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Tirza Arta Hutagalung
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**The Report Committee for Tirza Arta Hutagalung
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Magnet:

An affordable and adaptable table for active-learning classrooms

**APPROVED BY
SUPERVISING COMMITTEE:**

Supervisor:

Kate Catterall

Carma Gorman

Magnet:
An affordable and adaptable table for active-learning classrooms

by

Tirza Arta Hutagalung, B.S.

Report

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Dedication

To my beloved family who always have my back and Arddy who always inspires me.

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I would like to thank my supervisor Kate Catterall for the support, guidance, and never-ending questions that pushed me to make my work better. I also would like to thank Carma Gorman as my reader and advisor who was always there to support and patiently help me with any kind of problems. I also extend my gratitude to all of the other professors in the Design Division and in the Department of Architecture who shared their knowledge with me, including Jiwon Park, James Walker, Kit Morris, Wilfried Wang, Tamie Glass, Elizabeth Danze, and Stephen Sonnenberg. To all of the lab supervisors, Khanh Nguyen, Jonas Hart, Rick Mansfield, José Pérez, and Eric McMaster, thank you for all your advice, teaching, and time; you answered all of my questions and helped me build my ideas into reality. I really learned a lot. And last but not least I would like to thank Anne Duncan, my writing professor, who encouraged me to write more and better.

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Abstract

Magnet:

An affordable and adaptable table for active-learning classrooms

Tirza Arta Hutagalung, M.F.A.

The University of Texas at Austin, 2017

Supervisor: Kate Catterall

The goal for designing a classroom is to enhance the teaching and learning experience, even in the smallest classroom. The design of such a space should avoid any prescriptive and restrictive behaviors, for both teachers and students. Because current pedagogical trends favor flexible and dynamic teaching and learning styles, it should also increase students' levels of engagement and foster active learning and teaching. However, the furniture in existing university classrooms rarely supports today's active teaching and learning styles. Most classrooms are filled with fixed, prescriptive furniture that prevents students and teachers from choosing or changing their learning and teaching modes. Although there are new furnishings designed specifically for active-learning classrooms, they are often too expensive, as well as too large and heavy, for small classrooms.

Magnet is a flexible, modular, one-person table with a flexible working surface and gate-leg fold-flat construction that allows it to be easily moved, stored, and reconfigured to accommodate lectures, small-group work and large-group discussions even in small classrooms. Its unusually shaped "wings" or drop-leaves can be adjusted to accommodate

many uses and group arrangements, so a single model of table can serve many different instructional needs. Magnet can be made of solid wood, plywood, and/or MDF using durable, inexpensive, traditional joinery—plus a few magnets—which makes it uniquely flexible and affordable.

Keywords: table, desk, active learning, classroom furniture, flexible furniture, adaptable furniture, instructional furniture.

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Introduction

In summer 2016, I was working with the University of Texas at Austin's Center for Russian, East European, and Eurasian Studies (CREEES) to redesign one of their classrooms. They engaged me to provide an interior and interaction design proposal for the CREEES collaborative learning space that could be used by faculty, graduate and undergraduate students, and also staff members. The CREEES hopes to more fully embrace digital humanities in collaborations between international researchers and faculty and students at UT Austin. They wanted the new classroom to accommodate their vision by employing appropriate interior, furnishing and technological design solutions.

The classroom was quite small, and we could not change the fact that there were only 280 sq. ft. However, they wanted to modify the space into a multi-purpose classroom that could work as a lecture classroom, collaborative classroom, library, and even meeting room. It was impossible to achieve their goal with the existing furniture: one bulky table surrounded by 10-12 rolling chairs. But all of the furniture on the market was too big for their space, too heavy to move easily, and/or too expensive for their limited budget.

To solve CREEES's design problem, I researched classroom furnishings, classroom activities, and contemporary teaching practices. I learned that existing classroom furniture is usually difficult or impossible to reconfigure, and that contemporary classroom furniture that is designed specifically to favor collaboration is expensive.

