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Scholarship of Design Research

THE SAFETY CONVERGENCE OF CHEMICAL EXPOSURE & FLAMMABILITY

Debra Harris
Baylor University

Abstract

According to the National Fire Protection Association (NFPA), ignition of upholstered furniture is a significant contributor to deaths (22%) from reported home fires.1,2 Most residential upholstered furniture fire-related deaths occur when open flames are present and the fire spreads beyond the initial source.3 Upholstered furniture is one of the largest fuel loads in a typical home, causing full room involvement with low oxygen levels and extremely high temperatures that are not sustainable.4 The use of a barrier has been found to be an effective strategy to delay the involvement of upholstered furniture filling materials in a fire incident.4-6 Fire suppression strategies specifically to reduce open flame involvement of upholstered furniture, like a barrier, may reduce the number of deaths attributed to home fires.

Previous studies on the availability and effectiveness of fire barriers used in upholstery furniture have been conducted by the National Institute of Standards and Technology (NIST),5,7-9 The State of California Department of Consumer Affairs Bureau of Household Goods and Services (BHGS),4 and Chemical Insights Research Institute (CIRI).6,10,11 These studies found that barriers extended flashover from 6 or 7 minutes to 21 minutes or more; multiple barriers currently on the market met the criteria for smolder and open flame testing; and that barriers outperformed other flame suppression technologies or upholstered furniture with no flame suppression technologies. Contrary to these efforts, these studies did not account for barrier chemical composition or the inherent conflict between the smolder test and the open

flame criteria.

Chemical exposure risks occur during normal use of the upholstered furniture product and during a structure fire. Research12 shows that classes of flame retardants traditionally used in polyurethane foam (PUF) are found in studies where normal use is simulated in a chamber environment. The most significant exposure route is dermal transfer, followed by ingestion and inhalation. Reactive flame retardants did not produce measurable chemicals in the study. Data from product burns showed that flame retardants used in upholstered furniture were found in the burn emissions at significantly higher levels than found during typical consumer use. This study also found that mechanically aged chairs measured lower levels of flame retardants than new chairs. 12

The intersection between a chemical safe and fire suppression solution for upholstered furniture is the focus of this study. Challenges are identifying chemical or technical solutions that do not compromise health while providing a solution that meets both the smolder test requirements and provides flammability suppression to minimize the fuel load in a structure fire. Our findings will contribute to the existing knowledge on fire suppression strategies for home fires. The evaluation of the textiles assessed for compliance with TB 117-2013, open flame testing, and chemical composition, will discern the potential solution or determine that further research and development is necessary to respond to the need for an upholstered furniture fire barrier to reduce home fire deaths.

PowerPoint Presentation

Chemical Identification:

(1) Carcinogen
(2) Probable carcinogen
(3) Possible carcinogen

International Agency for Research on Cancer
World Health Organization

- Acenaphthene (3)
- Anthracene (EPA)
- Benz[a]anthracene (2B)
- Benzo[a]pyrene (1)
- Benzo[b]fluoranthene (2B)
- Benzo[k]fluoranthene (2B)
- Chrysene (2B)
- Fluoranthene (3)
- Fluorene (3)
- Naphthalene (2B)
- Phenanthrene (3)
- Pyrene (EPA)
- EHDPP (EPA)
- TDCPP (EPA)
- Cis-permethrin (EPA)
- Malathion (2A)
- Piperonyl Butoxide (EPA)

Chemical Identification: Non-carcinogenic

Organophosphate esters and pesticides

- TEHP – skin and eye irritation, Glucocorticoid and Pregnane X Receptor Antagonistic Activity
- T35DMPP – respiratory distress
- TBEP – skin and eye irritation
- TCPP – emits toxic fumes
- TMTP – intestinal, muscular
- TPhP – endocrine disruption, neurotoxicity, organ toxicity
- Malaoxon – acute toxicity, bronchoconstriction, death

Health Effects of Chemical Exposures

Cancers
- Multiple myeloma
- Prostate cancer
- Non-Hodgkin's lymphoma
- Testicular cancer
- Digestive cancers
- Oral cancers
- Respiratory cancers
- Urinary cancers
- Mesothelioma cancers

Neurodevelopmental Effects
- Decreased memory & learning
- Reduced IQ
- Hyperactivity

Endocrine System Disruption
- Obesity
- Chemicals that mimic estrogen
- Alters thyroid hormone

Reproductive Toxicant
- Decreased fertility
- Decreased birth weight
- Decreased sperm quality

Cardiovascular disease

Study 1: Managing Fire & Chemical Exposure Risks of Residential Upholstered Furniture

- Tested 4 Conditions of the Same Chair (N=20)
  - No Flame Retardants (FR) – new and aged
  - Organophosphate FR – new and aged
  - Reactive Chemistry FR – new and aged
  - A Fiberglass Barrier with No FR – new and aged

    +
  - Large Screen TVs
  - Computer Laptops
- Phase 1: Chemical exposure during everyday use
- Phase 2: Chemical exposure during a fire
- Phase 3: Flammability testing

Chair Construction & Composition

- All chairs constructed to specification
- 20 chairs divided into 4 test sample groups: changes in cushion composition
  1. Non-FR Foam – 70% PUF, 30% Soy-based, No FR detected
  2. Traditional FR Foam – TBPP Mixture
  3. Reactive FR Foam – Proprietary, No indication of FRs
  4. Non-FR Foam + Fire Barrier, No FR detected

Content Analysis conducted by independent lab

Fiberglass Fire Barrier Composition

- Commercially available
- Content: 100% Fiberglass
- Fiber:
  - Warp Yarn – ECE 225-1/0 1.0 Z Twist
  - Fill Yarn – ECE 225-1/0 1.0 Z Twist
  - Coating – Approximately 7% Organic Coating
- Finished weight: 3.4 oz/sq yd.
- Count – Warp: 60 per inch
- Count – Fill: 58 per inch
- Weave: Plainweave
- Breaking Strength – Warp: 115 lbf/in
- Breaking Strength – Fill: 105lbf/in
- Shrinkage: Fabric is dimensionally stable up to at least 700°F

