FINAL REPORT [DRAFT V1.0]

ARCHITECTURE 5670

F 2018

The Educational Research Studio

All contents not otherwise protected are copyrighted by
The College of Architecture Planning + Public Affairs, the University of Texas at Arlington, 2018
The work included herein is the product of Architecture 5670, Fall 2018, the third of 3 such studios focused on emerging issues impacting the design of educational facilities. As with the first two, this studio was generously supported by the North Texas Chapter of the Association for Learning Environments A4LE. A special note of appreciation to Anne Hildenbrand of BRW Architects, Beverly Fornof and Haley Walton of Corgan Architects and Roberto Zuniga of Huckabee for again giving their time and expertise to this endeavor.

The studio is a fine example of a productive relationship between academia and the profession in ways meaningful to both parties. The profession, through A4LE, established a challenge to investigate emerging issues in school design, most of which represent broad cultural forces affecting much of society, and implications for architectural form in the future. This semester the specific project type was career technology education and the areas of research were security, universal design and modularity. All 3 topics were defined as broadly and inclusively as possible. Thus security included externally generated threats and violence but also included internal threats of physically and emotional bullying and psychology insecurity; modularity, which started with an obvious response to expanding and contracting student populations utilizing temporary classrooms but expanded to become a useful strategy for fundamentally organizing program, use, and form. Universal design was taken for its spirit of intent and ultimate goal—that of creating environments in which the absolutely most diverse range of inhabitants can thrive.

The semester was broken into 3 distinct segments: research, design analysis, concept design. The research consisted of a broad literature survey of the 4 topics, which then resulted into a summary bibliography of those references; “discoveries” made in the literature search became design patterns, recommendations and strategies for translating into form; and then the third phase was individual projects testing these insights. The design projects are intentionally conceptual, and while conforming to the laws of the physical universe, are not intended as proposals for construction at this time, or even schematics that respond to all the issues that would confront in a project for execution. Rather, the projects are multiple explorations of possible directions for future development.

The contents of this publication are the work of the following young professionals:
Alexander Bowman
Yesenia Brena
Jared Brown
Philip Caekhaert
Dulce Chavarria
Jesus Cortes
Erik Guerrero
Michael Hailu
Javier Hernandez
Fernando Longoria
William Lucas
Angie Monge
Alden Obenit
Johan Oberle
George Tobar
Daniel Williams
Donald Gatzke, Studio Instructor
Intentions:
- To direct the activities and intellectual resources of a traditional architectural design studio towards the identification and dissemination of emerging issues in educational facility design that will impact this building type in the future;
- To contribute to the collective knowledge base in school design and make it available to the profession;
- To explore the implications of collected knowledge in the formal design process; and
- To foster a knowledge based design process in the next generation of professionals.

Process:
The studio was organized into 3 distinct modes, more or less in sequence:

1. Research
   A literature search of all relevant published information regarding emerging issues in school design;
   Local site visits to existing schools in north Texas for direct observation and discussion with educators;

2. Analysis
   Distillation of identified emerging issues;
   Categorization under 4 broad rubrics:
   - Career Technology Education
   - Security
   - Universal Design
   - Modularity

   Generation of design recommendations, guidelines and patterns to address the identified emerging issues.

3. Design Synthesis
   Development of individual student design proposals over three successive iterations to explore, test and visualize the issues for implementation in future school design.

   The resulting design work is intended as informed design speculation on the evolution of educational facilities of the future, as responsive to socio-cultural and pedagogical forces. The projects within should be understood as visionary explorations of discovery.
Bibliographic Research
Career Technology Education

This site provides you with information on curriculum, programs, rules, and other information for Career and Technical Education (CTE).


16 Career Clusters: Agriculture, Food, and Natural Resources; Architecture and Construction; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Finance; Government and Public Administration; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections, and Security; Manufacturing; Marketing; Science, Technology, Engineering, and Mathematics; Transportation, Distribution, and Logistics


Career Clusters (10 out of 16): Agriculture, Food, and Natural Resources; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Finance; Health Science; Human Services; Law, Public Safety, Corrections, and Security; Manufacturing; Science, Technology, Engineering, and Mathematics


Career Clusters (9 out of 16): Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Finance; Health Science; Human Services; Information Technology; Transportation, Distribution, and Logistics; Science, Technology, Engineering, and Mathematics


Career Clusters (14 out of 16): List career clusters not available.


Career Clusters (11 out of 16): Architecture and Construction; Business Management and Administration; Education and Training; Finance; Health Science; Human Services; Information Technology; Law, Public Safety, Corrections, and Security; Manufacturing; Science, Technology, Engineering, and Mathematics; Transportation, Distribution, and Logistics
Career Clusters (11 out of 16): Architecture and Construction; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Finance; Health Science; Hospitality and Tourism; Human Services; Law, Public Safety, Corrections, and Security; Marketing; Science, Technology, Engineering, and Mathematics

Career Clusters (12 out of 16): Agriculture, Food, and Natural Resources; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections, and Security; Marketing; Science, Technology, Engineering, and Mathematics; Transportation, Distribution, and Logistics

Career Clusters (11 out of 16): Agriculture, Food, and Natural Resources; Architecture and Construction; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections, and Security; Science, Technology, Engineering, and Mathematics; Transportation, Distribution, and Logistics

Career Clusters (13 out of 16): Agriculture, Food, and Natural Resources; Architecture and Construction; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections, and Security; Manufacturing; Science, Technology, Engineering, and Mathematics; Transportation, Distribution, and Logistics

Career Clusters (15 out of 16): Agriculture, Food, and Natural Resources; Architecture and Construction; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Finance; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections, and Security; Manufacturing;
Marketing; Science, Technology, Engineering, and Mathematics; Transportation, Distribution, and Logistics

“Courses / CTE Courses.” Plano ISD, Website, August 28, 2018, https://www.pisd.edu/Page/15761

Career Clusters (14 out of 16): Architecture and Construction; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Finance; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections, and Security; Manufacturing; Marketing; Science, Technology, Engineering, and Mathematics; Transportation, Distribution, and Logistics


Career Clusters (13 out of 16): Architecture and Construction; Arts, Audio/Video Technology, and Communications; Business Management and Administration; Education and Training; Finance; Health Science; Hospitality and Tourism; Human Services; Information Technology; Law, Public Safety, Corrections, and Security; Marketing; Science, Technology, Engineering, and Mathematics; Transportation, Distribution, and Logistics


CTE High School Students that take one CTE class for every two academic classes minimizes the risk of students dropping out of high school. The average high school graduation rate for students concentrating in CTE programs is 93 percent, compared to an average national freshman graduation rate of 80 percent.

Half of all STEM jobs call for workers with less than a bachelor’s degree. Health care occupations are projected to grow 18 percent by 2026, adding more than 2 million new jobs. 3 million workers will be needed for the nation’s infrastructure in the next decade, including designing, building and operating transportation, housing, utilities and telecommunications. Almost half of the energy workforce may need to be replaced by 2024, and demand for solar and wind energy technicians will double.

In 2009, the average number of credits earned in CTE by high school graduates was 3.6. Over time, the percentage of students taking a few credits of CTE and students spreading their CTE credits across multiple career fields has increased, while the percentage taking a higher concentration of credits in one field has declined.


CTE is offered regular high schools (67 percent of all public high schools), career and technical high schools (4 percent), and other types of special-focus schools (e.g., science high school, special education high school; 29 percent). In 2008, 83 percent of all public high schools offered CTE courses. This includes 94 percent of regular high schools and 55 percent of (non-CTE) special focus high schools. The most common occupational CTE subject areas for secondary students were business (33 percent of high school graduates earned credits), communications and design (30 percent), and computer and information sciences (21 percent).
International research points to a significant downside of such programs: Students may benefit early in their careers but are harmed later in life as the economy changes and they lack the general skills necessary to adapt. “Individuals with general education initially face worse employment outcomes but experience improved employment probability as they become older relative to individuals with vocational education,”

As of 2009, the average American student took 3.6 CTE classes in high school. One recent study of Arkansas’s high-school CTE program found that participants had higher earnings and employment rates as young adults. Longer-run impacts were not examined.

CTE programs have higher employment and earnings than demographically-similar peers in the short run, but they do not necessarily have better academic outcomes. The biggest challenge in evaluating CTE is that students typically self-select into such programs, or student choices are circumscribed by the types of programs offered in nearby schools. Virtually all existing research on CTE has focused on relatively short-run outcomes. This is a notable limitation because many believe that career-focused education involves a tradeoff – namely, learning a narrower set of technical skills that can provide short-run benefits at the expense of learning more fundamental skills that will better serve individuals in the long-run.

Providing tax credits for businesses offering high school internships and making it easier for schools to involve industry professionals in the classroom are two of the ways policymakers can encourage strong cross-sector partnerships to support career and technical education (CTE) programs according to an ExcelinEd report (see below). CTE initiatives, such as career pathway programs, apprenticeships and internships, aren’t very successful if students can’t learn from industry experts or apply what they’re learning in a real work environment.

Career and technical education preparing K-12 students, two examples of the several mention:

At the 375,000-sf Olathe West High School, which opened last fall in this Kansas City suburb. The high school includes eight maker spaces. Olathe West has two distinct CTE learning environments: a space for green technologies that includes a green roof, rainwater catchment, solar panels, and a wind tower; and a place for public safety that can accommodate a full-size fire truck and ambulance. The school district partnered with the community—including a local community college and the fire department. Students participating...
in the public safety program can graduate with a certificate toward becoming a police officer, firefighter, or emergency medical technician (EMT).

At the 237,000-sf, $67.5 million Ross Shaw Sterling Aviation High School in Houston ISD, opened in 2017. The school offers education in business, automotive repair, and aviation training that includes equipment maintenance, flying, and operations management. The school has its own 7,100-sf hangar for two single-engine planes, flight simulators, and movable work stands for mounting up to 17 engines. Students might graduate with a pilot’s license before they get their driver’s license.

The words “collaboration” and “flexibility” inescapably pop up as design criteria. More demand for “scale-up rooms,” with flexible and even removable walls so spaces can be sized depending on their usage. Non-classroom space has increased by anywhere from 10% to 20% over the past several years.

School districts are adjusting how their schools teach in response to community and corporate concerns that students are not adequately prepared for a workplace and proactively engaging their communities and local businesses for advice, counsel, and funding.


The facility, which once housed BMI Defense Systems, will open for the 2019-2020 school year, the first programs: welding, automotive, construction science, industrial engineering and robotics. With 35,000 square feet of manufacturing and lab space and 14,456 square feet of office, research and meeting space, the facility had everything the district needs, plus 119 acres of land.

Communicating with representatives from various industries in the Brazos Valley, the district’s CTE advisory committee associated with the Texas Workforce Commission can help determine industry needs and trends.

Students who study at the CTE Center will be expected to work in conditions that mimic or replicate industry environments, students will use time clocks, and some may have to work in the heat or the cold. The facility specifically will serve juniors and seniors, but a selection process still is being developed.

Tyler ISD didn’t just meet the state’s goals for career and technology certification. Where the state goal was for Tyler ISD to have 37 Texas Education Agency approved certifications completed by students in the 2017-18 school year, Tyler ISD delivered close to 10 times that many with 352 completed. Last school year, 80 percent of Tyler ISD students participated in at least one CTE course, Brown said. Brown said that number included more than 75 percent of the district’s economically disadvantaged students.

The biggest challenge the district faces is finding qualified professionals to teach the career and technology courses. Crawford said many of the professionals would be losing tens of thousands of dollars per year at the average teacher salary of $45,000.


CTE programs are designed to provide training for five of the 10 fastest growing occupations in Texas in high-growth industries between 2014 and 2024. In addition, four of these fast-growing occupations are also high-wage STEM occupations.