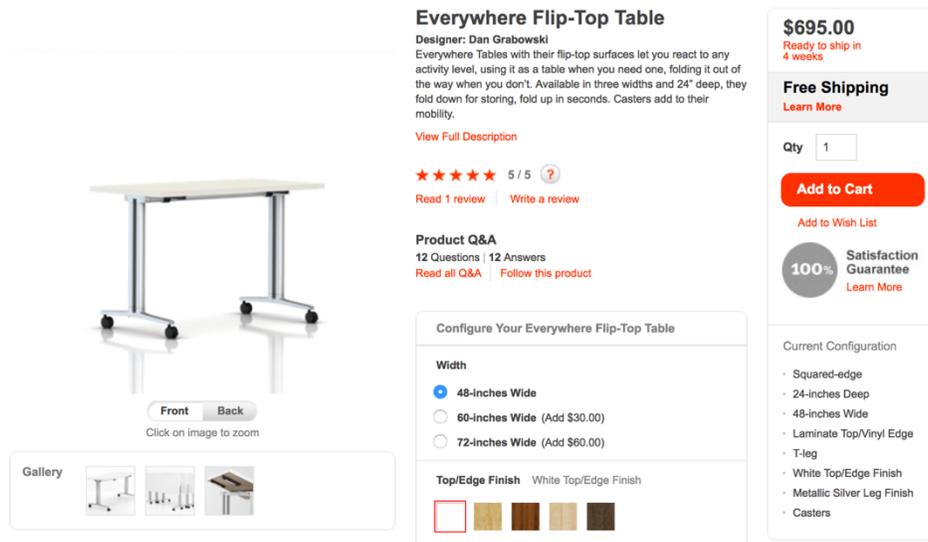


Figure 1. Everywhere Flip-Top Table by Dan Grabowski. Photo from www.store.hermanmiller.com/Products/Everywhere-Flip-Top-Table

For example, the Herman-Miller tilt-top tables on casters that you can nest at the side of the room cost \$695 apiece. And the furniture sets that require you to buy a certain number of trapezoidal tables, plus a certain number of rectangular ones, are expensive, often too large, and not flexible enough to work in classrooms where space is a constraint.

The problems that CREEES had with their small classroom and its furnishings made me realize that there was a real need for modular, flexible furniture that could adapt easily to different kinds of classroom activities, especially in small spaces. Many educational institutions are currently redesigning their classroom spaces to support active learning. But replacing legacy furniture is surprisingly complicated and expensive. There are many active learning furnishings on the market that are designed by well-known designers and endorsed by professional researchers. However, these designs are rarely attentive to the issues of limited space and budget. In this report, I propose a novel design for an attractive, adaptable, multi-purpose, and affordable classroom table that can be

arranged in multiple configurations, even in small classrooms, to effectively support both student-centered and teacher-centered instructional styles.

Research

A SHORT HISTORY OF ACTIVE LEARNING

Until the late twentieth century, teacher-centered education was the most popular style of education, and it remains popular even now, especially in large university lecture halls.¹ Students passively absorbed information provided by teachers, who were in full control of both classrooms and activities. Classroom furniture and architecture were premised on this model. In some classrooms, the furniture was fixed and bolted to the floor in orderly rows of desks and chairs facing forward, which required students to sit still, remain quiet, and pay attention to the teacher, who often sat at a desk or stood at a podium in front of the class. Sometimes the furniture was bolted to the floor in order to maintain neat rows. And in other classrooms, the desks, drafting tables, or tables were often too large and/or heavy to be rearranged easily. Both kinds of classrooms made it very difficult for teachers and students to use anything other than a passive-learning, lecture-based teaching style.

However, beginning in the early twentieth century, a few novel pedagogies such as the Montessori and Harkness methods favored more dynamic student-teacher interactions that replaced passive study with active learning, and increased the use of technology at all levels of education.² In the 1930s, Edward Harkness, a philanthropist, educator, and businessman, funded Philips Exeter Academy to create an innovative way of teaching. He believed that students needed to look other students in the eye to promote meaningful discussions. He used oval-shaped tables to support his pedagogy, which facilitated dialogue

¹ Rose, Joel. "How to Break Free of Our 19th-Century Factory-Model Education System." *The Atlantic*. May 9, 2012. <https://www.theatlantic.com/business/archive/2012/05/how-to-break-free-of-our-19th-century-factory-model-education-system/256881/>

² Rose, Joel. "How to Break Free of Our 19th-Century Factory-Model Education System." *The Atlantic*. May 9, 2012. <https://www.theatlantic.com/business/archive/2012/05/how-to-break-free-of-our-19th-century-factory-model-education-system/256881/>

among students in addition to conversation between teacher and student. He began to favor what he called “conference pedagogy,” which used a system of small group discussion and shifted the focus from teachers to students.³ Also in the 1930s, Maria Montessori introduced her education style, which was based on self-directed, hands-on, and collaborative education. There were no rows of chairs and desks in Montessori schools. Their classrooms were instead beautifully crafted spaces designed to accommodate the need of children to choose their own environment.⁴ Montessori classrooms provided spaces suited to group activities and areas for students to be alone. These education philosophies were among the first to suggest that classrooms should not have prescriptive arrangements, and to suggest that teaching could involve something other than lecturing or Socratic dialogue with the instructor. The term *active learning* was first used in 1982 by English scholar R.W. Revans, and the term itself was clarified by Charles C. Bonwell in 1991.⁵ It is a teaching method where students participate in the learning process rather than only passively listening.⁶ Active learning is popular today because it engages students in dynamic and active classroom activities, such as individual tasks, pair tasks, and group discussion, and enables students to learn better through discussing and doing (rather than only listening).

