and rigorously than others.) As a result, final grades in the course tend to be high.

In addition, some teams have full working prototypes. The number of working prototypes is on the rise despite not being a course requirement. For the Fall 2008 semester, teams produced working ducted-fan type unmanned aerial vehicles (UAVs) and air-drop vaccine containers which successfully survived being thrown off of tall buildings. Modular eco-friendly paper furniture including a desk which retracts into the ceiling and bookshelves which can be reconfigured into chairs were produced. Students also designed and built bio-mimetic robots that could climb stairs and navigate rough terrain. Some of the designs that are being produced are junior/senior level work and not what one would normally expect from a freshman design class.

6.2 SURVEY RESULTS

The Spring 2008 final survey shows that the students felt that their overall understanding of design (6.92/10) and their ability to think (6.83/10) both improved during the course. They also reported that they mostly enjoyed the course (6.74/10) and were satisfied with the course (6.77/10). Results from the Fall 2008 survey also show that students feel that

they have learned a lot during the semester (4.90/7) and mostly enjoyed the course (4.11/7).

Survey results are likely affected by three sources of bias. First, the surveys are conducted in English. This introduces a risk that students will not fully understand the meaning of some questions. Second, surveys are conducted during finals week when student stress levels are highest and students have not had time to reflect upon their experiences. Lastly, the Spring 2008 survey was not mandatory and may not adequately reflect the opinions of the entire student population. As a result, the surveys are used primarily to improve the course for the next semester.

6.3 CONTINUING WORK

After the Fall 2007 pilot of ED100, three teams were invited to present their design projects at the Fifth China-Japan-Korea Joint Symposium on Optimization of Structural and Mechanical Systems in Jeju, S. Korea. A fourth team continued their work as an Undergraduate Research Project (URP) and presented their work as a research paper at the 21st International KKCNN Symposium on Civil Engineering in Singapore.

After the Spring 2008 semester, one team continued their work as a URP and filed two patents on their design. (Several other teams were considering filing patents, but those statistics are not currently available.) In addition, Samsung invited nine teams with projects related to the company's interests to participate in a 'KAIST Freshman Invitation Competitive Seminar'.

It is expected that a substantial number of patents will be filed from the Fall 2008 projects, but the number is not yet known.

6.4 UNSOLICITED FEEDBACK FROM FACULTY

Unsolicited feedback from various faculty members associated with ED100 has generally been very positive. Many faculty members regularly voice their support for the course and express interest in continuing to be a part of the course as time allows. However, there were some initial reservations about the course, including concerns that the students did not have enough domain knowledge to do design, or that the course material was too non-traditional or not applicable to all students and majors. As time goes on, those concerns seem to be diminishing. One of the project advisers from the Spring 2008 semester sent the course coordinators (and the president of the university) an email with the following statement:

> "At the beginning of this semester, I was uncertain about whether this kind of design course would work for freshmen. … However the seriousness and heated atmosphere of the students in the team discussion convinced me that they know what they are doing and this course will work. I was also re-convinced that you don't need to be a master or PhD to be a good designer."

The greatest strength of any educational experiment is not shown by its initial supporters, but in those who are convinced after experience with the project. Comments of this kind are considered to be excellent indicators of success for ED100.

6.5 UNSOLICITED FEEDBACK FROM STUDENTS

Similarly, the initial response of the students to ED100 is frequently mixed. The course material is new to all of the students and very challenging. Students often complain that the course work load is too high and the course itself is too fast-paced. They also sometimes feel that the lecture material is "trivial" or "useless" at first and that the course should not be required. However, these opinions often change after the students have completed their project and participated in the poster fair. One student email to the course coordinators from the Spring 2008 semester said:

> "I want to give my thanks to you. Frankly speaking, even until the last period of the semester, I didn't like this class because the homeworks [sic] was too hard, big and a lot.
>
> But, during doing the poster fair and presentation, I changed my mind. I thought that it is just hard and doesn't help my study, but now I think that it changed my view of thinking. And I also could feel the happiness of accomplishing something with the members with same object. It was really the one of the happiest things in my first semester.
>
> I like your class and thank you for giving me the chance to have this good experience^^."

(Note: The double carrots at the end of the statement are the local equivalent of a smiley face.) Similar sentiments were echoed by a student from the Fall 2008 semester:

> "To be honest, this course was one of the toughest courses that I have learned since my elementary school years :) Also, as our team's project topic was not making any tangible thing, but rather creating a policy, it was a lot tougher. Getting started was such a huge job that it took us more than about three weeks to get the idea of what we are going to do. However, after the poster fair and all those difficult days are past, I think we learned a lot! I feel really thank you for this course for giving me such precious lessons! Hope the coming freshmen students next year learn a lot from this course as well :)"

These statements are significant for three reasons. First, again they show that the course is successful in accomplishing its goals in changing the students' attitudes towards their education and their role in the world. Second, they show that students who were not initially supportive of the course were convinced of its value through their experiences. But they are most important because surveys have shown that most undergraduate students do not realize the full value of their experiences in design courses until 5 years after graduation. The fact that these students are beginning to recognize the

value of ED100 both for themselves and for future ED100 students after only a single semester is phenomenal.

6.6 CULTURE SHIFT

Finally, there have been both successes and failures in producing a culture shift in the students. Students are increasingly comfortable with expressing themselves in English. They are becoming more vocal and pro-active both inside and outside of the class. Their questions and comments frequently demonstrate a very mature and impressive understanding of design. They are actively seeking help and looking for feedback. They are beginning to debate with each other and their professors. And, we are finally starting to see students valuing the results of their work (and the opportunities and rewards) that exist outside of grades. Although these changes may seem small, they are a drastic departure from the traditional Korean educational system.