In 2016, the graduation rate for students with two or more CTE classes was 95.6 percent compared to 89.1 percent for all Texas high school students. In 2016 the dropout rate for students with two or more CTE classes was half that of all Texas students.

A 40-hour course is giving students at two Mission-area high schools the training they need to operate drones for a range of public safety applications. Through a new partnership between the S.O.A.R.D. Solutions LLC and Sharyland Independent School District students will receive this training for the remote pilot certificate exam — the first step toward operating drones legally for a law enforcement agency or private company. Sharyland High School and Pioneer High School students in the Career and Technical Education (CTE) program’s Law, Public Safety, Corrections & Security practicum will spend the rest of the school year learning how drones are used for search and rescue operations and damage assessments and will be exposed to 3-D mapping and thermography.
Citation/s:

The Office of Career and Technical Education manages the CTE programs of 746 public schools in Florida, each program is reviewed by career-specific business and industry members on a three-year cycle to ensure the program remains relevant in today’s market. Out of the 50 fastest growing job markets only 34 percent require a higher education, 54 percent require a PSAV or associate degree, and 12 percent require high school or less.

Illustrations:
Out of the 17 Career clusters in Florida’s middle schools and high schools, here is the enrollments from greatest to least.

<table>
<thead>
<tr>
<th>Career Cluster</th>
<th>Enrollments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Management and Administration</td>
<td>149,596</td>
</tr>
<tr>
<td>Arts, A/V Technology and Communication</td>
<td>144,432</td>
</tr>
<tr>
<td>Information Technology</td>
<td>105,975</td>
</tr>
<tr>
<td>Hospitality and Tourism</td>
<td>99,333</td>
</tr>
<tr>
<td>Engineering and Technology Education</td>
<td>96,181</td>
</tr>
<tr>
<td>Agriculture, Food, and Natural Resources</td>
<td>71,766</td>
</tr>
<tr>
<td>Health Science</td>
<td>70,026</td>
</tr>
<tr>
<td>Education and Training</td>
<td>33,819</td>
</tr>
<tr>
<td>Human Services</td>
<td>29,385</td>
</tr>
<tr>
<td>Architecture and Construction</td>
<td>20,482</td>
</tr>
<tr>
<td>Marketing, Sales and Service</td>
<td>20,186</td>
</tr>
<tr>
<td>Law, Public Safety and Security</td>
<td>18,325</td>
</tr>
<tr>
<td>Finance</td>
<td>17,213</td>
</tr>
<tr>
<td>Transportation, Distribution and Logistics</td>
<td>13,506</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>6,262</td>
</tr>
<tr>
<td>Energy</td>
<td>925</td>
</tr>
<tr>
<td>Government and Public Administration</td>
<td>&lt;700</td>
</tr>
</tbody>
</table>
Almost half the students enrolled in public schools are also enrolled in CTE classes on some level, with Perkins Funding increasing each year.
Citation/s:

CNA Education, “The CTE Equation in Florida” (CNA ANALYSIS AND SOLUTIONS). 2015,

The CTE Equation refers to high wage-high demand, which refers to jobs that pay 20 percent or above the annual average in a state and provide a skilled workforce for growing economic needs. The Perkins Act actually requests that CTE responds a state’s economic needs in order for funding to continue.

Illustrations:
Collier County school district in Florida is one of the leading districts in the state with graduation rates, technology, and CTE. Their demographics show that their enrollment is evenly split between males and females, almost 70 percent of student are economically needy, 50 percent Hispanic, and 46 percent are from an English-speaking household.

Illustrations:
Citation/s:


The Shanghai Construction School is run by the 16th largest construction company in the world. Though education based, the curriculum is meant for students that don’t do well in academics and need to find employment at an early age. Practical skills learned in the classroom offer the students the opportunity to work and go school at the same time with guaranteed job after they graduate. The company recruits 1/3 of its graduates while the rest are offered jobs by other companies.

Illustrations:
Citation/s:


More rigorous research on CTE programs is clearly needed. To its credit, the Institute for Education Sciences (IES) recently initiated several new data collection and research grants in this area. The recent study by Dougherty is a great start, but only a start. Further progress requires a series of studies that build on each other, and examine different approaches to CTE. Because states play a large role in developing and overseeing CTE programming, they must take the lead. States have been very active in passing laws, issuing regulations and disseminating policies about CTE. States now need to step up and support a research agenda that can help ensure these new initiatives are successful.
Germany requires students at age 10 to choose a vocational high school, academic high school, or what one Atlantic article described as “something in between.” Students have frequent opportunities to move between tracks down the line. Compared to America where the average high school students take 3.6 credit hours of technical classes.

Illustrations:

Image description:
- German Education System
  - Primary Education: Grundschule
  - Secondary Education: Gymnasium, Realschule, Hauptschule
  - Tertiary Education: Bachelor, Bachelor, Bachelor
  - Vocational Education: Fachoberschule, Berufsfachschule, Berufsschule
  - Key: Complimentary Education, Apprenticeship-based qualifications, General Education, Vocational Education
Citation/s:

Università europea. “Advanced Career and Technical Education Programs” (Università europea), 2017,

“Our students can do their internships at the most prestigious companies and sign up for extracurricular activities designed to enhance and enable access to the labor market. Likewise, the Workplace Training Modules - developed in a real work environment - allow students to work in their study field during their training and provide advice and guidance from a company advisor and a European Career College of Madrid advisor.”

Illustrations:
What is STEMx?

Network consisting 19 states in the U.S. that provide platform for the program STEM, Science Technology Engineering and Mathematics. Each States have their own websites and as well as people who oversee the programs on to the school itself. Connecting all the programs nation wide have contributed to the growth and success to the program and currently they are overseeing the integration to more schools and careers.

- 19 States
- 2 Territories

The integration of this program through earlier years of education or other programs such as CTE.
Citation/s:


Advancing New York State Career & Technical Education: Quality, Access, Delivery

New York State’s CTE delivery system, consisting over 1,100 providers and over one million students. Ranging over 6 areas of studies that help provide training and real experiences for technical positions. Besides preparation they also take in consideration with reviews of former students and their success.

Areas

- Agricultural Education
- Business & Marketing Education
- Family & Consumer Science Education
- Health Occupations Education
- Technology Education
- Trade, Technical & Industrial Education
Citation/s:


Yorktown Central School District

School District in the State of New York, that are pioneers in infusing new form of education ranging from Elementary to High school. One of their new form of education is ESTEAM, Empathy in the STEAM (Science, Technology, Engineering, Arts and Mathematics. They believe that no form of education with any level of authenticity can exist without first teaching students to be empathetic.

Curricular Areas

- History
- Arts
- English/Foreign Language
- Math

Career Clusters

- Technical – BOCES
  - Occupational Ed
- Physical Ed
- Business/Computer Tech
- Career Ed
  - College ready Education
Citation/s:


Building Skills Outside the Classroom With New Ways of Learning

Utilizing new technologies with the existing environments to help students learn and have real world experience, Mayfield Innovation Center for example. Where addition with Virtual reality, 3D printers, robotics and other advancing technologies to their open architecture, which seems more like a corporate office rather than an actual academic facility.

Other institutions following similar approach is Alamo Academies in San Antonio, where utilizing industrial technologies and other forms. Besides all the new integrations there has been partnership with various programs such as Project lead the way and STEM.

Companies like Toyota have as well joined various institutions with utilizing their facilities and offering summer and high school programs.

Students work on a model of the heart during a cardiopulmonary project at the Mayfield Innovation Center in Mayfield Village, Ohio. Credit Maddie McGarvey for The New York Times

Orion Tillotson, 18, operates a robot during class at Alamo Academies in San Antonio, an innovative high school program designed to get students on a career track with local employers, including Toyota. Ilana Panich-Linsman for The New York Times

https://careertech.org/cte

https://www.districtadministration.com/article/schools-promote-career-tech

“California” Advance CTE, web, August 31, 2018
https://careertech.org/california

“Building the future: Virtual CTE Classes offer new career paths”. Ceam, Web, July 6, 2017
SECURITY
How well can anyone plan for the chaos and violence of a school shooting?

Citation/s:

• Flynn Katherine. Architects prioritize design as a school security solution. www.aia.org. Pgs 1-7. 06/20/2018
Physical Security measures aren’t going to be 100% effective. The need to go beyond those measures within the social environment is necessary.

Illustrations:

“Scott Johnson Middle School Principal Mitch Curry greets students as they arrive. Curry has been chosen as the 2016 region 10 Outstanding Principal of the year by The Texas Association of Secondary School Principals.”
Citation/s:

- Rethinking School Safety: Communities and Schools Working Together. The National Association of School Psychologists
  www.nasponline.org/safety_crisis. pgs 1-5. 08/30/2018

  www.nasponline.org/safety_crisis. pgs 1-3. 08/30/2018

The Psychological impact on students from physical security measures inconsistently ineffective. Measures such as metal detectors, large amount of cameras, and a building design that resembles a fortress.

Illustrations:
The degree to which individuals feel comfortable taking positive interpersonal risks (such as trying something new).

Illustration:
Citation/s:


Protective design can reduce the risk of an active shooter incident and, if one occurs, can mitigate or reduce the number of potential victims. CPTED should be considered when evaluating design. Slowing or delaying even by just a couple minute allows critical time for law enforcement to arrive. Access denial through choke point.

CPTED relies on the ability to influence an offender’s decisions before they commit a criminal act.

Department of Homeland Security (DHS) demonstrated film applications that can be added to windows to resist against forced entry. Example on the left is of the broken window the Sandy Hook intruder used to gain access.
Advocating for legislative support in open learning design with enhanced built-in security. The two biggest problems are a lack of quality school design information and the ability to fund these designs.

1. “making architectural and design services for schools an allowable use of funds within existing federal funding and grants”
2. “Establishing a federal clearinghouse of resources on school design best practices for school officials, architects and other design professionals to keep them informed.”

“The primary goal is to provide an inspiring, healthy environment that promotes learning. Security features, while vital and necessary, should be as invisible as possible and incorporated into the school’s design. Failing to do so puts children’s education, emotional development and pro-social behavior at risk.” – Jay Brotman, AIA.


Developing educators’ social and emotional skills lays the foundation for success with students. But to do so, teachers need learning opportunities and resources to integrate these competencies into their instruction.

- Seattle public school implemented RULER (Recognizing, Understanding, Labeling,
Expressing, and Regulating emotions) evidence based 3-year program that teaches instructors how to manage and understand their own emotions so that they can then teach the students.

“peace corners” in classrooms give students room to decompress and gain control over their emotions.

“tap in-tap out” system when a teacher needs a break they can text another teacher to step in for them while they take a break.

Citation:

Discussing whether an authorized person may carry a firearm on school property. Rural districts have longer response times and
could benefit from having on-site armed protection for students and citizens. There are two plans that are used the Guardian Plan and the Marshal Plan

- **Guardian Plan**: authorizing designated persons to carry a firearm with only a handful of administrators knowing who those people are. Typically require other restrictions like being a CHL holder, training. Each district keeps these requirements confidential. Written regulations are required and must follow any applicable laws. https://assets.aspeninstitute.org/content/uploads/2018/01/SupportingWholeTeacherUpdate.pdf
  1. Harrold ISD – minimum 4 years of working in the school to qualify
  2. Almost all school districts that have armed defenders use this plan.

- **Marshal Plan**: Under “Protection of Texas Children Act” (2013) a category of peace officers known as “school Marshals” were created who may carry a concealed handgun. Requirements include:
  a. Licensed by school marshal training program through “Texas Commission on Law Enforcement” (TCLE)
  b. Have a CHL
  c. Complete 80hrs of instruction
  d. Pass a psychological exam (TCLE)

In this Journal, Clarke describes the three approaches on CPTED and describes their benefits and downfalls.”