³ Williams, Guy J. "Harkness Learning: Principles of a Radical American Pedagogy." *Journal of Pedagogic Development* 4, no. 3 (November 2014): 58-67. November 2014. Accessed March 18, 2017. <https://www.beds.ac.uk/jpd/volume-4-issue-3/harkness-learning-principles-of-a-radical-american-pedagogy>.

⁴ "Montessori Classroom." American Montessori Society. Accessed April 25, 2017. <http://amshq.org/Montessori-Education/Introduction-to-Montessori/Montessori-Classrooms>.

⁵ David Weltman, A Comparison of Traditional and Active Learning Methods: An Empirical Investigation Utilizing a Linear Mixed Model, PhD Thesis, The University of Texas at Arlington, 2007, p.7

⁶ Bonwell, Charles; Eison, James (1991). [*Active Learning: Creating Excitement in the Classroom*](#) (PDF). Information Analyses - ERIC Clearinghouse Products (071). p. 3.

LITERATURE REVIEW AND FINDINGS

Many university classrooms are currently fitted with fixed furniture that prevents students and teachers from adjusting their classroom's configuration to meet their needs. Fixed furniture does not have the ability to adapt to different activities and to share the space with other furniture for other functions. Classrooms need working surfaces that are flexible and adaptable enough to change to accommodate different classroom needs and technologies, but many lecture-hall desks have work surfaces that are too small for anything but taking notes in a very small notebook. Therefore, there are classrooms that are suitable only for lectures, others suitable only for small-group discussions, and some only suitable for individual work. This is an inefficient use of space, and prevents faculty from implementing active-learning pedagogies in some classrooms.

Active learning classrooms, where students and teachers interact actively and dynamically, require furniture that can accommodate different configurations. While electronic devices might be the biggest attraction to students and teachers, new research from Steelcase shows that moving chairs and tables are more engaging than those devices.⁷ By moving chairs and tables around, teachers and students can find the most conducive layout for their classes. This activity also builds connections among the students and teacher. The flexibility and fluidity is not only built on the physical space but also in the discussion, which can also improve students' success. For example, in "Designing Space for Active Learning," Aimee Whiteside and Steven Fitzgerald mention that circular settings are better for engaging students in group work.⁸ Their findings parallel those of

⁷ Scott-Webber, Lennie, Aileen Strickland, and Laura Ring Kapitula. "How Classroom Design Affects Student Engagement." Steelcase. June 2014. Accessed March 18, 2017. <https://www.steelcase.com/insights/white-papers/how-classroom-design-affects-student-engagement/>.

⁸ Whiteside, Aimee, and Steve Fitzgerald. "Designing Spaces for Active Learning." *Implications* 07, no. 01. Accessed November 5, 2016. http://www.informedesign.org/_news/jan_v07r-pr.2.pdf.

Harkness, who argued that students who can see each other face-to-face create more meaningful discussions, and that these are as important as teacher-student discussions.

Dr. Lennie Scott-Webber’s research also supports the need for flexible furniture. She argues that there are five main pedagogical activities: delivering, applying, creating, communicating, and decision making.⁹ She suggests that a circular setting works best for informal discussions, but that a square setting works for more formal discussions such as decision making, and that a linear configuration works best for “delivering” content via a lecture or presentation. Her article gives insights into the different configurations that a classroom needs to accommodate in order to support teaching and learning activities to the fullest.

ENVIRONMENTS	ARCHETYPAL ATTRIBUTES*			
	Icon	Behavioral Premise	Process Steps	Protocol Attributes
Delivering		<ul style="list-style-type: none"> Bring information before the public Instructor led Knowledge is in one source 	<ul style="list-style-type: none"> Prepare and generate presentation Deliver to an audience Assess understanding 	<ul style="list-style-type: none"> A formal presentation Instructor controls presentation Focus is on presentation Passive learning
Applying		<ul style="list-style-type: none"> Learner-centered An apprentice model 	<ul style="list-style-type: none"> Knowledge transferred via demonstration Practice by recipient Understanding achieved 	<ul style="list-style-type: none"> Controlled observation One-to-one Master and apprentice alternate control Informal Active learning
Creating		<ul style="list-style-type: none"> Innovation or knowledge moved from abstract to a product 	<ul style="list-style-type: none"> Research Recognize need Divergent thinking Incubate Interpret into product / innovation 	<ul style="list-style-type: none"> Multiple disciplines Leaderless Egalitarian Distributed attention Privacy Casual Active learning
Communicating		<ul style="list-style-type: none"> Share information Provide quick exchange 	<ul style="list-style-type: none"> Organize information Deliver Receive and interpret Confirm 	<ul style="list-style-type: none"> Knowledge is dispersed Impromptu delivery Casual Active learning
Decision Making		<ul style="list-style-type: none"> Make decisions 	<ul style="list-style-type: none"> Review data Generate strategy Plan Implement one course of action 	<ul style="list-style-type: none"> Knowledge is dispersed Information is shared Leader sets final direction Situation is protected Semi-formal to formal Passive / Active learning

Figure 2. Archetypal Attributes for Knowledge Environments. Tables by Scott-Webber.