However, there is still a lot of confusion and debate about the definition of "design" for both the students and the faculty and the value of AD. The term "design" when translated directly into Korean strongly implies aesthetic or industrial design. It also frequently equated with "creativity" and "optimization" in Korea. It is uncommon to see design discussed as a larger field and within a larger context. This is demonstrated in some of the comments from students in their final surveys. One student from the Fall 2008 semester suggested:

> "[S]implify the lectures and get out of the strict structure of the design process that ED100 demanded. Instead, grant the teams to produce their own process and get on with it. Of course, this would mean that there would be no FRs but I'm sure the teams will get along fine without them."

(Note: The course does actually permit students to use their "own process and get on with it" but AD is still required for homework assignments and is a small part of their technical evaluation.) This shows that this particular student still doesn't fully understand the necessity of defining what they are trying to do, before going about doing it. Or, perhaps they do not understand how FRs help to do that. But in any case, the course has failed to adequately convey these ideas to all of the students.

Another student recognized the differences between the more common definitions of design that they are used to and the course material. However, they also do not appreciate the role of FRs and DPs in the design process. AD is seen as an impediment to creativity and ideation, instead of a way to help organize and focus those efforts.

> "What I've found out is that the way most of the teams thought of 'designing' was very different from the 'designing' that this course tended to do. We thought all we needed to do was think of a good idea and finalize it into an awesome product. But this ED100 designing was trying to create 'something' from 'nothing' which didn't allow any creative, popping ideas to be fulfilled directly. If I were to teach this class, I'd give the topic and develop it without the FRs and DPs and get onto specifying people's ideas right away. In this way, the teams will be relieved from the stress of FRs and have fun making their product more attractive and useful."

A third student's comments indicate that we have not adequately explained why is will never be possible to optimize a poor design into a successful one. Although, we do seem to have succeeded in helping them learn to value patents:

> "It was helpful in that we had to find solutions for problems in a different method, but we did not have a chance to optimize existing systems, which would actually be the realistic, "patent inducing" design approach that could actually assist in creating realistic solutions."

These alternate or limited views of design are sometimes reinforced by faculty, family, and friends.

The suggestion to begin with ideation and more traditional types of design is one that should be seriously considered. This may help students fully engage in their projects earlier and also provide a context for them to use and appreciate AD later in the semester.

Despite the obvious disappointments, these detailed comments show that the students are beginning to value "design" – whatever it is. They are also beginning to evaluate the design process that they used and suggest alternatives or improvements. These represent the third (valuing), fourth (organization), and fifth (characterization by value set/internalization of the value) levels of Krathwohl's taxonomy in the affective domain. This, in itself, is a major achievement.

Finally, other student comments do express an understanding of and an appreciation for axiomatic design theory and the course materials. The extent to which students do (or do not) appreciate some of the more formal aspects of the course are not known at this time.

7 DISCUSSION

ED100 faces many challenges, but also provides unparalleled opportunities for educational and design research.

7.1 CHALLENGES

There are many challenges associated with running any large design course and ED100 is no exception. However, some of the challenges in ED100 are specific to the course.

The majority of the students in ED100 (93%) and many of the faculty members, staff members, and TAs are Korean citizens who learned English as a foreign language. English is the second (or third) language for many of the international students as well. Taking and teaching courses in a foreign language is always a challenge. However, trying to explain, understand and use the highly abstract, conceptual material from ED100 in a foreign language is especially difficult.

Most of the faculty and almost all of the TAs involved in the course are unfamiliar with formal design processes, theories and methodologies. Thus, it is an additional burden for them to learn the course material so they can answer questions and support their students.

Most of the design theories being covered in ED100 were originally developed by or for mechanical engineering or product design. Although many of them were intended to be universally applicable to all areas, the course material is still more suitable for some projects than for others. This is a challenge both for the faculty and the students and is reflected strongly in the survey responses.

Finally, because the all course material is being combined from different sources and because some of the material has never been taught to first year students, the course material is constantly evolving and no unified textbook is currently available for the students. A textbook is planned for the course and should be available within a few years but this is little consolation for the current students.

7.2 OPPORTUNITIES

Despite the challenges, there are also many opportunities especially for the advancement of design education and design theory. ED100 provides an unprecedented occasion to study how undergraduate students learn axiomatic design theory and apply it to non-traditional areas. Trends in questions that students ask or problems that they have applying a given idea to their projects often indicate research areas to explore. Ultimately, the field of design as a whole and axiomatic design theory in particular will likely continue to grow and evolve as a result of this course, its faculty, and its alumni. The areas which have already been identified by ED100 will be the subject of future work.

8 CONCLUSION

A new required freshman design course at KAIST has been developed which combines axiomatic design theory with traditional product design and other areas of design. The goals, philosophy, and basic format of the course were discussed. It was shown that the course has been successful in helping first year students to develop, and in some cases realize, innovative new designs. Feedback from the course faculty and students indicate that the course is challenging, but valuable and that a shift in the student culture is beginning to take place. There are a number of challenges associated with the course, including problems with helping the students to fully understand and appreciate axiomatic design theory and other formal design methodologies. However, the students are demonstrating a solid understanding of design and are beginning to value design and internalize that value. Finally, ED100 has great potential to open up new areas of design research and expand current design theories.

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