A lot of research has been done conducted under the rubric of situational crime prevention and most of the current “opportunity” theories that now underpin crime prevention through environmental design, and that have made this a respectable approach among a large and influential body of “environmental criminologist.”

1. Biology of crime, exposure to lead caused brain damage and delinquency in children and to reduce environmental opportunities for crime.

2. “defensible space” theory of the architect Oscar Newman, blamed high crime rates in public housing on design. He criticized inhumane scale making it easy to get away with crimes because neighbors didn’t know each other.

3. Situational Crime prevention, general approach to reduce the opportunities for any kind of crime, occurring in any kind of setting including airline hijakings, welfare fraud, etc.
Minnich, Brian, AIA
“Make schools safer with these three design elements” (2018)

http://www.topicarchitecture.com/articles/73946-make-schools-safer-with-these-three-design-elements

This article is written by a practicing architect who has an experience on the planning and design of K-12 schools. He talked about how better security can be achieved by addressing what he calls the three key factors. 1. Life safety, 2. Addressing external security concerns, 3. Addressing transparency of the buildings.

Centers for Disease Control and Prevention
“Youth Violence: Using Environmental Design to Prevent School Violence”


This reading from Centers for Disease Control and Prevention (CDC) talks about how they are studying CPTED and its influence on school violence preventions. It briefly stated the five CPTED design principles and how they can benefit the school environment.

1. Natural Surveillance: Maximizing visibility using strategic use of windows
2. Access Management: Guiding people by using signs, well-marked entrances and exits, and landscaping
3. Territoriality: Clear delineation of space and creating welcoming environment
4. Physical Maintenance: Repairs & general up-keeping of the space
5. Order Maintenance: Attending minor unacceptable acts

- American School Health Association

This research study used CPTED assessment tools to test the associations between schools and violence related behaviors and perceptions of students.

- **Dorn, Michael**
  “Safe Schools by Design”, School Planning & Management; Social Science Premium Collection, Pg. 12, Jan 2003

This short article by Michael Dorn talked about school safety and what CPTED is. He also looked into some of the limitations of CPTED in school safety.

- **Federal Emergency Management Agency**
  “FEMA 453, Safe Rooms and Shelters - Protecting People Against Terrorist Attacks (2006)”

This site lists multiple recommendations for safe school design and construction. It also provides multiple manuals and guidelines to provide directions for the protection of school buildings from natural disasters and manmade hazards.

- Emelina Minero

https://www.edutopia.org/article/architecture-ideal-learning-environments
To get a sense of the best practices in contemporary school design, the author interviewed four of the top k-12 architecture firms in the US and pulled out five common design principles--technology, safety and security, transparency, multipurpose space, and outdoor learning space.
UNIVERSAL DESIGN
Universal Design is defined as the design of products and environments to be usable to the greatest extent possible by people of all ages and abilities.

- Universal Design respects human diversity and promotes the inclusion of all people in all activities of life.
- Universal Design does accommodate those with disabilities, but that is not the primary focus of the design movement.
- The Principles of Universal design attempts to cover the widest range of users in mind:
  - Equitable Use
  - Flexibility in Use
  - Simple and Intuitive
  - Perceptible Information
  - Low Physical Effort
  - Size and Space for Approach and Use


“Education environments that facilitate cognitive mapping reinforce the principles of universal design.”

- Cognitive mapping is formally defined as “the process composed of a series of psychological transformations by which an individual acquires, stores, recalls and decodes information about the relative locations and attributes of the phenomena in his everyday spatial environment”. Cognitive mapping is the skill of using sensory resources (sight, hearing, smell, haptic feeling, etc.) to recall, remember, or interpret an environment in order to navigate or interact in a space.
- Environments with segmented routes, “critical choice points”, and various points of destination full of sensory opportunity allow users to develop a frame of reference and move more efficiently through space. Moving through a space in repetition improves mobility overtime.
- Spatial Updating is the ability for a traveler to know from moment to moment where her or she stands in relation to place in the environment. The base skills of spatial updating are recognizing landmarks or environmental patterns, reconstructing previous movements, perceptually relating locomotive actions, and establishing object to object relations.
- Ambiguous landscapes without breaks in repetition are harder to develop cognitive maps for.
  - i.e. a maze constructed purely of right angles was shown to result in more error in comparison to one with a variety of angular trajectory and varied path segment length.

If color coding is used as a form of communication, there needs to be a 70% difference in contrast of colors used to cater to those who are color blind. When in full color there is a clear difference between the two colors on each rectangle, but once the rectangles are desaturated, the difference is only slightly clear.
There is a clear separation between the vertical circulation space for those who are physically impaired and those who are not impaired. A ramp is usable by all, but you only get one function out of this element. A staircase can have multiple functions from circulation to seating but isn’t usable by all. To blur the distinction between accommodations for those who aren’t physically able and those who are, we need to blur the difference between stairs and ramps.
MODULARITY


EL Education, “Design Principles.” EL Education, 2018, eleducation.org/resources/design-principles


Herman Miller, “Rethinking the Classroom.” Herman Miller, 2018, www.hermanmiller.com/research/categories/white-papers/rethinking-the-classroom/


Kurani, “Kurani.” Kurani, 2018, kurani.us/


“Design patterns encourage reuse. They speed up prototyping, design, and development. They ensure consistency, and through improving them independent of other concerns they lead to greater usability.”

Summary – Modularity allows designers to find more creative solutions independently of the project, since modules promote and encourage variety. Variety can come from the module itself or from the combined use. Modules can be viewed as constraints, like all design, which specifies the need for a solution.

Frank Lloyd Wright developed what he termed “Usonian homes”. They were designed to control costs during the great depression. They had no basement, no attic, and little in the way of ornamentation. They were built from inexpensive and modular concrete blocks. These prefabricated modular blocks could be combined in a variety of ways to create unique houses, which could be built efficiently and inexpensively.
Gilbert, Scott F. “Modularity: The Prerequisite for Evolution through Development.”
Advances in Pediatrics., U.S. National Library of Medicine, 1 Jan. 1970,

“Design patterns encourage reuse. They speed up prototyping, design, and development. They ensure consistency, and through improving them independent of other concerns they lead to greater usability.”

**Summary** – Modularity occurs at the atomic level, with all atoms splitting and reproducing to fulfill a larger purpose within the cell. Thus, cells are parts of tissues, which are parts of organs, which are parts of systems, and so on. It either be used for its intended purpose or transformed and used in response to a certain need. Modularity is an almost autonomous response to the constant needs certain systems need in nature. By being able to duplicate or adapt to meet certain needs when needed, the system grows and retains of those adaptations to pass on, constantly evolving to be smarter.

Miller, Chris. “CCTP711: Semiotics and Cognitive Technology.”
IDST 325 University as a Design Problem, 8 Oct. 2014,
blogs.commons.georgetown.edu/cctp-711-
spring2014/is-modularity-natural-and-other-silly-questions/.

“In many technological cases, as in nature, modularity is an efficient means to accomplish three goals: manage complexity, enable parallel work and accommodate for future uncertainty”

**Summary** – Modularity found in nature can and does have influence on how we organize and design our technologies. Since natural systems of hierarchy are found frequently throughout nature, we study them and understand their complex construction.

Modules develop several general characteristics that can serve as definition points, such as their internal integration, by giving them a definition applicable at different levels within the hierarchical system. This reduces the direct selection pressure to reduce the connections between a system’s modules, making the system truly modular. By reducing the reliance upon each module to the next, this creates a modular network due to its interchangeability.

“The brain’s modular, yet integrated, functional architecture could potentially involve each module executing a discrete cognitive function mostly autonomously or intelligently encapsulated from the other modules.”

**Summary** – Brain anatomy and brain data consistently shows distinct modules and connector nodes with diverse connections across the modules. Each module performs discrete cognitive function while connector nodes provides autonomy to the modules. Connector nodes increase in activity with the introduction of additional cognitive functions, resulting in the connector nodes being located where cognitive function happen.

“People with highly modular brains that constrain tasks to the modules also show low flexibility, while people with high-flexibility brains that share tasks across the network show low modularity.”

**Summary** – Flexibility measures the brains network growth to changes over time and Modularity is the degree of interconnectivity between different parts of the brain responsible for specific tasks. Flexibility and Modularity do not measure the same property, but instead give independent contributions to the overall performance, such as links to different cognitive functions. Flexibility likely accounts for the ability to learn and process new information; Modularity retains processed information as a familiarity, requiring less flexibility.

“During the twentieth century, the most important modular and/or proportional systems that have been invented are those of architects Rudolf M. Schindler (1887-1953), Le Corbusier (1887-1967), and Hans van der Laan (1904-1991). Though born very nearly at the same time, these three architects have known very different destinies and reputations, as well as their systems which are called, respectively, the Schindler Frame, the Modulor and the Plastic number... When devising a modular or proportional system, architects do not deal with space as such, or even with size (or magnitude) as perceived, but with measure.”

The paper goes into detail for each of the listed architects’ modular systems, detailing the processes and integers involved as well as several diagrams. In addition to modular conditions, Coruff also delves into spatial magnitudes and sounds, which can be applied to acoustic design.

“Of the two modular methods that were systemized during the Edo period (1600-1868), the kyō-ma method is based on standardized tatami and variable column distances, or the ken, whereas the other, the inaka-ma method, is based on a standardized ken, but includes variable tatami sizes... Gropius contended that Japanese tradition provides ‘perfect solutions’ for modern architecture: ‘complete flexibility of movable exterior and interior walls, changeability and multi-use of spaces, modular coordination of all the building parts, and prefabrication.’”

The article goes over 2 sets of studies in which children were exposed to 2 kinds spaces, large and small, to determine whether only geometric features were used to reorient themselves in an unknown area, or if it was a combination of landmarks and geometric information. Results show children had more success in finding the target in larger spaces when using nearby landmarks, and the ability to use landmark information increase with age, specifically past the 5-year mark. With this information, modules containing landmarks such as a painted wall or a simple sculpture can help orient children in larger spaces.
“Previous studies have shown that disoriented children use the geometric features of the environment to reorient... That children can use geometric information in combination with landmark information challenge the modularity interpretation... The ability of children to use landmarks in combination with geometric information raises important questions about the existence of an encapsulated geometric module.”

The article goes over 2 sets of studies in which children were exposed to 2 kinds spaces, large and small, to determine whether only geometric features were used to reorient themselves in an unknown area, or if it was a combination of landmarks and geometric information. Results show children had more success in finding the target in larger spaces when using nearby landmarks, and the ability to use landmark information increase with age, specifically past the 5-year mark. With this information, modules containing landmarks such as a painted wall or a simple sculpture can help orient children in larger spaces.
“During the 1960s and 1970s, Japanese housing manufacturers focused solely the ‘mass production’ of their products, resulting in a supply of virtually identical, rather monotonous houses. Due to the ‘inferior’ image associated with the low-quality appearance of these houses, the public immediately rejected them. Since then, manufacturers have placed greater emphasis on improving industrialized housing quality, and thereby customer faction, such that today Japanese housing manufacturers enjoy a reputation for providing quality housing that, while still mass-produced, is customized – i.e., ‘mass customization.’ … As a result, even though affordable homes are still in great demand, manufacturers have actually been successful in producing and marketing more expensive quality homes.”

Although initially prefabricated homes were down upon in Japan, as manufacturers overcame this obstacle through a “quality oriented” production approach, focusing more on the house quality rather than affordability. The prefabricated industrial homes were more structurally resistant, especially to earthquakes, more efficient, housed better living conditions, and were customizable by the client. The manufacturers designed housing components, or modules, rather than the entire home, and this reduced productions costs as well as consumer interest.