⁹ Scott-Webber, Lennie. *In Sync: Environmental Behavior Research and the Design of Learning Space*. Ann Arbor, Michigan: The Society for College and University Planning, 2004.

In order to design a work surface that could accommodate the needs of two contrasting configurations (circular settings and rectangular settings) in a limited space, I looked next at the literature on multi-functional and collapsible furniture. In an article called “The small world of multi-functional furniture,” Nancy Jehmlich mentions that multi-functional and collapsible furniture shares the same objective: to save space.¹⁰ But saving space is not the only advantage of collapsible furniture. Collapsible furniture is also able to reset and reshape the space to support multiple uses. And as Per Mollerup contends in his discussion of collapsible furniture, “It is a principle that simultaneously constitutes a fundamental survival strategy: If you don't adapt you don't survive.”¹¹ Therefore, to accommodate several needs in an active learning classroom, I decided that I should try to design one table that could adapt and change according to teachers’ and students’ needs, and that could collapse and be moved out of the way as needed to save space.

In multi-functional and collapsible furniture, well-designed joinery facilitates easy and effective transformation of the furniture. But because cost is one of the limitations in many small spaces, affordable joinery that does not sacrifice aesthetics or function is a necessity. There are two main ways to make tables or desks collapsible: fold them flat vertically or horizontally. To avoid having to lift cumbersome pieces for stacking, it is better to stack them horizontally, which means it needs to fold vertically. There are many ways to fold a table vertically, such as gate-leg, drop-leaf, accordion, etc. But I realized that to keep the cost low, the table’s system and joinery would need to be simple and traditional, and when possible made of wood rather than of expensive metal hardware.

¹⁰ Jehmlich, Nancy. "The small world of multi-functional furniture." *Stylepark Magazine*. November 19, 2011. Accessed October 22, 2016. <https://www.stylepark.com/en/news/the-small-world-of-multi-functional-furniture>.

¹¹ Mollerup, Per. *The Genius of Space-Saving Design*. San Francisco, CA: Chronicle Books LLC, 2001. p.7

PRECEDENT STUDY AND FINDINGS

A number of people have designed classroom furniture intended to foster active learning, and/or have designed adaptable furniture for classrooms or workspaces. I studied classroom tables that was designed based specific education philosophy and tables that was design by designers without any educational philosophy background. First example is the Harkness table. It is well known for its oval shape, which encourages students to look at each other and have a conversation.¹² This idea was a breakthrough in the 1930s because the common norm for classroom furniture was square tables in a row for lecture sessions. Although the Harkness table is great for group discussions, it is not a good model for today's active-learning classrooms: the oval-shaped table is too big and fixed. There is no room for expanding or compressing the group discussion. The most obvious way to make it work for both large and small groups would be to chop the table into modular units that could be used all together or in smaller arrangements.

¹² Williams, Guy J. "Harkness Learning: Principles of a Radical American Pedagogy." *Journal of Pedagogic Development* 4, no. 3 (November 2014): 58-67. November 2014. Accessed March 18, 2017. <https://www.beds.ac.uk/jpd/volume-4-issue-3/harkness-learning-principles-of-a-radical-american-pedagogy>.