Material	EDX Analysis	Polymer Type (EGA)
Cover textile	C,O	Cotton
Ticking	C,O	Cotton + PET
Fiber	C,O	PET
Non-FR foam	C,O	PU
Traditional FR foam*	C,O	PU
Reactive FR foam	C,O	PU
Poly loose filling	C,O	PET
Fiberglass barrier	C, O, Al, Na, Cl, Ti	Glass fiber
Decking textile	C,O	Cotton + PET

*Traditional FR foam: triphenyl phosphate and isomers of tertbutylphenyl diphenyl phosphates
(confirmed by two separate labs)

Chemical Identification: Furniture Components

Material Identification Analysis – Electronic Components

- TV and laptop casing:
  - C, O, Mg, Si
- TV and laptop Printed Circuit Board Laminate:
  - Br
- TV wire insulation:
  - Cl

Research Plan

Test Sample (Chairs)

- New - conditioned
- Aged – mechanical aging process – 10 years

Environmental Chamber Exposure Testing

- VOC
  - Environmental Chamber Lab and Fire Performance Lab Sampling
  - Air
- SVOC
  - Environmental Chamber Lab and Fire Performance Lab Sampling
    - Air
    - Dust
    - Surface

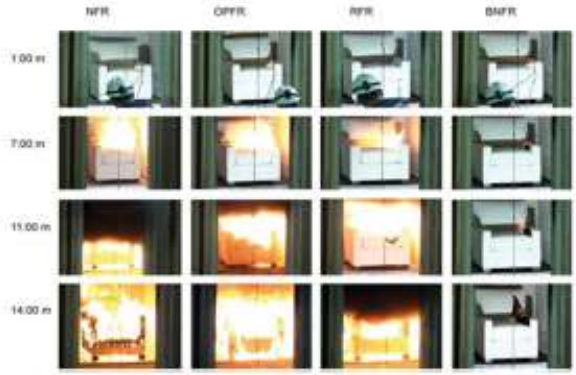
Study 1: Managing Fire & Chemical Exposure Risks of Residential Upholstered Furniture

Summary of Findings: Chem Exposure During Use

- Chairs: Emissions of VOCs and aldehydes from all four chair types - low and met current indoor air guidelines.
- TVOC levels of the chairs ranged from 68-160 $\mu g/m^3$ (high)
- VOC emissions included: alcohols, carboxylic acids, and aldehydes
- VOC emissions from the TV were higher than the chairs - TVOC value of 384 $\mu g/m^3$.
- The laptop had low VOC emissions
- Chemicals of concern emitted at low levels

Summary of the Findings: Flammability

- More than 500 different VOCs were identified.
- Benzene - present in high levels during all chair burns; significantly higher than the allowable occupational exposure limit.
- Other VOCs detected during the chair burns - aldehydes, nitriles, isocyanates, acrylates, phthalates, aromatics, carboxylic acids, and others.
- Fewer VOCs were released electronic product burns.
- Fiberglass fire barrier
  - Performed well in open-flame test
  - Failed the TB-117-2013 smolder test.



Still frames of the ISO 9705 Test Room burns for the four chair types representing flame suppression for NFR, OPFR, RFR, and BNFR at 1, 7, 11, and 14 minutes (m) from ignition.

Study 2: The Search for a Chemical Safe + Fire Safe Fire Barrier for Upholstered Furniture

Actionable Research + Insights

Protection from fire hazards and chemical risks are not mutually exclusive and both should be essential safety features of residential furniture.

Evaluating Existing Fire Barriers

- Identified 16 potential fire barriers
- Tested and evaluated:
  1. Passes the CA TB 117-2013 Smolder Test
  2. Passes a Small Scale Open-Flame test
  3. Material and Elemental Composition Analysis
  4. Chemical analysis for flame retardants

Barrier Selection - 16 total barriers received, 10 selected for short list:

CATEGORY	MANUFACTURER/DISTRIBUTOR	RATIONAL
Cotton & Fiberglass	Herculite SureChek Blaze Blocker FG	Cotton wrapped fiberglass FR? Hand - OK. Feels like duckcloth - kind of stiff
FR Rayon	Spec-Tex 6.8 oxy 100% FR Rayon Mel Godwin	FR Rayon 100% (knit) Hand - Very good
High Loft	Whisper Shield Wm T. Burnett - Foam Division 1.0 OSF - High Loft	Silica based rayon and other polymeric fibers (FR Rayon) Can be needlepunched, quilted or used as is. If 1.0 passes, we could test .80 (weights include: .5, .75, .80, 1.0 osf May be able to offset cost by replacing batting
Intumescent Phosphorus	Preferred Finishing - Kyle K200	Intumescent Acrylic Coating 59% and Polyester/Cotton/Fiberglass Knit Blend 41% Hand - OK, not good
Modacrylic Blend	Herculite SureChek Blaze Blocker HP	FR Rayon, Nylon, Continuous Filament Silica, Modacrylic Hand - soft knit, very good
Modacrylic Blend	Spec-Tex 4.4 oxy Blended Yarn Mel Godwin	Polyester/modacrylic/fiberglass/Rayon Hand - very good, loose knit dh tested - does not ignite
Modacrylic Blend	Preferred Finishing - Kyle K400	Modacrylic/FR Rayon/Fiberclass Knit Fabric 49% and Heat reflective coating 51% Hand - poor
Modacrylic Blend	Preferred Finishing - Kyle UD-408	Modacrylic/Rayon/Inherently Flame Resistant/Glass with a 1 Mil Polyurethane Film "Green Chemistry" Hand - OK May have PFAS (moisture barrier)
Polyester	Regal Fabrics Scott Kahan DL041 White or Black 100% Polyester	100% polyester - no FRs Model: DL041 (white or black) Hand - good
Polyester	Regal Fabrics Scott Kahan	90%/10% polypropylene/polyester, no FRs Hand is ok - Rough and a little stiff Cost more than the polyester provided by same distributor

Study 3: The Development of a Chemical Safe + Fire Safe Fire Barrier for Upholstered Furniture

Development of a Textile Fire Barrier

- Worked with a fabricator for design & composition
- Tested and evaluated:
  1. Passes the CA TB 117-2013 Smolder Test
  2. Passes a Small Scale Open-Flame test
  3. Material and Elemental Composition Analysis
  4. Chemical analysis for flame retardants
- Next Steps: Flammability Performance
  1. Mockup (Seat cushion in the Calorimeter)
  2. Full Scale Open-Flame Test (Calorimeter)
  3. Publish and promote in the market

This project was driven by a need for a response to young families that were concerned about fire safety in their homes.