**Summary** - Mentions that a schedule can be condensed 30-50% simply by producing modular work in factory at the same time as site work is being done. Details how modular buildings can produce any scale of solutions to buildings, and how projects with repetitive are more likely candidates to benefit. It continues by delving into the different typologies of building which are produced by permanent modular buildings, versus temporary buildings. It further mentions that this is a way of thinking, “modular construction must be made from the onset of design.” Permanent Modular Construction is not always beneficial, changing schedules and delayed decisions can impact schedules resulting in a loss of potential savings.

“An office building shell designed with unfinished interiors and intended for multiple tenants who would finish out their own individual space would not be a good option for Permanent Modular Construction (PMC).”

Article Abstract: “Modular constructions are frequently used in industry because of their multiple advantages. Used from the antiquity as a measuring system that ensured good proportions for the objects or buildings, the module is used in present industry as a tool for improving the product maintenance, repair, upgrading, and/or recycling. Modular constructions can be assembled and disassembled easily, facilitating the postuse actions like subassemblies reuse, or materials recovering for the recycling process. An important aspect of this paper is that designers should create the modular solution even from the conceptual design stage and build a structure of functions based on well motivated arguments and which can easily be brake out according to technological possibilities, product functioning and assembly solutions.”

Fig. 1 The structure of fractions built on modules.
Summary - This article begins by asking a rhetorical questions in regards to shortages in labor. Then a solution is proposed, pre-assembly building practices are one answer. Various topics are discussed, including BIM increasing in usage, as well as an increased prevalence of pre-assembly over the last 10-15 years. Mentions that modular has been around for a long time in the oil and gas industry, but that other sectors can benefit from it as well. PPMOF: Prefabrication, Pre-assembly, Modularization, and Off-Site Fabrication. Was developed to make sense of a variety of off-site construction typologies by the Construction Industry Institute.

**Summary** - This article delves into what Off-Site Construction is, and details traditional methods in analogue with why off-site construction can benefit parties of the building services industry. Details streams of waste, and how planning and productivity can be achieved by utilizing off-site construction properly. Benefits of off-site construction can, shorten schedules, produce savings to the project, owners, and other parties. Furthermore it details how partiers should address the differences between off-site construction and traditional construction methods. This can impact how project management is handled and schedules are impacted by building officials and owners alike. Project typologies are mentioned, some show greater opportunities to benefit from off-site construction methods. A list of beneficial off-site situations are listed, as well as site specific scenarios which can affect the process.

**Article Abstract:** “The research project reported in this paper addresses the issue of using a cooperative method in delivering distance learning modules, adopting a collaborative way of working through the internet. The purpose was to analyze student perceptions of a collaborative distance learning environment and the factors that affected their online performance. Quantitative and qualitative data were collected from learners to offer insight into their perceptions and expectations of the e-learning experience.”

**Summary** – in Section 12 of the FAQ, states that various agencies at state and federal level recommend an array of ratios of Counselor to students based on needs of students and schools. The range specified is, one counselor to 250 students to one counselor to 350 students.

Summary – This is a Modular Building industry White Paper, with input from a number of resources. It highlights the differences in Prefabrication, Preassembly & Modular Construction, and also highlights the Efficiency of Modular Construction. When needs change, “Modular Buildings can be disassembled and the modules relocated or refurbished.” Also highlights how Adaptable modules can be, quickly adding and removing modules, while minimizing the disturbances to the site and occupants.

“It is significant to use the modular approach in architectural designs. Modular design is characterized by properties such as upgradability, serviceability, flexibility and so on. Also, the beauty of modular architecture is that you can replace or add any module without affecting the rest of the system.”

Summary – Modularity allows for the use of common, replaceable components to function within a larger, more complex system. Being interchangeable in nature, these modules allow the larger system to constantly adapt to needed conditions. Modularity is seamless, natural adaptation to a certain need with the use of modules to accomplish certain tasks within a larger system.
DESIGN ANALYSIS
Career Technology Education
CAREER CLUSTERS AND SPACE REQUIREMENT DIAGRAMS

Within Texas, Career Technical Education is broken into sixteen career clusters. Each career cluster has differing space requirement, from the standard classroom to a laboratory with specific infrastructure needs (environmental controls, equipment, HVAC, safety, shape/height, utilities). The following pages show a general overview for each career cluster space requirements and the diagrams below present the reader with a quick overview of which spaces are common in each career cluster.

In addition, some spaces have either an inside connection (a library that serves the school) or outside connection (a shop class ability to receive material and supplies). Some spaces require both types of connections (A school cafeteria that serves the school and receive deliveries).
The ideal Career Technical Education is a combination technology, work based learning, and traditional education
Different building types need different modules to accommodate them in terms of space and special environmental control systems. By combining different programs to like groups and into modules.
Career technical education can be experienced in many forms and its students exposed to work-based education, technical and traditional education. Resulting in a strenuous 12 work/school day.
Modularity

The program of a CTE center is divided between general and special environmental control systems creating the need for two forms.
Security

To increase daylighting and security, the buildings perimeter is skirted up separating the students inside from intruders on outside thru elevation. The underside of the buildings floor slabs protects those within, while sight of the surrounding area allows for early warning identification.
Universal Design

Within the modules are open lecture spaces adjacent from ramps and stairways that allow for impromptu classes, as well as, unconventional study areas for students. The study stairs are one such area that students can lounge and work much like an open auditorium space.
Yorktown Central School District

School District in the State of New York, that are pioneers in infusing new form of education ranging from Elementary to High school. One of their new form of education is ESTEAM, Empathy in the STEAM (Science, Technology, Engineering, Arts and Mathematics). They belief that no form of education with any level of authenticity can exist without first teaching students to be empathetic.
Dan Dipert Career & Technical center

Arlington Independent School Districts, new addition to the advancement in student education. Separate to all high school although integrated with various programs that all students 11th and 12th grade can join. The complex divided in to various regions, all centered to 4 specific use.
Career and Technical Education, organization, implemented as section of grid that deals with specified requirements for tasks or classrooms in general. This will also reflect various things such as façade, windows, and structure.
The space diagram is used to compare the sizes of the programs to one another while still representing the CTE as a hole.
Security
Security Personnel Placement

Marshal or security office should be near an entry and public spaces, but out of direct line of sight so that they are easily accessibly in case of a threat but not prevalent enough such that students feel they are not trusted.
Psychological DeafSpace

Rearranging furniture can help students who are hard of hearing feel more comfortable by allowing them to sit with their backs against walls so they can concentrate without worrying someone may try to get their attention from behind.
Walkways

Walkways should be 8'-6" of unobstructed space so two people can walk together having a conversation. Geared specifically towards people who are deaf who need additional space to sign to each other.
Ramp Slope

Using a ramp slope of 1:10 rather than the standard 1:12 is safer for people in wheelchairs who are carrying things or during inclement weather.
Classroom Transparency

Increasing transparency from traditional limitations creates a better line of sight for teachers.
Peace Corners

A peace corner or quiet place can be used as an area for students to decompress their emotions.

Notched spaces can be used as Peace Corners
Screening Layer

Placing administrative offices between the main entrance and classrooms allows for a layer of progression in which administrators can analyze visitors.
Controlled Access & Natural Surveillance

Having a limited number of entries with a single main access for easier control and identifiability.

http://www.topicarchitecture.com/articles/73946-make-schools-safer-with-these-three-design-e
Concentric Ring of Protection

Creating multiple barriers to entry. This layered protection makes it more difficult for a trespasser to get to the classrooms.
Access Management

Guiding people using signs, well-marked entrances and exits, and landscaping. This can include limiting access to certain areas.

Territoriality (Sphere of Influence)

Clear delineation of space and creating welcoming environment by utilizing physical signs such as pavement treatments, landscaping and signage that enables users a sense of ownership.
Visual Control & Transparency

Creating an internal space where students and staff can easily see each other to help prevent bullying and create a visual transparency for natural surveillance.
Universal Design
“Continuous segmented primary circulation improves user mobility in educational environments.”

- Singular ambiguous circulation is more difficult to cognitively map. Segmenting circulation helps users define the relationship between path and destination.
- “Segmentors”, or intersections of circulation, should act as a point overlap to where users can orient themselves in their environment.
“A system of unique tectonic landmarks creates intuitive circulation in educational environments.”

- Major circulation that has a system of landmarks is more intuitive for users to use.
- Landmark should also be unique in its form or spatial characteristics, allowing users to recognize it with a sensory response.
- Users can more efficiently cognitively map spaces when they are given different points of “critical choice”.
Modularity

Curriculum is:

- that which is taught in schools
- a set of subjects
- content
- a program of studies
- a set of materials
- a sequence of courses
- a set of performance objectives
- a course of study
- everything that goes on within the school
- extra-class activities, guidance, and Interpersonal relationships
- everything that is planned by school personnel
- a series of experiences undergone by learners in a school
- things an individual learner experiences as a result of schooling

“Anything and everything that teaches a lesson, planned or otherwise. Humans are born learning, thus the learned curriculum actually encompasses a combination of all of the following — the hidden, null, written, political and societal etc.. Since students learn all the time through exposure and modeled behaviors, this means that they learn important social and emotional lessons from everyone who inhabits a school — from the janitorial staff, the secretary, the cafeteria workers, their peers, as well as from the deportment, conduct and attitudes expressed and modeled by their teachers. Many educators are unaware of the strong lessons imparted to youth by these everyday contacts.”

Types of curriculum used in schools today: overt, societal, hidden, null, phantom, concomitant, rhetorical, curriculum-in-use, received, internal, electronic.

The term teaching method refers to the general principles, pedagogy and management strategies used for classroom instruction.

Your choice of teaching method depends on what fits you — your educational philosophy, classroom demographic, subject area(s) and school mission statement.

Teaching theories can be organized into four categories based on two major parameters: a teacher-centered approach versus a student-centered approach, and high-tech material use versus low-tech material use.
Brame, Cynthia. “Flipping the Classroom.” Vanderbilt University, Vanderbilt University, 7 May 2018, cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/.

“Flipped Classroom.” Craft a Teaching Statement | Faculty Innovation Center | The University of Texas at Austin, 2018, facultyinnovate.utexas.edu/flipped-classroom.


Flipping the classroom is a “pedagogy-first” approach to teaching. In this approach in-class time is “re-purposed” for inquiry, application, and assessment in order to better meet the needs of individual learners. Students gain control of the learning process through studying course material outside of class, using readings, pre-recorded video lectures, or research assignments. During class time, instructors facilitate the learning process by helping students work through course material individually and in groups. There are numerous ways to flip your class. In fact every teacher who has chosen to flip does so differently.


Direct Instruction (DI) is a model for teaching that emphasizes well-developed and carefully planned lessons designed around small learning increments and clearly defined and prescribed teaching tasks. It is based on the theory that clear instruction eliminating misinterpretations can greatly improve and accelerate learning.

Direct Instruction operates on five key philosophical principles:

- All children can be taught
- All children can improve academically and in terms of self-image
- All teachers can succeed if provided with adequate training and materials
- Low performers and disadvantaged learners must be taught at a faster rate than typically occurs if they are to catch up to their higher-performing peers
- All details of instruction must be controlled to minimize the chance of student’s misinterpreting the information being taught and to maximize the reinforcing effect of instruction


Kinesthetic learning centers on active participation, in the truest sense of the word. Learners who fall into this category prefer to stay in motion while training and find it challenging to sit still during lectures and online presentations. This is primarily due to the fact that their minds are not able to trigger the knowledge assimilation process unless their bodies are involved in the process. Thus, the information stays in their short-term memory, best case scenario, and never quite makes it to their long-term memory. However, there are a variety of techniques that eLearning professionals can employ in order to make their eLearning programs more kinesthetically inclined.