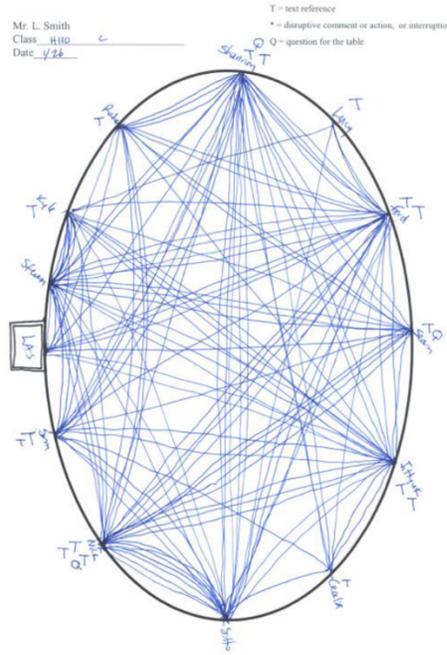


Figure 3. Harkness Table Diagram. Sketch from Guy J. William

The Waldorf/Steiner philosophy of anthroposophy provides another model for classroom furnishings. Adherents of this philosophy seek to use natural means to optimize physical, mental health, and well-being.¹³ Therefore, they only use wooden furniture to allow students to have real relationship to the natural world and to touch and feel the natural environment even in the classroom. Their well-crafted wooden furniture is cut into individual modules, so the desks are easy to move and re-arrange to support various learning and teaching styles. But, they only come in a rectangular shape, which makes them hard to use in a circular configuration, even though the Waldorf/Steiner philosophy involves collaboration and group work instead of individual work.

¹³ Vasagar, Jeevan. "A different class: the expansion of Steiner schools." *The Guardian*. May 25, 2012. Accessed April 25, 2017. <https://www.theguardian.com/education/2012/may/25/steiner-state-funded-free-schools>.



Figure 4. Steiner's classroom furniture and layout. Photo from <http://mileswoodworking.com/school-furniture-2/>

In contrast to the older Hardness and Waldorf/Steiner classroom furnishings, Steelcase's contemporary Verb Chevron Table¹⁴ is a multi-purpose classroom table that can accommodate range of learning modes, and is easy to shift between lecture, discussion and group work. It is well-known for its flexibility to move and form different shapes. It can form both circular and rectangular configurations, because it has a flattened pentagonal shape. The back side is straight, so two tables can be combined to create one larger flattened hexagonal shape. Its smallest size is 24"x60" which makes it a two-person table. But, it has a special feature in the middle of its table. It has a clip to support a small whiteboard (that normally hangs on the side of the table) as a divider. However, the smallest size of this table (24"x60") costs \$472, even without the small whiteboard divider.

¹⁴ "Verb Chevron Table." Steelcase. Accessed April 25, 2017. <http://store.steelcase.com/tables-desks/tables/verb-chevron>.



Figure 5. Verb Chevron Table by Steelcase. Photo from <http://store.steelcase.com/tables-desks/tables/verb-chevron>.

Work in Motion by Fedor Katcuba¹⁵ is a prototype designed for active-learning classrooms. Because it is a one-person module, it is perfect for individual use. The main goal for this table is “to minimize the amount of moves needed to transform the object from its stationary to mobile state.”¹⁶ The pair of wheels allow users to simply take the desk by the handle and move it, as a result, multiple configurations can be created for different modes, such as events, group projects, or extra surface area to place objects. This table works best for circular and square configuration, but it requires another part (a triangular table) to fill in the angles of the circular setting. This is a concept design which is not out on the market yet, so there is no price that I can compare to. But the separate triangular

¹⁵ "Transform the office with workinmotion tables by fedor katcuba." Design Boom. January 11, 2015. Accessed September 17, 2016. <http://www.designboom.com/design/fedor-katcuba-workinmotion-tables-furniture-01-11-2015/>.

¹⁶ "Transform the office with workinmotion tables by fedor katcuba." Design Boom. January 11, 2015. Accessed September 17, 2016. <http://www.designboom.com/design/fedor-katcuba-workinmotion-tables-furniture-01-11-2015/>.

units seem like they would often be in the way when not in use, and thus not very practical for a small classroom.



Figure 6. Work in Motion by Fedor Katcuba. Photo from <http://www.cubebreaker.com/movable-tables/>

The advantages of the Tesella Desk by Nos Design,¹⁷ another prototype, are modularity and easy assemblage. The Tesella Desk can accommodate either open settings or private settings with two dividers that are slotted down the middle. The dividers can be stored easily under the table. It generates a four-way modular array that allows the user to have unique configurations. But, it is too big for small classrooms, and works only for circular settings because of the angle. This is a concept design which is not out on the market yet, so there is no pricing information available.

¹⁷ "Nos designs tessella desk LVLV bookshelf to fit every need." Design Boom. November 29, 2015. Accessed October 15, 2016. <http://www.designboom.com/design/nos-tessella-lvlv-desk-bookshelf-11-29-2015/>.



Figure 7. Tesella Desk by Nos Design. Photo from <http://www.designboom.com/design/nos-tessella-lvlv-desk-bookshelf-11-29-2015/>

From these five examples of past, present, and prototyped furniture for active-learning classrooms, I found that form and material have an important role in dictating how people work and feel. Wood is able to bring natural environment inside the classroom which according to the Steiner philosophy is good for students' mental and emotional health.¹⁸ Since circular settings are important for collaboration, but rectangular settings are also needed sometimes (for lectures and formal meetings), I realized that a table that could shift between having angled or curved sides and straight sides would be the most useful option. Finally, these examples suggested that it would make more sense to create a one-person module that could be grouped into bigger configurations, rather than have a two-person module that would require a divider in between.