Expected Outcomes

- Improve flashover times using a fire barrier for suppression on upholstered furniture
- Contributed to UL fire safety programs
- Developing educational programs for designers, manufacturers, and homeowners
- Fire Barrier available in the market

Thank you!

Debra Harris, PhD

Baylor University

Appendices

The Safety Convergence of Chemical Exposure and Flammability

- Chemical exposure during use and during a fire
- 140,000+ chemicals used to manufacture products that we use daily.

Summary of Findings

- Emissions of VOCs and aldehydes from all four chair types were low and met current indoor air guidelines.
- TVOC levels of the chairs ranged from 68-160 µg/m3
- VOC emissions included alcohols, carboxylic acids, and aldehydes
- Chemicals of concern emitted at low levels
- VOC emissions from the TV were higher than the chairs - TVOC value of 384 µg/m3. The laptop had low VOC emissions

I conduct research with an outside group, Chemical Insights that is a part of UL. Emory University Rollins School of Public Health was also part of the team. I was responsible for research design, execution of specifying and procuring the chairs, and evaluation of the findings. We also tested large screen TVs and computer laptops.

There are more than 140,000 chemicals used to manufacture products that we use daily, and many of these chemicals have not been evaluated for their impact on human health. In addition, most people are exposed to a complex mixture of chemicals, and we do not understand how these mixtures may synergistically react with the human body. So, this study evaluated chemical exposures during normal use through simulation of chairs with 4 conditions – there were 20 chairs, 5 each made to spec for no flame retardants, organophosphate added, reactive chemistry added, or no flame retardants with a barrier added. We found that:

- Emissions of VOCs and aldehydes from the four different chair types were low and would meet current indoor air guidelines.

- TVOC levels of the chairs ranged from 68-160 microgram per cubic meter (µg/m3) and were similar among new and aged chairs.
- Primary VOC emissions of the chairs included alcohols, carboxylic acids, and aldehydes, as commonly associated with polyurethane foam.
- Chemicals of concern emitted at low levels included toluene, naphthalene, formaldehyde, and acetaldehyde (known carcinogens or reproductive toxins). These are likely associated with industrial solvent contamination or material composition.
- VOC emissions of the operating television were higher than the chairs with a TVOC value of 384 µg/m3, and a complex mixture of siloxanes, alcohols, aromatics, acrylates, and phthalates measured. The laptop had low volatile organic compound (VOC) emissions, slightly above detectable levels.
- Chemicals of concern with the television included acetaldehyde, formaldehyde, naphthalene, toluene, ethyl benzene, and styrene (known carcinogens or reproductive hazards). These are likely associated with industrial solvents and product components.

The Safety Convergence of Chemical Exposure and Flammability

- 3 ½ minutes

Summary of the Findings

- More than 500 different VOCs were identified
- Benzene, a known carcinogen was present in high levels during all chair burns and is significantly higher than the allowable occupational exposure limit.
- Other VOCs detected during the chair burns included aldehydes, nitriles, isocyanates, acrylates, phthalates, aromatics, carboxylic acids, and others.
- Fewer VOCs were released from the electronic product burns.

Still frames of the ISO 9705 Test Room burns for the four chair types representing flame suppression for NFR, OPFR, RFR, and BNFR at 1, 7, 11, and 14 minutes (m) from ignition.

3 ½ minutes.
In just 3.5 minutes the heat from a room fire can exceed 1100 degrees F., causing flashover. Everything in the room bursts into flames. There is no more time to get out. Back in the day, when we used fewer synthetic materials, flashover was closer to 30 minutes.

The second part of this study focused on the same chair when fire was present. 20 chairs were produced to spec. 5 each were made with no flame retardant, organophosphate FRs, Reactive FRs (green chemistry), and no flame retardant with a barrier added.

Chemical Exposure from Product Burns

• Very complex mixtures of volatile organic compounds (VOCs) were released during the chair burns. More than 500
different volatile organic compounds (VOCs) were identified, but the reported air levels are considered semiquantitative
at best, due to high contamination in the backgrounds and exploratory methodologies.
• Benzene, a known carcinogen was present in high levels during all chair burns, reaching an estimated level of greater
than 25 milligrams per cubic meter (mg/m3) and is significantly higher than the allowable occupational exposure limit.
• Other volatile organic compounds (VOCs) detected during the chair burns included aldehydes, nitriles, isocyanates,
acrylates, phthalates, aromatics, carboxylic acids, and others. Many of these are carcinogens, reproductive and
developmental toxins, irritants and odorants.
• Fewer volatile organic compounds (VOCs) were released from the electronic product burns. The television burn primarily
released aromatics including benzene, styrene

The Safety Convergence of Chemical Exposure and Flammability

Actionable Research and Insights

Protection from fire hazards and chemical risks are not mutually exclusive and both should be essential safety features of residential furniture.

Evaluating Existing Fire Barriers

- Identified 16 potential fire barriers
- No chemicals of concern/flame retardants & meets fire safety testing:
  - Passes the CA TB 117-2013 Smolder Test
  - Passes an Open-Flame test
  - Material and Elemental Composition Analysis
  - Chemical analysis for FRs (BS EN ISO 17881-2:2006 Phosphorous Flame Retardants
  - Full Scale Open-Flame Test (Calorimeter)

The research showed that both fire and chemical exposure safety could be achieved by using a fire barrier material without the use of flame retardants, and that one safety measure did not have to be sacrificed for another.

We started out evaluated textiles to find an existing barrier that would meet our criteria for chemical safe and flammability. Through a design selection process we limited our results to 16 textiles. While we found textiles that would meet design expectations as a barrier layer that does not impact an occupant's experience, none met the testing process.

A few passed the open-flame, but those did not pass the smolder test. Some manufacturers were not truthful about the chemical composition and those were eliminated. At this point, we new that the solution was not already in the market.