Tables, benches, and mobile seating all facilitate working collaboratively and will support project based learning. Furniture that can easily be moved into different configurations to accommodate a particular lesson or to make more room for movement is also essential in facilitating learning for kinesthetic learners.

What’s a kinesthetic learner?

- like to move around
- struggle with lecture classes
- do well in lab environments (sciences)
- prefer to work in groups, rather than individually
- like to make posters, do experiments, use hands
- become easily bored
- remember what they did, not always what they saw or heard
- can be impulsive (blurt out answers, getting up quickly)
- enjoy trying new activities and new routines


Personalized learning is instruction that offers pedagogy, curriculum, and learning environments to meet the individual student’s needs. The experience is tailored to learning preferences and the specific interests of different learners. In a personalized learning environment, the learning objectives and content, as well as the method and pace, may all vary. Personalization also encompasses differentiated instruction that supports student progress based on subject matter mastery.

The way people learn is ‘messy’ and intensely personal — research has shown that it doesn’t happen in a straight line or easy progression. Because learning isn’t linear, true personalization can’t be either. Learning is a complex, interconnected web, particularly in the early elementary grades. Students need to have the opportunity to learn concepts and construct their own knowledge and understanding in a way that honors students’ ideas.

After assessing each student academically and understanding ‘where they are’ in their learning progress, it’s important to learn about their strengths, weaknesses and learning style. The classroom can have different areas or stations based on needs and abilities to accommodate auditory, visual, and kinesthetic style learners. For example, some stations may support inquiry-based, independent learning; while there can be a separate area for group activities. Groups can be based on content, ability and assessment results.

Social-based learning, which gives students the opportunity to collaborate with each other, is important to the new personalized learning classroom. In many cases, the classroom may not be a ‘room’ at all.


Game-based learning involves designing learning activities so that game characteristics and game principles inhere within the learning activities themselves. Gamification applies game elements or a game framework to existing learning activities; game-based learning designs learning activities that are intrinsically game-like. Games can introduce goals, interaction, feedback, problem solving, competition, narrative, and fun learning environments, elements that can increase learner engagement and sustain motivation.

Augmented reality (AR) is a technology that layers computer-generated enhancements on top of an existing reality in order to make it more meaningful through the ability to interact with it. The use of augmented reality (AR) in formal education could prove a key component in future learning environments that are richly populated with a blend of hardware and software applications. There are four design requirements that need to be considered if AR is to be successfully adopted into classroom practice, along with just any classroom to flourish. These requirements are: flexible content that teachers can adapt to the needs of their children, guided exploration so learning opportunities can be maximized, in a limited time, and attention to the needs of institutional and curricular requirements.

Virtual reality (VR) is an artificial, computer-generated simulation or recreation of a real life environment...It immerses the users by making them feel like they are experiencing the simulated reality firsthand, primarily by stimulating their vision and hearing. VR's immersive representational abilities have promise for teaching and for visualization. It also demonstrates that characteristics of the learning experience such as usability, motivation, and simulator sickness are important part of assessing this medium's potential.
Inquiry-based learning asks students to notice and observe as they experience the world around them and to ask questions. They are encouraged to wonder, to be curious and to notice opportunities for solving problems and making things better. Students put their curiosity into action by investigating. They gather information and ideas and start to develop genuine lines of inquiry and questions to explore. Inquiry-based learning implies that students are actively asking, investigating, creating, discussing, and reflecting.


Differentiated instruction deals with factoring students’ individual learning styles and levels of readiness first before designing a lesson plan. Differentiation benefits a wide range of students, from those with learning disabilities to those who are considered high ability. Differentiating instruction may mean teaching the same material to all students using a variety of instructional strategies, or it may require the teacher to deliver lessons at varying levels of difficulty based on the ability of each student.

Teachers who practice differentiation in the classroom may:
- design lessons based on students’ learning styles
- group students by shared interest, topic, or ability for assignments
- assess students’ learning using formative assessment
- manage the classroom to create a safe and supportive environment
- continually assess and adjust lesson content to meet students’ needs

Expeditionary learning can be defined as learning by doing, with a particular focus on character growth, teamwork, reflection and literacy. Instead of sitting in a traditional classroom each day, schedules are broken into projects that engage students, challenge their thinking and teach them critical problem solving skills. Work may be done inside or outside the classroom, with a particular emphasis on Outward Bound expeditions that promote teamwork and challenge students to their physical and mental limits.

10 design principles that reflect the values of expeditionary learning:
- the primacy of self-discovery
- the having of wonderful ideas
- the responsibility of learning
- empathy and caring
- success and failure
- collaboration and competition
- diversity and inclusion
- the natural world
- solitude and reflection
- service and compassion

When these design principles are properly incorporated into the classroom experience, students develop curiosity, skills, knowledge and courage in a safe, supportive environment. They learn to imagine a better world and how to do their part to realize it.


“Kurani.” Kurani, 2018, kurani.us/.


“Rethinking the Classroom.” Herman Miller, 2018, www.hermanmiller.com/research/categories/white-papers/rethinking-the-classroom/.


- Modularize spaces of different SCALE to allow students to easily shift between different modes of learning. Use the proportions of the HUMAN BODY to measure scale.

The variations in scale are:
- Individual/Single (1 person)
- One-On-One/Partner (2 people)
- Small Group/Collaboration (8 people)
- Class/Small Educational Program (30 people)
- Multiclass/Large Educational Program (120 people)
- Large Group/Assembly (480 people)
Individual/Single (1 person)
One-On-One/Partner (2 people)
Small Group/Collaboration (8 people)

Class/Small Educational Program (30 people)

Multiclass/Large Educational Program (120 people)

Large Group/Assembly (480 people)
• Flexibility of modularization is a way of thinking, and what was once the room and the seat in schoolhouse design is now the container and its contents. A FLEXIBLE SPACE is adaptive to multiple uses and teaching methods.
Students want learning environments to be available ANYWHERE and ANYTIME. Every space is a module in this plug-and-play system. The modules push and pull to meet any type of use and size requirement.
The space from modular repetition fosters the sense of COMMUNITY and CONNECTION. The concatenation, or building up of elements, leads to a wholeness. Repeating the modules connects them all together as a larger community-focused module.
• Modularizing spaces undergoes a process that NATURALLY SIMPLIFIES program and organization. Spaces become mix-use and modules can be versatile.
Optimize ergonomics with modularized SEATING and STANDING spaces. Flexible learning spaces include a group gathering area, multiple seating options, and a flex zone that can be adapted for unique learning activities to foster: “Share, Collaborate, & Create.”
Design modules where TECHNOLOGY and the classroom adapt together. The technology provided must be the most up-to-date, and students and teachers should have the ability to interact with it all. Currently, this looks like VR, AR, AI, and more.
Simplification of Program

Modularity is a way of thinking. Both in a practical and theoretical frame of how to devise a strategy of parts which relate to functions in reference to a larger total project objective. Using this as guidance for a School, it should be broken down into constituent parts, to allow for planning for current and future spaces.

- General Classroom highly repeatable.
- Labs, and workshops can be modularized, but would take a higher degree of planning and coordination.
- Assembly spaces could be fabricated off-site, but may not benefit as much from off-site methods.
Scalability

Providing modular solutions to spaces that may change in 5-10 years time, will allow for the school to adapt and scale as the educational environment requires.
Plug and Play

Facilities should be organized in a manner to facilitate the ease of renovating or relocating the space. Temporality of space, being the larger determining factor. Not everything needs to be modular.
Counselor Ratio and Distribution

Counselor to Student Ratio should be approximately one counselor to 300 students and should be distributed throughout the school, not concentrated in one location.
Library shelves can be made into a modular system to better organize material, as well as into different categories to take into consideration those who are cognitively impaired, such as the deaf and the blind. These can be separated into traditional print, audiobooks, e-books, and refreshable braille displays. Braille can also be incorporated into the shelves themselves to inform the blind.
Landmarks can be incorporated to help students navigate through large and potentially complex spaces and can act as both a guide and a sculptural piece. The base can include slots for the various modules and can all be removed and interchanged as the program of the spaces change. Modules can be put into 3 categories, being the type of space, whether it’s for a group or the individual, and a module pointing to where it’s located. Helpful for the dyslexic who may have difficulty reading a traditional map.
FLEXIBILITY ACCOUNTS FOR THE ABILITY OF A SYSTEM TO PROCESS AND LEARN DIFFERENT INFORMATION AND PROGRAMS. MODULARITY RETAINS PROCESSED INFORMATION AS A FAMILIARITY OR DEFINED ROLE, REQUIRING LESS FLEXIBILITY. MODULES SERVE AS DEFINED SPACE WHILE THE PROGRAM AND FUNCTION PROMOTES VARIETY AND FLEXIBILITY.

NEURON TYPES
Brain anatomy and imaging consistently shows distinct nodes and connectors. Each node performs a cognitive function, while the connectors relay the function through the system autonomously. The more complex the functions within the node, the more activity happens at the connector.

Much like each building varies, so does individual brain anatomy. Although brain structure is complex, the method for understanding this design has become theoretically simple. Unipolar, bipolar, pseudounipolar, and multipolar are the general classification types for neurons, but can vary drastically in combination, making a limitless amount of combinations. A complex system is organized by a set number of nodes and connectors combined in a variety of ways to get a degree of flexibility.

Modularity is constructed with standardized units of dimensions for flexibility, efficiency, and variety in use. Modularity should assist in the overall function of a system by completing tasks autonomously and seamlessly without affecting the system.

Flexibility
A truly modular system could easily replace any smaller piece without any change to the rest of the system. Any one piece should be able to assume a different role if the need arises, making a module flexible in use.

Efficiency
As a principle of evolution, modularity suggests that all living beings are comprised of smaller, interchangeable modules. This creates a natural sense of hierarchy that can be found in all natural things, in which they replicate and reproduce to adapt and survive.

Variety
With larger systems being comprised of smaller modules, a variety of different modules correlate in order to fulfill a multitude of varying tasks ranging from simple to complex.
Connectors and nodes should be a predetermined set number of variations defining the edge between the two provides the variety and freedom to make each module unique.

Edges help define the experience of a space or the transition of space through interior design. Edges happen at any interaction point between nodes and connectors.

Flexible use of space allows certain spaces to adapt and change to the different pragmatic requirements that arise. This creates wide flexibility throughout the building without altering form.

Predetermined modules give the system a sense of structure, while additional secondary connections that happen at random give the system variety. Predetermined paths show the system as a whole, while random connections help highlight key points of the system, such as focal points and wayfinding points within the building.

Entry and lobby (1)
This space creates a barrier between the school and the public. Meant to receive and funnel guests into a controlled area adjacent to the admin.

Gathering spaces (2)
This happens at the main circulation intersection, and serves as the building’s primary secondary and tertiary gathering spaces. This focuses the school on the accumulative student body all the way down the individual student, also serves as the central circulation point of the building.

Administration (3)
This area obviously houses the admin and faculty, but it also serves as indirect connection between the education programs and entry, possibly being used for security measures. This would also have an open office concept to allow for maximum visibility towards the entry.

Labs and workshops (4)
These are to be accessed through their associated classrooms to provide a layer of security and also use the class as both node and connector space. Also these areas are clustered together due to need of exterior access.

Education programs (5)
Are to be clustered according to their similarities in both career field and square footage required. To encourage efficiency, the larger areas will be situated closer to the gathering spaces.
Design Implementation + Development
This project directly focuses on solving three extensively researched issues of Universal Design, Modularity, and Security:

- **Flexibility of Space (Modularity)**
  - How can the educational spaces of the future be prepared for the inevitable emergence of new careers developed through technological advance?
  - How can a system of spaces adapt over time to the needs of the educators of the future?