¹⁸ Vasagar, Jeevan. "A different class: the expansion of Steiner schools." *The Guardian*. May 25, 2012. Accessed April 25, 2017. <https://www.theguardian.com/education/2012/may/25/steiner-state-funded-free-schools>.

Design Development

DESIGN PROCESS

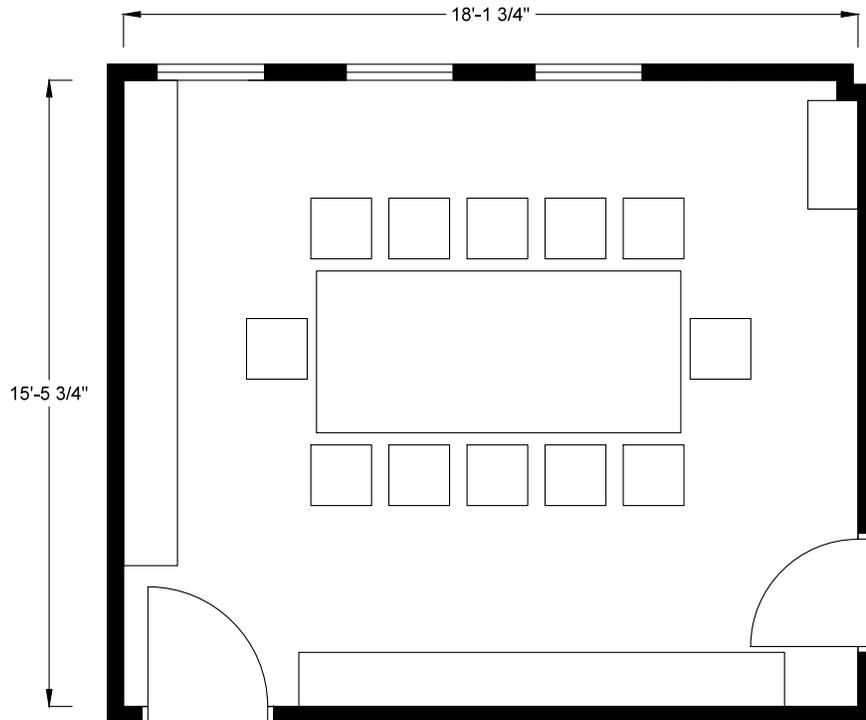


Figure 8. Plan of existing CREEES classroom. Diagram by author.

Design parameters help delineate the project brief. They help designers to establish constraints and objectives as guidance for every design decision. Architects conduct a site analysis at the outset of a project, and similarly, I analyzed the room space as the site for my furniture. This analysis included interviews with educators and students who would use the space, measurements, and photos of the existing space. I analyzed the space, which was relatively small (18' 1" x 15' 5"), and calculated the maximum occupancy. Then, I worked on the functionality and organization of the room for each activity that it needed to accommodate. This table needs to accommodate two major function, square setting and

circular setting. These changing features are meant to allow the potential of the act of learning where students and teachers are able to change the tempo and the configuration of their teaching and learning mode without any boundary.

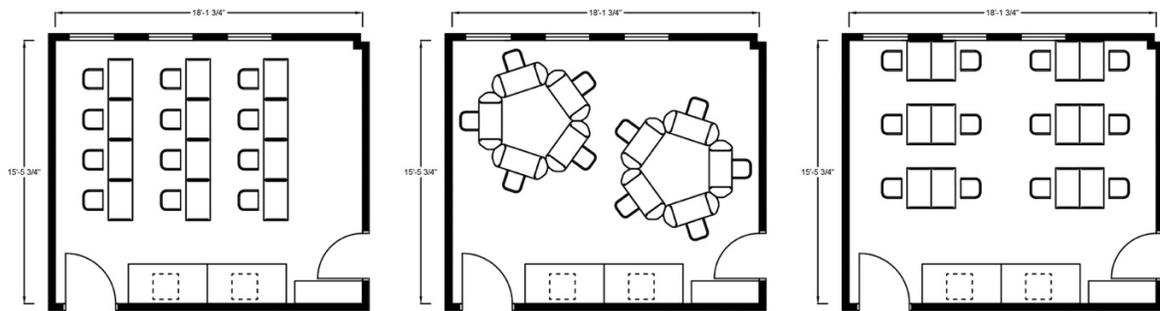


Figure 9. Plan of CREEES classroom with Magnet tables. Diagram by author.