Fire Barrier: Upholstered Furniture

Development of a Barrier for Upholstered Furniture

- Currently working with a fabricator for design
- No chemicals of concern or flame retardants & meets fire safety testing:
  - Passes the CA TB 117-2013 Smolder Test
  - Passes an Open-Flame test
  - Material and Elemental Composition Analysis
  - Chemical analysis for FRs (BS EN ISO 17881-2:2006 Phosphorous Flame Retardants)
- Iteration of the process until a final textile is developed that meets the criteria for this project
- Full Scale Open-Flame Test (Calorimeter)
- Expected Result:
  New fire barrier for upholstered furniture

This study was born from consumers, mostly young families reaching out to UL and asking about how to improve fire safety in their homes, specifically infant bedrooms. This study will result in an affordable new product for the market that is chemically safe and improves fire safety and extends time to flashover, providing more time for occupants to get out of a burning building.

Scholarship of Design Research

EXPLORE THE RELATIONSHIP BETWEEN COLOR, CROWDING AND TIME PASSAGE IN EXAMINATION ROOMS

Jahnia Wright
Oklahoma State University

Introduction

Color is an essential yet often underutilized aspect of healthcare environments, affecting emotions and behavior in individuals including patients, caregivers and healthcare personnel (Nasar & Devlin, 2011; Dijkstra et al., 2006). However, its use in healthcare settings is often not optimized, leading to potential negative impacts on cognitive and physiological wellbeing in individuals. Healthcare environments typically use color schemes that are relatively unsaturated (weak chroma), light values of yellow, orange, etc., but empirical research on the effects of these colors on veterans is limited.

Purpose

The purpose of this pilot study is to assess the effect of an advancing and receding color scheme, that incorporates more saturated (higher chroma) hues, on cognitive and physiological measures in a virtual simulation of an examination room in a hospital.

Methodology

Five participants (age: 21-30yrs; 4-female, 1 male) participated in the study. Participants were immersing in two virtual environments, one with a receding color scheme consisting of blue and green, and the other with advancing color scheme consisting of red and yellow using 3D models of an examination room. The participants were required to wear a heart rate monitor, and also use a virtual reality (VR) headset to experience the two environments. Upon

experiencing each environment for three minutes, the participants were required to respond to survey questions assessing cognitive load, emotions experienced in the space, along with perceived crowding and time passage. A paired-test was used to compare heart rate data and survey responses across the two environments for all participants.

Results

The results show that there was a statistically significant difference found in the receding color scheme for perceived time spent in each environment ($p = 0.02$), feeling of satisfaction ($p = 0.04$), happiness ($p = 0.03$), relaxation ($p = 0.002$), calmness ($p = 0.01$), autonomy ($p = 0.04$).

Conclusion

These results have important implications for research methodology, technology application, and practical healthcare design. Assessment of how receding and advancing color affects individuals can help better design examination rooms that are tailored to enhance health and wellbeing of occupants of the exam room. Through future studies, continued exploration of the relationship between color, crowding, and time passage in healthcare settings, can aid interior designers to design better healthcare environments. This study has important implications for the design of healthcare environments for veterans.

Keywords: Advancing and Receding color, heart rate, virtual reality. healthcare environment

Scholarship of Design Research

DESIGN ATTRIBUTES OF HEALTHCARE ENVIRONMENTS: PREFERENCES BETWEEN FEMALE AND MALE VETERANS

Payton Losh
Oklahoma State University

Background

There are two million female veterans in the United States (U.S. Department of Labor, 2019). Veterans are often diagnosed with mental health challenges, with the most common being post-traumatic stress disorder (PTSD). Female veterans are often not diagnosed for PTSD when compared to male veterans as they are less likely to report trauma experienced which can include sexual assault during their military service (Feczer & Bjorkland, 2009). Evidence-based design has shown that environmental attributes such as natural lighting, color, texture, patterns etc. within a space can play an important role in a) the willingness of female veterans to talk about their traumatic experiences, and b) the treatment of PTSD in female veterans. Though studies have explored health benefits of different environmental attributes of a space, there have been no studies conducted on specific needs and preferences of female veterans with PTSD focusing on the emotions they experience when they spend time in healthcare environments.

Purpose

The primary goal of this pilot study was to determine if the emotions experienced (stressed, satisfied, calm, nervous etc.) by female veterans in healthcare environments was different from male veterans. The secondary goal of the study was to determine if there are differences in preferences of environmental attributes such as natural light, color, pattern, texture etc. between male and female veterans.

Methodology

The study was conducted in two phases: a) survey, and b) focus group. Purposive and snowball sampling was used to recruit participants for the study. 15 female (age: 47.9 ± 13.7yrs), and nine male (age: 46.3 ± 24.4yrs) veterans participated in the survey, and one female (age: 51) and three males (age: 61.3 ± 20.1yrs) veterans participated in the focus group. The participants were given a survey with Likert scale questions on emotions experienced when in a healthcare environment and preferences of different environmental attributes. A t-test was used for the quantitative analysis and a content analysis was used for the qualitative analysis.

Results

The results showed that there was a statistically significant difference for a variety of emotions experienced between female and male veterans including feelings of calmness ($p = 0.003$), security ($p = 0.01$), tension ($p = 0.005$), easiness ($p = 0.004$), satisfaction ($p = 0.04$), fright ($p = 0.04$), comfort ($p = 0.009$), nervousness ($p = 0.029$), indecisiveness ($p = 0.038$) and relaxation ($p = 0.02$). As for preferences of environmental attributes, none of the design attributes including color, lighting, texture pattern, layout, materials, acoustics etc. showed statistically significant difference in preferences between male and female veterans. As for the qualitative data, the themes included lighting, layout, furniture, accessibility and perceived crowding.

Implications

This study has important implications for the design of healthcare environments for both female and male veterans.

Keywords: Veterans, healthcare environments, design attributes, emotions, preferences

Keynote: Cassini Nazir “Designing Curiosity: A Beginners Guide”

https://www.notion.so/cassini/Cassini-Nazir-Bio-Details-4384bd0692b345288e89356851dd77fd?pvs=4

Scholarship of Design Research

PERSPECTIVE PLAY: A GAME OF EMPATHY

Donald Orf
Oklahoma State University

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Abstract

Empathy is defined as the ability to understand how others feel and what they mean, and to convey these emotions to others (Richendoller, & Weaver III, 1994). Gender identity is defined as a person's deeply felt, inherent sense of being a girl, woman, or female; a boy, a man, or male; a blend of male or female; or an alternative gender (American Psychological Association, 2015). Research and society still include transgender and anything beyond male and female as part of the binary, even though society is often selective of gender identities. This can be defined as cisnormativity: the perception that all people are inherently cisgender. Due to this, there is a lack of empathy in people when they enter a traditionally gender defined space, where the space is projecting a social standard of a male and a female as opposed to entering a neutral space.