- **Ease of Navigation (Universal Design)**
  - How can a system of spaces and the circulation between become more intuitive to use?
  - How can all circulation be universal in use and not have ADA specific circulation not be secondary?
  - Due to the nature of most CTE programs, the average student only spends a small portion of their day in the environment. So, it is crucial that students, faculty and staff are able to intuitively and effectively operate within their environment.

I. PROGRAM ANALYSIS
- Analysis of the program revealed that there were 3 primary types of classroom spaces within a CTE program that could be grouped into modular building blocks:
  - LARGE - PERMANENT EQUIPMENT – AVG. 4000 SF
  - MEDIUM - SPECIALIZED SPACES – AVG. 1500 SF
  - SMALL - GENERAL CLASSROOM – AVG. 1200 SF

II. (PROGRAM = CIRCULATION) + (NON-SIMILAR CIRCULATION) = BUILDING MODULES
- Building Modules were then created by configuring the simplified programmatic blocks into groupings of program and circulation. According to research involving Universal Design, wayfinding in spaces becomes more intuitive when circulation length relates to the program associated to the circulation. When pairing that principle with an additional Universal Design principle stating that circulation should be segmented and non-similar lengths; different modular blocks are the product of the pairing of the principles.

III. CONNECTION/MANIPULATION
- By connecting these building modules at their nodes, it offered the opportunity to create a building form by manipulating the orientation of each building block about their connection points. This allows for a flexibility of form to better fit the needs of the client/district. This manipulation of form is a direct reflection of the research of modularity stating that a modular system a manipulatable system of connectors and nodes.
- Once the building framework is set, the spaces are segmented by a primary ramp of circulation descending into the third building. This allows the primary circulation to be very direct and the ramp is universal in nature. The ramp acts a segment or and divides the building into sections, making the entirety of the environment easier to navigate in orientation to the ramp.

IV. TECTONIC SITE MANIPULATION
- Once the building is placed on the site, the site is manipulated to enhance security. In this specific project the site is reconfigured into a wetland to create an environmental separation between the public and the school.
CTE Prototype: Universal Design, Modularity, and Security

Program Analysis
- Classroom Program
- Services from Use of Third Types of Classroom
- Large Instrumental Equipment
- Small, Flexible Classroom
- Multi-Program

Modularize Building Elements
- Create modular layouts to group building elements according to use
- Integrate design, technology, and flexibility
- Reduce fabrication and construction time

Manipulation of Building Form
- Adapt the building form to the program
- Create a minimally obtrusive building form
- Adapt the building form to the context

Implementing Support Spaces
- Designing the necessary support spaces to respond to the program
- Integrate technology and flexibility
- Create a minimally obtrusive building form

Circulation
- Optimize circulation to reduce obstructions
- Ensure flexibility and adaptability

Outdoor Classroom
- Enhance outdoor learning opportunities
- Integrate technology and flexibility
- Create a minimally obtrusive building form
There are three main topics of research that the CTC should integrate in its design: Universal Design, Modularity, and Security. This career tech center is designed so the students, faculty and guests can navigate their way around the building with ease while also being able to study and socialize freely. The building is designed around the courtyard which is the heart of the center with a parasol structure above the whole building to provide shade for the courtyard and also serve as a water collection system.

For Universal Design the organization of spaces and alignments of building make it easier for students to navigate. The student entrance is located on the first level with no stairs so students with disabilities can have easier access. Also, the student entrance is designed so that when they pass the entry point and go to their right, classrooms can easily be located on their right side as a trail rail. Some for the left: courses will be on their left. The suspended glass cube serves as lecture hall and collaboration space. The space under the glass cube serves as a dining, studying and socializing area. Movement to spaces like the courtyard and gardens gives students benefits by allowing them to move around to provide them with different learning environments. Architectural landmarks allow easier navigation by identifying the various program locations to accommodate the program’s needs. Faculty and staff are located in landmarks on the upper level for privacy which can be access by elevator and through the mezzanine.

For Modularity, the two buildings are the same shape but can be adjusted separately to accommodate different areas. The elevated sections used for faculty and staff can be alternated to serve different purposes for the students and for the accommodation of students with disabilities. Grouping of programs such as automotive, construction and architecture is in response to infrastructural needs, access to service entries and similarity in activity. Many of the rooms are flexible and can serve more than one function.

For Security, the entrances are separated to diminish disruption that comes from the guests entering the building. The student and guest entrance are on opposite corners of the building so that security has a wider angle of vision. The students have access to the building through a separate entrance with card swipe. Visitor/guest entrance is near the student entrance but is facing away so that security can identify if someone who isn’t a student is entering through the student entrance. Service entrances are on the opposite side to separate the public gathering services from cosmetology, automotive, culinary arts, etc., from students, staff and school visitors. There are two entrances/exists for the courtyard so that students don’t have to go back in the building to escape the building in case of an emergency. The parasol roof and surrounding structure create a secure “shell” around the school activities. There are vestibules along with walls so that customers and visitors won’t go past the areas they need to be in unsupervised. Also, vertical windows are used to diminish the harm of a passerby/active shooter.
SERVICE ENTRIES:
- Separated from student and guest entrances to avoid unwanted disruptions and for security.
- Lead to automotive, cosmetology, and culinary arts courses.

COURTYARD:
- Serves as the heart of the CTC where all the students can gather to socialize, study, and eat.
- “Floating” glass box also emphasizes that idea as it serves as a lecture hall and collaboration space for the students.
- Flexible spaces for modularity.
- Parapets provide shade and light to the courtyard but can also serve as a water collection system.

SERVICE/VISITOR ENTRIES:
- For security, customers and visitors, in their corresponding entries, must go into a first checkpoint with the receptionist before going to their destination.
FLEXIBILITY ACCOUNTS FOR THE ABILITY OF A SYSTEM TO PROCESS AND LEARN DIFFERENT INFORMATION AND PROGRAMS. MODULARITY RETAINS PROCESSED INFORMATION AS A FAMILIARITY OR DEFINED ROLE, REQUIRING LESS FLEXIBILITY. MODULS SERVE AS DEFINED SPACE WHILE THE PROGRAM AND FUNCTION PROMOTES VARIETY AND FLEXIBILITY.

NEURON TYPES


MUCH LIKE EACH BUILDING VARIES, SO DOES SINEVINDUAL BRAIN ANATOMY. ALTHOUGH BRAIN STRUCTURE IS COMPLEX, THE METHOD FOR UNDERSTANDING THIS DESIGN HAS BECOME THEORETICALLY SIMPLE. UNI-POLAR, BIPOLAR, PSEUDOUNIPOLAR, AND MULTIPOLAR ARE THE GENERAL CLASSIFICATION TYPES FOR NEURONS, BUT CAN VARY DRASTICALLY IN COMBINATION, MAKING A LIMITLESS AMOUNT OF COMBINATIONS. A COMPLEX SYSTEM IS ORGANIZED BY A SET NUMBER OF NODES AND CONNECTORS COMBINED IN A VARIETY OF WAYS TO GET A DEGREE OF FLEXIBILITY.
Connectors and nodes should be a predetermined set number of variations defining the edge between the two provides the variety and freedom to make each module unique.

Edges help define the experience of a space or the transition of space through interior design. Edges happen at any interaction point between nodes and connectors.

Flexible use of space allows certain spaces to adapt and change to the different pragmatic requirements that arise. This creates wide flexibility throughout the building without altering form.

Predetermined modules give the system a sense of structure, while additional secondary connections that happen at random give the system variety. Predetermined paths show the system as a whole. While random connections help highlight key points of the system, such as focal points and way finding points within the building.

Entry and lobby (1)
This space creates a barrier between the school and the public. Meant to receive and funnel guests into a controlled area adjacent to the admin.

Gathering spaces (2)
This happens at the main circulation intersection, and serves as the buildings primary secondary and tertiary gathering spaces. This focuses the school on the accumulative student body all the way down the individual student. Also serves as the central circulation point of the building.

Administration (3)
This area obviously houses the admin and faculty, but it also serves as indirect connection between the education programs and entry, possibly being used for security measures. This would also have an open office concept to allow for maximum visibility towards the entry.

Labs and workshops (4)
These are to be accessed through their associated classrooms to provide a layer of security and also use the class as both node and connector space. Also these areas are clustered together due to need of exterior access.

Education programs (5)
Are to be clustered according to their similarities in both career field and square footage required. To encourage efficiency, the larger areas will be situated closer to the gathering spaces.
THE SUBURBAN SITE IS LOCATED IN DOWNTOWN DALLAS AND DIRECTLY ADJACENT TO A HOMELESS SHELTER. THIS PREVENTS SITE SECURITY ISSUES TO THE INCREASED AMOUNT OF FOOT TRAFFIC CAUSED TO INFLUX OF PEOPLE COMING AND GOING TO THE SHELTER. THIS IS A PROBLEM THAT WAS TO BE ADDRESSED THROUGH SITE DESIGN AND SITE SECURITY.

CERTAIN SITE PRECAUTIONS WERE CONSIDERED DURING THE EARLY DEVELOPMENT OF THE BUILDING FORM. CONTROLLING TRANSPARENCY AND VISIBILITY INTO THE BUILDING IS A KEY SECURITY FEATURE TO HELP ALLOW FOR NATURAL LIGHT TO ENTER THE BUILDING, BUT ALSO CONTROLLING WANDERING EYES. RAISING THE BUILDING OFF OF THE GROUND COULD ALSO BE ANOTHER SECURITY FEATURE TO HELP DETER ANY VEHICLES FROM DRIVING UP THE SCHOOL, PROVIDING LAYERED SECURITY.
THE PRELIMINARY BUILDING FORM HELPS SHOWCASE THE RESEARCH KNOWLEDGE LITERALLY creating clustered spaces to be used as education programs. The "axon" or gathering spaces serves as the building connector. The admin helps serve as entry and building control while being open and available to students to seeking help or counseling.

The geometry created in plan was then completed in section to give a wide variety of spaces to all floors of the school. This also allowed for a variation in heights throughout the building, as seen in section, helping designate certain spaces.

Transparency within the building plays a big role in child security, allowing for eyes on at all times, hopefully deterring any form of bullying or wrongdoing. Also gives teachers a chance to display their students work as well as them working.
Floor plans showcase various design points that help organize the program and also help create the building form. Research points such as flexible moving walls to open up and create larger space for various pragmatic uses. Controlled vestibules are very common at public entries to schools; this center includes one at the student entrance as well. A variety of different size spaces helps accommodate an individual student all the way up to the entire student body, also being flexible in.

Varying space sizes and volumes throughout the building helps create different sensations and experiences when entering into each space. This can create different modes for different types of learning styles, whether they are social learners or prefer to have their own isolated space. The learning studio also can serve as additional collaboration space for the whole student body.

Green space and access to the outdoors is a point that is commonly under utilized and should be a necessary part of a school of the future. Since a security issue of flowing access into a school prevents access to the outdoors, the solution would be to place a green space on the roof, only accessible by occupants. This allows for students to access the outdoors at all times of the day and also serves as an outdoor learning space if it is desired.
Varying space sizes and volumes throughout the building helps create different sensations and experiences when entering into each space. The can create different moods for different types of learning styles, whether they are social learners or prefer to have their own isolated space. The learning star also can serve as additional collaboration space for the whole student body.