Next, I decided that an 18” x 30” table was large enough for one student to work at with one laptop and a couple of books, but was still small enough to allow 12-15 tables to fit in the small classroom. I also decided that it was important to use simple and familiar joinery, because a too-complicated mechanism might prevent users from trying to modify the tables for their needs. Using traditional wood joinery was also a good way to keep costs down. I also decided the main material for this table would be wood. Wood is a sustainable material and in term of senses, wood has a smooth and warm surface which gives a natural and calm effect to the room. On other hand, it is also renewable, lasts for a long time, and is easily fixed when it is broken. It is also lightweight enough for an adult to lift and move around.

Lastly, the design brief mandates a flexible work surface in order to accommodate various seating arrangements. Therefore, I explored different furniture forms and

configurations for different scenarios, such as traditional classroom, meeting room, library/lab, and seminar/workshop. Finally, to make sure that they all fit in the space, I digitally mocked up different seating arrangements/scenarios for different kinds of uses.

PROTOTYPE

I did two full-scale prototypes. For my first prototype, I decided to divide the table top into two parts. The first part is the 18"x30" rectangular table top. The second part is 10" wing with trapezoid form. This wings were meant to work as surface extension and dividers. The angle on the trapezoid wings served as guidance for circular configuration. And when the wings went down, the table worked as normal rectangular table. I used a sliding system to connect the wings to the table top.

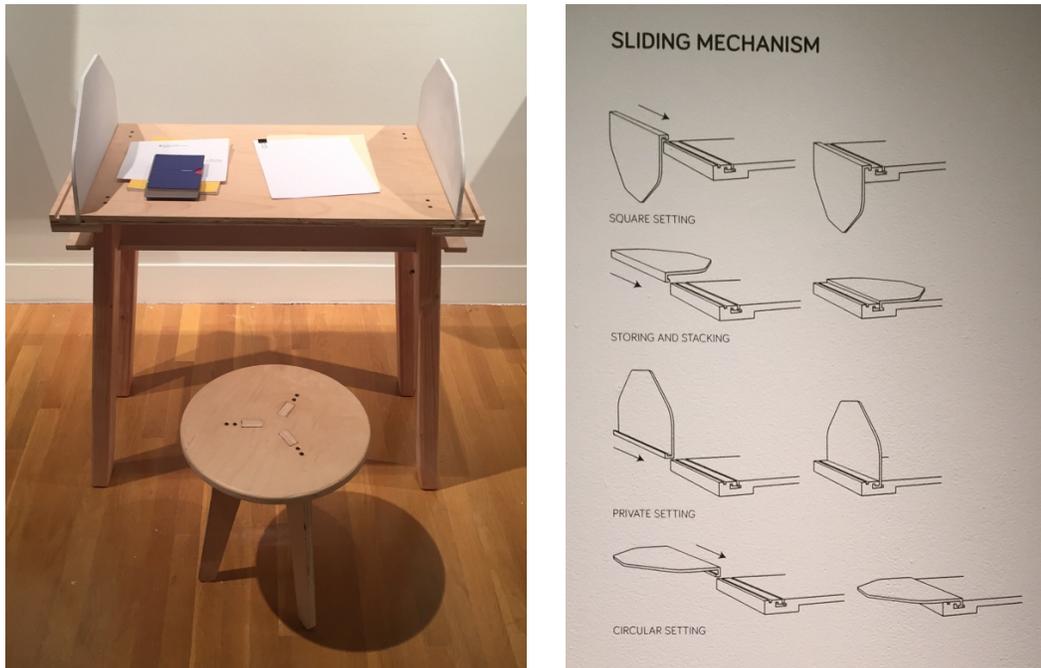


Figure 10. SliDesk, first prototype of the table. Photo by author

Since the length of the table top was the same as the length of the leg, I needed to design a foldable system that was not compromising the look. Usually, people tend to shift the table leg (so they are not parallel) in order to have the legs folded nicely under the table top. Instead, I used different table legs for each side: solid (with wood) and hollow (with metal). This setting allowed the wooden table legs to fit nicely inside the metal table legs without shifting the table legs' position.



Figure 11. Table Leg's folding system from first prototype. Photo by author.

But, I was not satisfied with this prototype. The sliding system was too complicated and there was a risk of missing wings when they were detached. The other problem was the gutter on the table top (where the wings slide) which was prone to collect dust and small objects. Considering the size of the gutter, the accessibility to it was limited. The table legs also had several problems. They needed a locking system for them to be able to pushed or pulled. This contradicted my goal of simplicity. The table leg also folded horizontally, therefore users needed to stack them vertically. There were height limitations

for the stack, and users needed to lift the table high. These were other problems that needed to be reconsidered.