Spatial empathy is a concept that has been developed to describe how a person feels about the ambience of an environment and how that space relates to their personal identity (Duarte, & Pinheiro, 2016). There is a critical need to develop empathy towards people who identify within the spectrum of gender. This study focuses on assisting individuals in developing empathy by gamifying spatial experiences in which the player actively makes choices in relation to gender and how they react in binary gender coded spaces and non-gender conforming spaces. A pre-post empathy survey was developed based on several existing instruments and was used in assessing the change in empathy in the two conditions. The Toronto Empathy questionnaire was

used in measuring the cognitive load in the two conditions. The outcomes of this study will compare how people interact with spaces based on how society perceives their gender, within the binary or nonconforming scope of gender identities.

Scholarship of Design Research

CODING-FREE VR FOR INTERIOR DESIGN EDUCATION ZOOM MEETING

Hong Shih
University of Wisconsin - Madison

Abstract

It is already a reality that Virtual Reality (VR) technology has become an important tool in designing interior spaces as well as architectural structure and exteriors that offers the audiences and stakeholders along the design process a virtual presence of 360º 3D visualization within the spaces and all the important interactions with the design that would not be possible until the spaces are physically built and constructed. It is clearly that blending the rapidly evolving VR technology into the design process would produce a profound effect that VR creates an immersive mutual communication between the audiences and the designers, residents and the environment, designers and constructions, the spaces and residents' behaviors, etc. In other words, VR offers all parties the interactions "within the design" that would not have been possible before the interior spaces or buildings are constructed at which time it would be difficult or impossible to make any revision. However, only a few schools put Virtual Reality into their curriculum, and it is also difficult for interior design students to learn VR because of the complicated computer science knowledge. Therefore, the goal of the research is to provide a coding-free standard operating procedure for interior students to be able to develop their own VR interior design projects with programmed interactions. In addition to address the importance of the cutting-edge VR technology being applied onto the interior design process, this research goes one step further to prove the feasibility of designers developing the VR application and programming interactions based on their own designs.

From the start, 3D models are already the norm of interior and architecture design nowadays with 3D modeling tools such as Revit, Rhino3D, 3ds Max, etc. And it is quite straightforward to use the completed 3D model to develop a VR application with VR development software. This coding-free VR research project selects Simlab Composer VR as the VR development tool because it is code-free, that is, no coding is required at all. With its Training Builder the designer can program VR interactions relatively easily and quickly. The VR hardware is also easy to acquire inexpensively, Oculus Quest 2, Pico, etc., to name a few which are all commercially available consumer electronics at rather inexpensive prices. With the goal of developing VR, the same development method and experience can serve as a role model for other interior designers. Based on the consideration and evaluation on availability, functionality and cost-effectiveness, the author selects Rhinoceros 3D, V-Ray, Adobe Illustrator, SimLab VR and Oculus Quest 2 as the development tools for the coding-free research VR project.

Scholarship of Design Research

THE RELATIONSHIP BETWEEN NATURAL LIGHTING AND BIOPHILIC ELEMENTS AND CHILDREN'S BEHAVIORS

Naila Hasan
University of Oklahoma

"A room is not a room without natural light"- Louis I. Kahn

Abstract

Lighting is one of the most important elements of the indoor learning environment, and natural lighting is the most sustainable form that should be introduced to all interior spaces (Taha, R. G. A. 2013). Light affects the body's internal clock; thus, it can improve sleep, release hormones, and boost overall well-being (Boubekri, M. et al, 2014). Students in classrooms with the most daylighting progress 20% and 26% faster in one year in math and reading tests respectively, compared to their counterparts in classrooms with little or no daylight (Taylor, A. P., & Engass, K., 2009).

Biophilic design is another element that can be used in school grounds and in indoor spaces for greater connectivity between interior design and nature to promote children's well-being (Ghaziani, R., 2021). "Rich environments" that support brain development provide numerous opportunities for social interaction, direct physical contact with the environment, and a changing set of objects for exploration (NRC, 2000, p. 119). In childhood, it is important to build social interactions for psychological well-being. Children are natural learners and inherently seek to learn things that matter in their immediate everyday world (Darling-Hammond, L. et al, 2020). Public spaces like libraries are important to make social interactions. Hence, the purpose of this

study was to examine the relationship between natural light and biophilic elements in children's learning environment and their behaviors and activities.

An observational study was conducted in two different public libraries. Library A was a contemporary design style with big glass panels and an open concept layout. Library A had several biophilic design elements including visual connection with nature, a double height hanging sculpture at the entry, double height atrium with central stair and sitting space, live creatures, and sky light through clerestory. Meanwhile, library B was a conventional structure with traditional windows and had one biophilic element, a colorful yellow wall. Using place-centered observation mapping, children's behaviors, such as searching and reading books, playing, talking, and interacting with each other, were coded. A comparative analysis was drawn based on the collected data, 83 visitors in library A and 31 visitors in library B within the same time on different days (2pm–3pm, and 4pm–5pm.).

A large amount of natural lighting and biophilic elements encouraged children to participate in different activities, stay longer and socialize with others in library A. There was minimum use of digital learning; rather, children involved in creating new things and reading books. Children were interested in observing live creatures and their daily activities. Children participated in different activities with others, which was important for wellbeing. The number of children and their stay period in library A was higher than those in library B. In library B, most children came with their parents to do their parents' work, and the children exhibited different activities in between times. The duration of stay was less, no socialization was observed, and digital learning was more frequently used in library B.

Keyworks: Natural lighting, children's learning environment, biophilic design, social interaction, psychological wellbeing, digital learning.

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https://www.mindfulchildaerialyoga.com/natural-light-and-mental-health/

Poster

THE RELATIONSHIP BETWEEN NATURAL LIGHTING AND BIOPHILIC ELEMENTS AND CHILDREN'S BEHAVIORS

NAILA HASAN I Dr. YEJI YI I DIVISION OF INTERIOR DESIGN I C. GIBBS. COLLEGE OF ARCHITECTURE I UNIVERSITY OF OKLAHOMA

The purpose of this study is to examine the relationship between natural light and biophilic elements in children's learning environment and their behaviors.