Floor plans showcase various design points that help organize the program and also help create the building form. Research points such as flexible moving walls to open up and create larger space for various pragmatic uses, controlable vestibules are very common at public en
evironment at college campuses. The education is not just at the student entrance as well, a variety of different uses, spaces helps accommodate an individual student all the way up to the entire student body, also being flexible in

Ground Floor Plan

First Floor Plan

Endecity
Flexibility
Variety

Green space and access to the outside is a prime feature for the education environment. seawalls can be incorporated into the design of the university, spread in different locations. bedeuting that we can design to place a corner space on the north, own accessible to the student, where students can get outside and study. Around the perimeter of the green space, the space could serve as an outdoor learning space if it is desirable.
With centralizing the courtyard, the program was laid out in an outward arrayed form that still allows connection between the different educational programs and an effortless clear navigational system. The connecting personalized spaces allow a transition between the courtyard, the primary circulation and the learning spaces, designed openly to allow students to adapt to learning environments and staff to have the space and ability to teach and communicate in different ways and making mobility easy for all users. Educational feedback shows students don’t learn in the same way which requires different methods of teaching through spaces that can adapt to those needs. The purpose of the communal spaces is for change to take place and interactions to be straightforward. These open interchangeable spaces also create a “pause” before entering a classroom, shown to help students step out if they need a moment or for faculty to take a time out when becoming overwhelmed. The continuous segmented primary circulation connects to all segments of the available programs while helping users define between path and destination. Access Management at the one entry point, a controlled approach, allows these connecting communal spaces to become the screening layer through this design of the centralized courtyard.
Our research in educational facility and design issues involved extensive literature review, several site visits of schools in DFW. Changes in educational philosophy and pedagogy, digital technology, economics and culture are dramatically changing the form of schools. Three research areas were of particular focus, modularity, universal design, and security. CTE is increasingly a focus of public education, as more high schools are being incorporated into their programs.

The research recommendations were incorporated into this project in the following ways. Modularity, the shape itself and the three different sizes can be constructed in prefabricated form, as well as the penalization of the curved skin. Universal design, using collaborative spaces, transparency, movement and nature through the site. Security, rather than focusing on a secure door, primary is in securing the site and surrounding buildings. Through bollards, secure wall and precise entry points for students and the public.
Program

Administration
- Advance Tech
  - A.I., V.R
  - Drones

Class Rooms
- Law
- Human Services
- Business
- General

Digital Lab

Shops
- Automotive
- Robotics
- Welding
- Energy
- Culinary

Design Studio
- Architecture
- Fashion

Health
- Bio Engineering
- Nursing/health science

Future CTE + Programs

Interdisciplinary Collaboration.... and the growth of CTE programs for future careers, jobs. Starting with new ideas, and integration of exploration in other fields.
Sections
The building design is heavily influenced from the research, ranging from building form, site, program, etc. The form addresses several of the issues as the mirrored/flipped organization is focused on the cognitive mapping function to ease the understanding of circulation, along with breaking the line of sight for security purposes. There are two wings that enclose the two main parts of the building creating a south and north courtyard. The wings accommodate for administration that monitor the two entrances, the student and main entry, that address the “bottle neck” effect from having just one entry.

There’s a unique quality of the building as the transparency is mostly internal, for security purposes, with about 90 percent of the spaces being provided with natural light, enhancing the learning environment. The vegetation/landscape provided is also a means for the learning environment, having collaborative spaces and peace corners that serve for individual space, or spaces for large groups to gather. There is also perimeter site control that keeps from having a direct path to the entries to add to the security. The design of the site is translated from the tangential regulating lines of the building form. From there, the spaces were able to be defined and differentiated from one another. Spaces were either changed in elevation, extensive landscape, exterior fixtures were placed, or even certain monuments were used for the intent of the long indirect path to the entries.

The organization is able to give the spaces its own qualities, but through the spatial sequence, it is still connected to the next, unifying the building as a whole.
Project Description

- My architectural approach capitalized on addressing security and access to natural green space.
- From research, I found out that student bullying and internal violence are more common and everyday issues that needed more attention and demands architectural resolutions.
- When it comes to natural green space, researches supported that exposure to green spaces especially with urban city schools improved the mental development of young students.
- My design concept divided the school into 3 zones, where each zone has its own functional use. The large educational spaces are located at the 3 corners of the building forming an enclosed triangular space with a cylindrical void space at the center of the building providing an outdoor green space for the facility.
- The primary circulation and the large circular open space located at the center provides an opportunity for each academic wing to be connected at the central collaboration space. The central round space addresses every surrounding equally and accommodates easier patterns of movement, congregation and habitations at different levels.
- There are 3 entries to the building. The north entry is the primary entry for students and for the general public and staff members use the east side entry.
- On 1st floor, administration office is located at a strategic central location between the north and south side entries of the building providing a full and constant surveillance.
- Central collaboration spaces, individual work areas, the class rooms and even the exterior envelope of the building are more open and transparent to provide clear lines of sight, even between different floor levels. These design approaches are recommended to prevent bullying and help bring natural light into the learning spaces to improve the learning and teaching environment for the school community.
MICHAEL HAILU
A Career Technology Center

FLOOR PLAN LAYOUTS

PROJECT DESCRIPTION:

The goal of the project was to create a new educational facility for a Career Technology Center in Minnesota. The design includes a diverse range of spaces and functions, including classrooms, workshops, and administrative offices. The building features a dynamic, fluid form, with curved and cantilevered elements to create an engaging and modern learning environment.

4TH FLOOR:

2ND FLOOR:

1ST FLOOR:

MAINTENANCE V!EW FROM SATE ST:

2ND FLOOR:

1ST FLOOR:

1ST FLOOR:

These small individual study areas provide a quiet and private protected view that are ideal for individual reflection space or group study sessions.

MICH 11

E16

ARCH 5670 FALL 2018 A4LE/UT ARLINGTON THE EDUCATIONAL RESEARCH STUDIO
MICHAEL HAILU

A Career Technology Center

CENTRAL COURTYARD VIEW

A well-lit, indoor green space with a skylight and a balance of natural light. The area is designed to promote an open, inviting, and collaborative environment.

2ND FLOOR CENTRAL COLLABORATION SPACE

The circular glass walls around the glass classroom walls provide a visual transparency with the building exterior. The large windows allow for natural light to enter the space, creating a warm and inviting atmosphere.

LONGITUDINAL SECTION 1

A cross-section view that highlights the structural design and flow of the building.

CROSS SECTION 2

An overhead view that provides a comprehensive look at the building's interior and design elements.
CTE schools are advanced technical schools that target a younger generation for the purpose of career training and to stimulate a localized economy. The idealized education is one where the traditional education is combined with CTE. This hybrid learning environment is not achieved on one campus it is usually split, thus forcing students to travel from their area’s high school or middle school to the CTE center that has programs for the student’s interests. Research into CTE centers, universal design, modularity and security has resulted in their conceptual design.

The problem with students arriving and leaving constantly is security, entries need to be monitored and secured. The drop off locations for students have to be separated from the visitor entrances. Controlling the entry to the premises is the first layer of security for the CTE center. The second layer of security is a perimeter wall around the campus or a fence. The third layer of security is the building’s form, by elevated the street facing exterior walls and allowing the floor slabs to act as a barrier. The last layer of security is compartmentalization between modules, though they are connected the student’s access to the entry of module they do not belong in on the ground level is prevented. However, once inside the configured modules you may move and interact freely within them.

The CTE program is split between special and general environmental control systems, two distinct categories for two distinctive module types. The first module must be able to nullify excessive sound, have proper spaces for dangerous equipment, and have large door access to the outside for bring in large equipment. The second module for the general environmental control is smaller and has fewer parameters making it there more pliable a form. More specific modules are gained from grouping like programs together in the same forms. These forms can take many shapes and scales, as long as, ample circulation is provided for all.

With these upward arching forms, it is an ideal structure to maximize daylighting into the building and the rooms that would benefit from sunlight. By arraying the modules radially, a courtyard space is created for social interaction and exposure to outdoor space. The unique forms offer many elevated views to the outside from within the building. Within the modules are open lecture spaces adjacent from ramps and stairways that allow for impromptu classes, as well as, unconventional study areas for students.
The clustering of the modules is decided on the careers and their environmental control requirements. Modules that require better sound proofing, use potentially hazardous equipment/technology, and outside dock door access are coupled together. As opposed to those programs that would do well in standard classrooms, with each program having a designated building students are able to attend the CTE center afterhours without complete access to the entire school.

- Compartmentalization between program areas for controlled access.
- Specific entries for ease of monitoring and controlling traffic in/out of buildings.
- Access to connected programs once inside a building. Promoting interaction and a more social environment, as well as, more security.
- Lifting the buildings allows for greater safety from outside threats by creating higher ground.
- The centroid of the arrayed module provides an outdoor courtyard and spaces away from school work and stress.
- Building's form and transparent shell allow for maximum daylighting and range of sight.
This project incorporates the floor plan research done in the classroom, lecture, and computer science courses. The design of the building is flexible and can be modified to accommodate various needs. The classrooms are equipped with the latest technology and are designed to be comfortable and conducive to learning. The building is located in a quiet area, away from the noise of the city. The green space provides a natural environment for students to relax and study. The building is also equipped with security features to ensure the safety of the students and faculty.
Transparency
The idea behind the transparency is to allow for a large field of view in the interior of the building while the transparency may not be evident in all parts of the interior this can help for security reasons but the overall idea is to be able to see as much as possible inside the building and outside.

Universal Design
The use of clear story windows in the building allows for natural light to be brought in to all parts of the building this along with the collaboration spaces allows for student to have an overall welcoming and productive atmosphere throughout the whole building.
As we began this process, we were split into four research groups: career technical education, modularity, security, and universal design. We were instructed to research these four topics, with groups of researchers focusing on one specific topic and the information obtained by each then brought together as a whole. This research was then to dictate the direction of our design. Therefore, all of the major design decisions of this suburban site were directly based on the research topics and the program. The only variable was what form it would take?

Our research and analysis resulted in sixteen different career clusters, thirty program classrooms and two general classrooms. Further analysis revealed three types spaces: with twelve general classrooms, twelve laboratories, and eight shop facilities. Laboratories and shop classes both had requirements best suited to the ground floor, while the general classrooms could be located anywhere. Modular spaces naturally simplify organization of spaces and the program. These ideas were combined with my design ingredients of transparency, modules, a skin, clerestories, overhangs and a courtyard. This became the initial plan configuration.

There are three module types: Class, Lab, and Shop. Each module type contained two classrooms, labs or shops. All the modules had the same widths but different depths. Individually, each had an attached room that could be used for either a small group space or for additional storage. Our research also indicated that modules needed to be highly adaptive due to changing needs over time. The dominant circulation linked to seventeen collaboration spaces that could be informally and flexibly used. This helped to incorporate what we’d learned about learning spaces of different scales promoting different modes of learning. The module configuration was scalable and provided flexibility for program needs and expansion. Configuration from the smallest configuration to the largest provided the potential for both a high school and a college level program.

We incorporated concentric rings of security with four distinct rings. The first ring was composed of aspects related to the organization of the site such as setback from the highway and walled berms. The second ring consisted of external elements of the building, including planters that act as bollards and the exclusive use of vertical windows on the first floor, with the windows spaced widely apart. The last two rings of security consisted of identification and screening procedures upon entry to the building and various internal security measures. One such internal security measure was the inclusion of large collaborative spaces and visibility, since research indicated that most security threats were students who felt that they didn’t belong, and such collaborative spaces foster a sense of community and belonging.

Universal design eloquently shapes the circulation, allowing the path to navigation throughout building and its destinations. It’s more than a circulation path to the next floor, it serves as the transition between formal and informal spaces, as well as those within and without.
DESIGN ISSUES: CTE PROGRAM, MODULARITY, SECURITY, AND UNIVERSAL DESIGN

DESIGN CONCEPT: TRANSPARENT collaboration spaces and scalable program MODULES that are wrapped in a SKIN with CLERESTORIES and vaulted OVERHANGS surrounding a central COURTYARD.
Circulation ramp with adjacent collaboration spaces and exits to the courtyard help break up long path with destinations other than just getting to the next floor. Shop modules to the left.