My second prototype, the one that I exhibited, was refined further by redesigning the table leg and the joinery of the wings to the table top. I found that having two parts of the table top worked for accommodating different settings. But, it was better and easier if the wings attached to the table top. Therefore I used rotating joinery for the wings and the table top. I used a hidden metal rod that connected the wings to the table top. This rotating joinery allowed the wings to rotate 180 degrees to serve different functions.



Figure 12. Different modes of Magnet. Photo by author.

I also added magnets on the wings' surface and metal plates on the table top's side so they could attach to each other when the wings were in the upright position. The wings functioned as a divider to provide a privacy barrier during testing when they were in the up position. I used the drop-leaf table structure to support the wings when they were flat.

I also changed the way it folded down. I chose to have it fold vertically so users could stack it horizontally, so that they did not have to lift the table. The folding system

was a gate-leg system. The front part of the table leg could be detached from the table top. When it was not folded, the table leg was locked into the table top with simple sliding locking system. When it was unlocked, the front table legs were able to fold flat, and the table top could then be folded down over them, so that unneeded tables can be stored easily against a wall.

All of the moving parts, including the magnets and metals, are colored in order to inform the users which parts belong together when it is being reconfigured. Because this table had wood as its major material, I thought there should be a bright color for the accent. But to maintain the natural effect, I used a color from green family. I named this table Magnet because it used magnets, which is the important material that allows this table to accommodate different configurations and fold down nicely to save space.



Figure 13. Different configurations of Magnet. Photo by author.

EXHIBITION

Presenting design work within an art gallery context is challenging. There are certain norms and expectations about galleries that I have to overcome, such as the hesitation to touch, sit, and modify the artifacts. Three Magnet tables from the collection were presented in the VAC on April 2017. I contextualized the pieces with a video, which

demonstrated the features and the ways of using the table, and a vinyl map on the floor, which showed different possible configurations. The prototypes for Magnet were constructed using three different materials: solid wood (maple), plywood, and MDF. All had the same clear-coat finish. The reason behind using the same finish was to compare the structure, appearance, weight, and cost of each version. I found that solid wood has the most stable structure, and MDF the least stable. For appearance, maple wood and plywood give similar light color and smooth feeling, while MDF shows darker shades. Plywood and solid wood have similar weights, and MDF is the heaviest. For material cost, the most expensive is the solid wood followed by plywood and MDF.



Figure 14. Magnet in “in order to” Exhibition. Photo by author.

These three tables are accompanied by a video that presents the problems that I have mentioned above and shows how this table works. The video was meant to inform the visitor how to reconfigure the table and urge the visitor to touch the prototype and play

with it. The other signifier is the vinyl plan on the floor. I put the table's plan on the floor to indicate how to configure the circular setting, square setting, and individual setting.

Conclusion and Reflection

The prototype, Magnet, resolves many of the issues I identified in active-learning classrooms at public universities.

First is the flexibility of small classroom furnishing. In order to accommodate active learning in small classrooms, it is important to have a flexible working surface that is able to accommodate different classroom modes. Magnet accommodates three types of classroom configuration: lecture (row configuration), group work (circular and square configuration), and individual work (private configuration with divider). This high flexibility cannot be achieved by having big tables or tables that are parts of systems that are currently available on the market. In addition, Magnet can be folded down flat to the wall to save space.

Second is the cost issue. Most adaptable desks on the market today are very expensive and not as flexible as is needed in many classrooms today. Magnet is affordable because it uses traditional construction (drop-leaf and gate-leg folding), low-tech joinery (wooden pin and metal rod) and sustainable material (wooden table top and structure) which allows it to be repaired easily. In contrast to larger and more expensive options, Magnet provides a smaller, adaptable, and cost-effective furniture solution for smaller classrooms.

It is important for higher education institutions to find a way to provide adaptable, affordable tables for multi-purpose classrooms, because different instructors use different methods of teaching and students need freedom to move their tables around to engage in active learning scenarios, even in a small classroom. And most of all, it is important not to overlook the needs of small classroom spaces, which arguably must accommodate the widest range of teaching and learning styles.

However future iterations are necessary for this table. The next important iteration would be the improvement of the metal hinge on the table leg. It was machine-made unlike the other unique hinges or joinery that people can easily produce/manufacture like the wooden pin. It will be better if I could do more iteration on that specific join and design a simple hinge, so the table as a whole is novel without any machine-made hardware. The other improvement would be the magnet and steel combination to lock the wings upright. I decided at the time that it was the simplest and fastest solution, but maybe there is another way to hold the wings upright.

My hope for this project is that schools that deal with space issues can afford furniture that accommodates active learning. This table was designed with plain material and joinery so anybody can produce it anywhere with simple tools. I might eventually distribute the design for this table on an open source website such as OpenDesk, but first I may reconsider once again the assembly process, and try to minimize the number of materials required to make the table function.

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