RQ 1: How do different lighting and biophilic design patterns are related to children's activities?
RQ 2: How do different lighting and biophilic design patterns are related to children's duration of stay in the library?
RQ 3: How do different lighting and biophilic design patterns are related to children's social interaction?

Previous studies are heavily relied on survey data of children's perception and preferences. Observational analysis will strengthen the current findings by adding objective evidence.

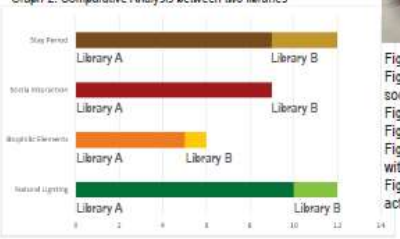
Study Design

Two libraries were selected with different layouts and different natural lighting conditions, Library A and Library B. Library A is a modern design with big glass panels and an open concept layout. Library B is a conventional old structure with traditional windows.

Participants

An observational study was conducted over 2 days period and observed children's activity within different times of the day. 83 visitors in library A and 31 visitors in library B was observed within 2 pm- 3 pm, and 4 pm- 5 pm on Saturday and Sunday.

Graph-2: Comparative Analysis between two libraries



Library A

Fig 1: Sky-light was coming through clerestory which enhanced the quality of reading space
Fig 2: Children were playing and socializing in natural lighting condition, no artificial light was needed
Fig 3: Visual connection with nature was present
Fig 4: Activity into sun-light was observed
Fig 5: Social interaction while playing was observed
Fig 6: Social interaction while reading books was observed

Library B

Fig 7: Children space had no natural light
Fig 8: Colorful wall made the space bright, a child was reading book alone, no socialization was observed
Fig 9: A child was playing board game alone, no socialization was observed
Fig 10: A child was using digital learning alone, no socialization was observed
Fig 11: A child was waiting for her parent, no socialization and no connection with activity was observed
Fig 12: Children were waiting for their parent, they were not focusing on their activities, no socialization was observed

Children's activities

A large amount of natural lighting and biophilic elements encouraged children to participate in different activities in Library A. There was minimum use of digital learning rather than creating new things and reading books. Children were interested in observing live creatures and their daily activities. All children came for their own activities and parents initiated that. In Library B, most of the children came with their parents to do their parents' work and the children were using different activities including digital learning in between time.

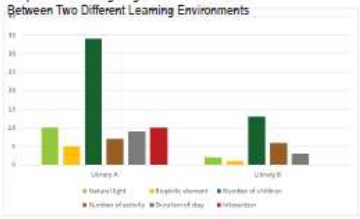
Duration of stay

In Library A children stayed longer than Library B. The number of children and their duration of stay was more than library B. In Library B the number of children was less, and duration of stay was less.

Social interaction

In Library A, children were involved with others while playing and reading. They were very inclusive doing their activities. Parents participated and initiated their activities, i.e., helped them organize the board games, read books for them. Social interaction, positive behavior, inclusion, attention, and concentration was observed in Library A. However, in Library B, all the children came with their parents to perform their parents' job. They were not inclusive and attentive in their activities. They were waiting for their parents to complete their work. No socialization was observed in Library B.

Graph-1: Natural Lighting Condition and Children's Activities Between Two Different Learning Environments



Scholarship of Design Research

DIGITAL HUMANITIES AND DESIGN: AN EXPLORATION OF FRANK LLOYD WRIGHT'S RESIDENCES

Elise King
Baylor University

Abstract

This presentation suggests the application of digital humanities methodologies as an approach and method of inquiry for interior design researchers. These concepts are explored through "Visualizing Frank Lloyd Wright," a digital humanities dashboard that connects interrelated data into a single digital corpus.

Digital humanities is the use of digital technologies to study traditional humanities subjects, enabling researchers to ask questions that would be difficult to answer with non-digital methods because of the size and scope of data and source material (Terras et al., 2016). Additionally, by integrating large, previously disconnected datasets (e.g., census data, court records, etc.), digital humanities can challenge dominant narratives and incorporate previously unheard voices. Examples of digital humanities methods include text analysis and data mining (e.g., frequency, sentiment analysis, similarity, topic modeling), mapping, and visualizations.

Though not a humanities discipline, interior design holds close ties to the humanities. In part because the built environment, as a product and reflection of human creation, necessitates a dialogue with human-centered inquiry. Additionally, the study of interiors is inherently interdisciplinary and complex; to capture the nuance and intricacy of the built environment, there is a need for diverse and varied scholarship and scholarly approaches. This point was underscored in 2020 by then incoming Journal of Interior Design editor-in-chief, Joan Dickinson,

in the journal's 5-Year Plan (Turpin & Dickinson, 2020). Despite interior design's ties to the humanities and a need for diverse and innovative scholarly approaches, digital humanities has been largely absent from interior design scholarship. A search of Journal of Interior Design articles (titles, abstracts, and keywords) between September 2004 and September 2021 did not reveal any instances of the phrase "digital humanities." This exclusion, however, should not suggest a lack of applicability, as the example below illustrates the potential usefulness of digital humanities for design researchers.

To illustrate the application of digital humanities to the study of design, we consider the case of Frank Lloyd Wright. Wright remains one of America's most well-known design figures, yet there is much about his work and life that researchers have been unable to study. Traditional research methodologies provide a wealth of insight, but they are generally ill-equipped to handle large, diverse datasets, having been developed prior to the "big data" revolution. This project connects interrelated data, creating a linked corpus that is explored through visualizations and mapping. Specifically, this presentation focuses on mapping and timeline data for Wright's residential designs. Data were collected from primary and secondary sources, and Tableau and ArcGIS were used to create a digital dashboard and visualizations. The dashboard is used to explore questions, such as how did the geographic clustering and distribution of Wright's residential work change over his career? Also, how can we study this distribution in light of personal and professional events and phases/periods? By applying digital humanities methods and tools, this research develops a fuller, more connected picture of Wright's career. An overview of methods, tools, and limitations will be discussed, aiming to encourage other design researchers to explore digital humanities methods.