A security gate under the bridge allows courtyard use throughout the day and the transparency surrounding the courtyard provides passive security to those within.

Multiple points of access to the courtyard allows an engagement with nature across disabilities.

View from upstairs, after passing through bridge. Glass modules to the left. Fixed routes and locations.

Avoiding one long hallway, break up circulation. Wider walk ways, not designing for the minimum.

View of downstairs, after turning right under stairs at lobby. Lab modules to the right. Predictable organization.

CONCENTRIC RINGS OF SECURITY

(Site layer)
Separate parking, dropoff & pickup zones for students & visitors (Green)

Topography barriers (Blue)

No straight traffic routes (Red)

Setback from highway (Black)

(External layer)
Dock doors on one side of building that is most active

Vertical windows with wide spacing

Bollards that are planters & seating

(Screening layer)
Two points of access: one for students & one for visitors

Identification & authorization

(Internal layer)
Transparency & open spaces for passive security

Transparent to opaque glass

Obvious video surveillance

Courtyard security gate

WILLIAM LUCAS
CTE DESIGN FOR A4LE
This project demonstrates how a collection of school design innovations can come together to create a secure space for everyone while remaining conscious of schools everchanging needs. This design resulted from analysis and extensive research into security, universal design, and modularity.

Out of the three, security had the most influence formally. The building is removed from the ground with three secure entrances at grade and only one being open to the public. The public entrance is in part monitored by a screening layer in between the entrance and classrooms. When transitioning from the public realm to the private, a visitor would pass through layers of security before they could gain access to the private park on the lower level. In addition to this submerged outdoor space, there is an elevated one that could be used in an urban setting where ground access and submerged areas are not a possibility. Though the curved hallways limit the line of sight of possible attackers, visual transparency is important for day to day personal security threats. Transparency increases awareness of surroundings while reducing the areas where students can bully each other or create trouble.

In terms of universal design, a few ideas were rooted in the possibility to encourage and redirect people while going beyond ADA requirements. For instance, a wider walkway allows people who are hard of hearing enough room to continue their conversation while others pass by. A shallow ramp placed in an ideal location reverses the idea that ramps are utilitarian, and stairs are alluring. Even though sharing experiences like moving between classes is important, so are moments when students and adults alike need time by themselves. Peace corners are small rooms within each classroom where students can emotionally decompress when they feel the need, in addition to this function, these rooms can also be secure areas in case of inclement weather or an attack.

Lastly, modularity was explored in several different terms but in this case, it was creating repetitive classrooms that can be modified according to changing class needs or functions. Meanwhile, consistent circulation cores are used as markers for wayfinding that can orient students and visitors.
Angela Monge

A Career Technology Center – As Presented

Private outdoor space can be used as learning areas without immediate connection to public realm.

Long gradual ramp with workstations every 30 feet. Encouraging people to take ramp over stairs.

Controlled access crossing from public realm to private.

To aid in wayfinding, circulation cores are wrapped in a colored and textured material.

Elevated interior outdoor area that can be used as lab space.

Glass panels offer ability to have collaborate space turn into class space as school needs change.
Approaching the main entrance, visitors receive a hint that the school is focused on green spaces. Situated in a suburban context, visitors are greeted by a descending courtyard with multiple ways of egress leading to the lecture hall, and the main path to the CTC itself. According to multiple sources, views and access to nature and daylight have a positive effect on the performance and mental health of occupants, especially children. The Children & Nature Network, an organization created with the goal of reconnecting children to the environment, found that contact with nature provides benefits to children’s mental, social, and physical health. Resulting in an improvement on academic performance, focus, behavior, creativity, and enthusiasm for learning. It’s through this reasoning that throughout the building, access and views to nature are never far away, whether you’re in the classroom or the workshop. Students are able to occupy a range of spaces from group collaboration to individual meditative spaces, sometimes referred to as peace corners in various schools. Another important issue is the rising number of school shootings. It is shown that 90% of all school shooters are students. Through the design of the school, the goal is to foster a caring and inclusive student community with the help of a comfortable and calm learning environment. By involving students in school activities and interacting with each other in a positive manner, the probability of the student harming one another drastically decreases. It’s through nature and the environment that school shootings can be stopped at the root – the mind. Although it’s not a black and white issue, that the reason they occur is strictly because of mental health, the goal was to design a learning environment that doesn’t sacrifice design and occupancy for a student prison.
RESEARCH SHOWS THAT ACCESS AND VIEWS TO GREEN SPACES IMPROVE STUDENTS' PERFORMANCE, IN ADDITION TO MENTAL HEALTH. WITH A FOCUS ON NATURE AND DAYLIGHT, THE GOAL IS TO CREATE A COMFORTABLE AND CALM LEARNING ENVIRONMENT TO FOSTER AN INCLUSIVE STUDENT COMMUNITY.
The “NEXT GEN” Career Technical Center (CTC) is backed by research and design strategies, and inspired by the career technical centers of Arlington ISD, Garland ISD, and Rockwall ISD. This career-focused and college-bound school consists of approximately 120,000 square foot, comprising of the most globally recognized and widely programmed career clusters, and educational programs. Each program has unique spatial requirements and a purpose that must be specifically designed for. The three main research topics this project focuses on resolving are security, universal design, and modularity. The issues of security are physical/mental/emotional/psychological security, exterior threats of shooters/non-custodial parents/natural disasters, and interior threats of behavioral issues among students/faculty/staff. The design strategies in response to these issues are access control, deaspase, wide walkways, transparency, screening layer, concentric ring, indirect path of site movement, line of sight, and areas of refuge. The issues of universal design are design for everybody, mainstream education, and choice of both/and. The design strategies in response to these issues are peace corners, wayfinding, landmarks, cognitive clues, fixed route/intuitive circulation, and blurred lines of accessibility. The issues of modularity are expansion and contraction, and efficiency of construction. The design strategies in response to these issues are nodes and connectors, scale of spaces, flexible/inflexible spaces, temporary/permanent spaces, plug and play, concatenation, and simplified program. All issues derive not only a direct, tangible insight, but resolve itself as a mindset, a way of thinking through the design.

This “School of Tomorrow” contains modules within a larger module that can be adapted to flourish anywhere, with any environment, across any culture. The context in focus presented in this project for orientation are urban and suburban regions in the DFW metroplex. As technology rises to the forefront, schools are changing, becoming more advanced, opportunistic, and efficient. Such technologies and forward thinking are represented in the design of this CTC, and reflected in the tectonics of the details.

The smallest modules are the “Individual/Collaboration Modules.” These modules are placed around the classrooms for students and teachers to offer space that can support an individual up to a small group size. This tessellated system has an infinite quality of malleability and arrangement due to the advancement in technology. It begins in a flat state that can be walked on, and can transform into the spaces needed for a required size. The next modules are the “Administration Modules.” These modules present a space with full transparency for a more secure environment, and are placed in a way that create a secured vestibule at the main entrance. The next modules are “Classroom Modules.” The modules contain all the educationally programmed spaces. They offer a plug-and-play system where any of these can be removed or combined per the need for that school year. They also exist as recognizable landmarks from the interior of the school for an easier navigation around the school. The next modules are the “Assembly/Learning Stair Modules.” This module is placed in the very center of the school, giving it a focus and importance. This assembly space also has three flexible arrangements: recessed in the floor for an intimacy, made flush with the floor so that it creates a large, open space for certain events, and raised for moments where it needs to act as a normal lecture space. The final and combination of all the modules is the “School Module.” This module is an adaptable and flexible system when assembled for any condition. The main design feature is the “Mobius Strip” ring that is the anchor for all the modules and acts as a connector. The infiniteness and paradox can be demonstrated in terms of a continuously twisting enclosure of visual dynamism. Another interesting aspect of the mobius form when expressed in this design is its ability to foster a sense of transformation. The circular formality represents the notions of wholeness, focus, unity, timelessness, and an inclusion. The school itself is an interactive device with its context and its occupants. What makes the technological aspects of the school coherent is their dynamic responsiveness to their environment, specifically the roof structure and the interactive zones of individual and collaboration space. The school is shown here in its suburban form that sprawls out, but can also be configured to a tight, urban site.
A4LE Career Technology Center

Research conducted during the semester produced a catalog of design techniques that can be incorporated into school design. The research was based on three main areas: security, universal design, modularity.

I conducted research with the security group and that was my focus. The research offered some strong recommendations about using landscape and transparency to better help with security.

My CTC center is focused on breaking up the conglomerate of one big building into several smaller buildings. CTC center has many programs that need special finish outs or space requirements that could be more efficient if they were grouped together with similar requirements. Grouping these liked programs would then become the different structures that would be on the site. I broke up the school in five separate buildings: administrative, shop, technology, service industry/hospitality, and classrooms/lecture. Also, by breaking up the school it increased the security of the whole, because you can then isolate threats or problems within a single building. This would help with narrowing down an affected area to just one area and not using precious time and resources on spaces. The buildings are then linked with sky bridges that connect them on different levels of the buildings. Also, the sky bridges work as choke points when there is a need of lock down. The skybridges and the separation of buildings work as two different layers of security. Another level of security that was incorporated in my projects was the addition of two berm walls located on the northern and southern parts of the complex to deter some people from entering the inner space in the middle of the building. The berm is 15' where it meets the fence line so if somebody does decide to go over the fence there is the extra layer of height that would deter somebody that would jump it without the berm. In the terms of universal design the buildings we proposed in the form of ellipses so there would be no true back to the classrooms and for some of the students that would have learning disabilities if would feel more of a uniform learning environment. Another reason for the ellipses if that the pathways are a play of the shape that even if you got lost you can essentially follow the outer wall and you can move between buildings even being lost. In terms of modularity the building themselves are modular in their construction components.
ARLINGTON CAREER TECHNOLOGY CENTER

BY: GEORGE TOBAR
ARLINGTON CAREER TECHNOLOGY CENTER

BY: GEORGE TOBAR
The school of tomorrow needs to be designed more securely, universally for all, and able to adapt to the always changing curricula, technology, and teaching environments. The CTE attempts to achieve these goals based on research into Security, Modularity & Universal Design and based on full-scale mock-ups of the research conducted in the publishing and testing phase. The design of the building is simultaneously determined by the location of the key utility areas, and the division of the program based on wants to seeking CTE’s. The division of the program into 4 distinct categories of Mass, Wall, Space, and Section ruby to represent the program’s layers of security. A central core is surrounded by opaque floors and is kept safe by several security measures, implemented due to research.

**Components of a CTE**

- A career technical education center can be divided into four groups:
  - Support Spaces
  - General Purpose
  - Specified
  - Specific

**Cool Not To Look Like A School**

According to research, a building normally looking different from a typical school building, students are more likely to attend.

**Access Control**

A central area with multiple controlled and monitored access provides a choke point and limits unauthorized entry.

**Curved Hallways**

Coved corridors throughout the building but sightings of possible-makers or active shooters.

**Concentric Rings of Security**

Layers and layers of security are entered to protect children in the learning environment.

**Urban Footprint vs Suburban Footprint**

- An urban environment requires a program to move towards and evolve.
- A suburban environment allows for program to spread out and conserve area.

**Multifunctional Adaptive Spaces**

Spaces that can function independently and additionally function in multistory, faster safer learning.

**Slurring the Vertical Circulation Distinction**

The blurring the division of accessible routes and the role direct route serves.

**Green Spaces**

Access to a biophilic environment and the outside is important for mental health of students.

**Moments in Pause**

Locations of places, spread throughout the building, give students and teachers a place to take a break.