Scholarship of Design Research

DESIGN FOR MOTION: THE ROLE OF SPATIAL COGNITION AND PERCEPTION IN DESIGN

Kristi Gaines
Texas Tech University

Introduction

Typically, individuals use their senses collectively to receive information about the nearby environment. The process of integrating this information and making meaning of a person's surroundings is complex. When engaging the senses, people most often consider sight, touch, sound, smell, and taste. However, two essential and lesser understood senses are the vestibular and proprioceptive, otherwise known as the hidden or inner senses. Understanding and applying design features to address all the senses is necessary in providing beneficial spaces for all users.

The vestibular sense "helps with movement, posture, vision, balance, and coordination of both sides of the body" (Myles, Cook, Miller, Rinner & Robbins, 2000, p.28). The vestibular system relates to spatial orientation and balance. Proprioception informs a person as to where his or her body parts are in space and the appropriate amount of force needed to lift an object. For efficiency, the "motion" will be used in this presentation to encompass the vestibular and proprioceptive senses. Designers should consider all seven senses with designing for everyone, and need to consider people who may have sensory perception differences.

Method

Sensory Integration (SI) theory was used for this study as a framework. For the first step, the vestibular and proprioceptive senses were investigated through scholarly publications. IRB approval was obtained for the next steps. A mixed methods approach was utilized to gather data

including 1) a series of interviews, 2) observations and 3) surveys. In all, data was collected from over 600 subjects who included children and adults with sensory processing differences, professionals working with this population, and the parents of children with difficulties with sensory processing.

Findings/Relevance to Interior Design

Additionally, spaces that accommodate opportunities for kinesthetic enrichment such as activities and performing jobs can help alleviate these challenges (Figure 8.2). People with ASD, especially the sensory seekers (those with vestibular hyposensitive who are under-responsive to movement) need constant motion. They frequently wiggle their legs, tap their feet, flap their hands and need to keep moving so their brain knows where their body is. They love to jump, run, bounce, spin around in circles and to wrap themselves tightly in blankets (Bogdashina, 2003, Hall, 2001, and Williams, 1999). Therefore, providing supports in the built and surrounding environments that accommodate their vestibular and spatial needs are important. Figures 8.3 and 8.4 illustrate hammocks and swings help manage need to rock and swing. Spacious pools allow for energetic movement common in people with ASD who have hypo-vestibular sensory needs (Figure 8.5).

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Scholarship of Design Research

THE USE OF ARTIFICIAL INTELLIGENCE IN INTERIOR DESIGN CLASSROOMS: OBSERVATIONS & ANALYSIS

Dr. Nathaniel B. Walker, IV
Stephen F. Austin State University

Abstract

Advancements in artificial intelligence have reshaped interior design practice and interior design programs' curricula. Its use has been widely documented across all design disciplines. This research observed and analyzed if virtual reality (VR) technology in interior design classrooms influenced students' problem-solving and critical thinking skills.

The study relied on three types of experimental research methods: pre-experimental, true-experimental, and quasi-experimental. The pre-experimental method analyzed students who primarily used Revit. The true-experimental method examined students who used Revit with the Sentio VR add-in. The quasi-experimental method compared the findings of the pre-experimental methods students' learning outcomes to students who were evaluated by the true-experimental method.

A total of 13 undergraduate interior design students enrolled in a summer Revit course volunteered to participate in the research study. Seven of them were analyzed using the pre-experimental research method and six were examined using the true-experimental method. There was only one VR headset the researcher purchased because of COVID financial constraints. The researcher observed both pre-experimental and true-experimental students, documenting their decisions about the course project related to critical thinking and problem-solving. Data

collection methods included online surveys, questionnaires, interviews, and observation. Participants made informed design decisions with and without VR technology.

According to the participants, VR technology offered a more accurate, easy-to-understand representation of how space looks, feels, and functions in real life. They identified flaws in their decision-making and thought processes relative to the course project. There was a significant difference in the decision-making and problem-solving skills of the pre-experimental and true-experimental students. The pre-experimental students indicated they thought VR would add more work for them to do which is why they did not choose it. After witnessing the capabilities of VR technology, they noted they had made the wrong decision; commenting, “They could see things in VR that they could not see in Revit that would have made a difference in some of their decisions relating to paint color, location of windows, choice of finishes, design flaws, and the size of the spaces."

The researcher concluded that VR technology can only support critical thinking and decision-making skills relative to the experience of the end user's knowledge base. An individual with a vast amount of design experience should be able to utilize VR technology to influence decision-making with few oversights whereas a student learner can expand their level of creativity and design awareness.

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PowerPoint Presentation

The Use of Artificial Intelligence in Interior Design Classrooms: Observations & Analysis

Dr. Nathaniel B. Walker, IV
AIA, NCARB, RID, IDEC

Introduction

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Method

The study relied on three types of experimental research methods:

- Pre-experimental,
- True-experimental, and
- Quasi-experimental

Method

- The pre-experimental method analyzed students who primarily used Revit.
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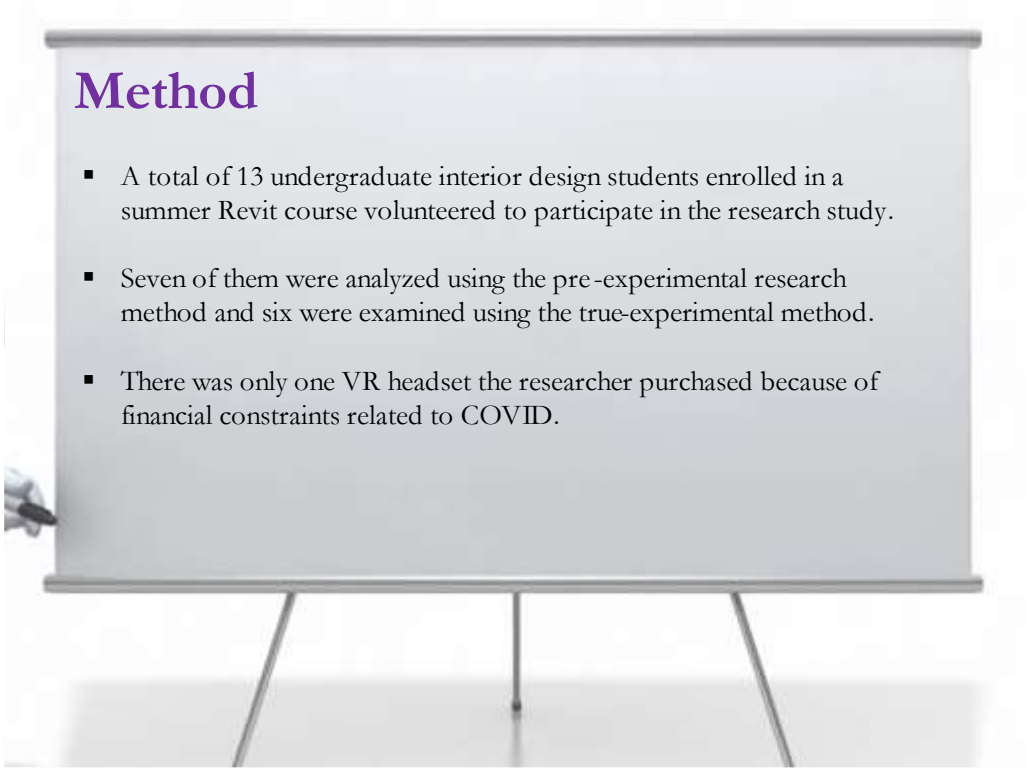
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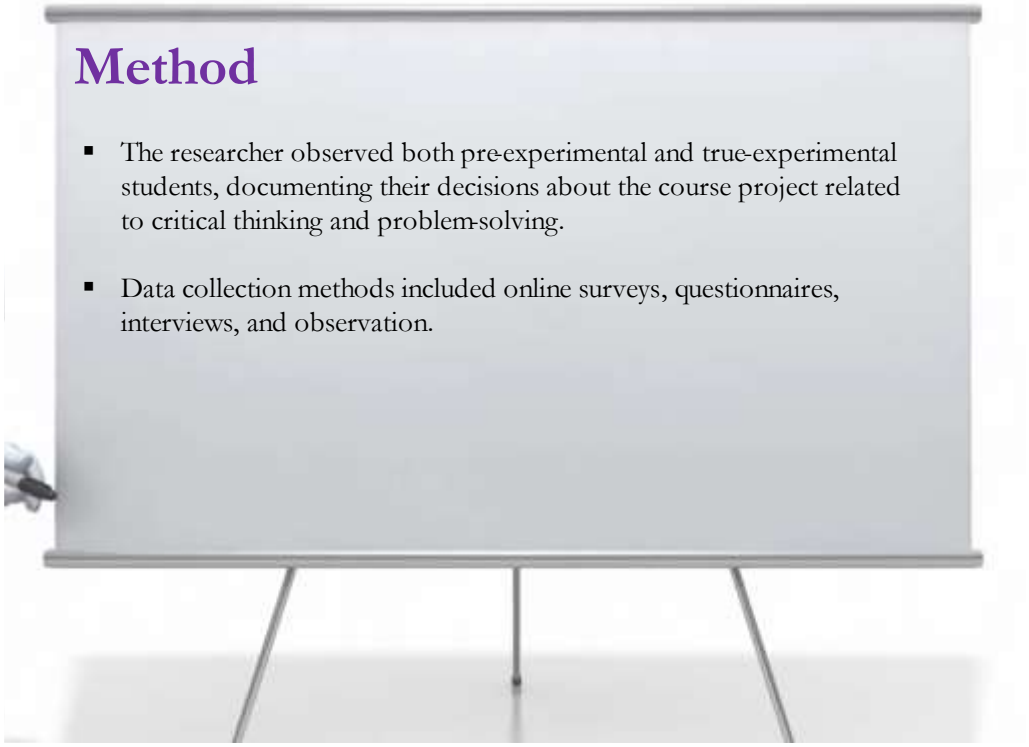
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The researcher observed both pre-experimental and true-experimental students, documenting their decisions about the course project related to critical thinking and problem-solving.
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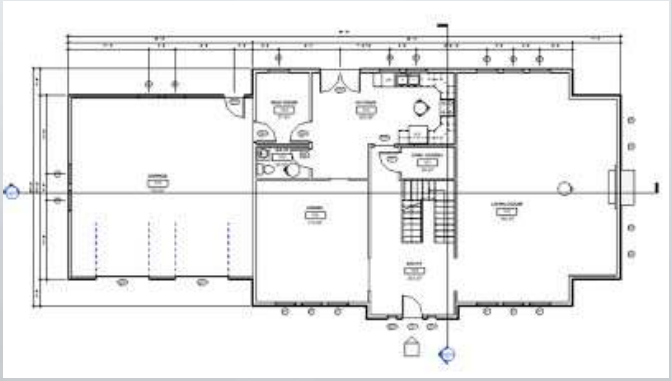
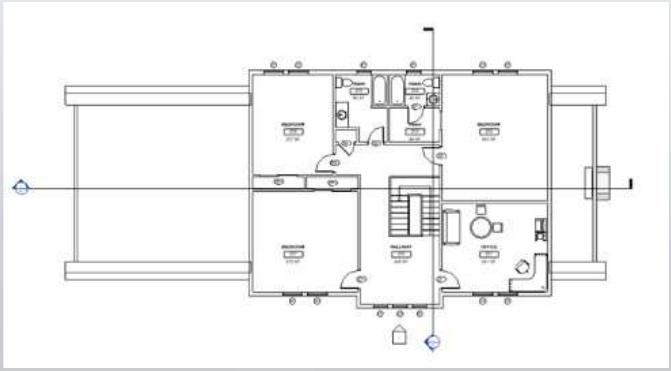
Findings



First Floor Plan- Not to Scale

Findings

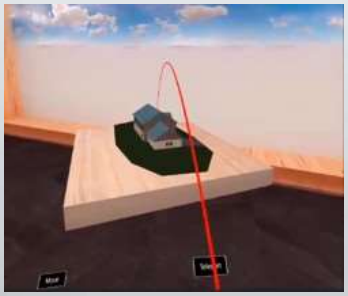


Second Floor Plan- Not to Scale

Findings

Perspective View- Not to Scale

Findings



Teleporting from the exterior to the interior of the model

Findings

Design flaws creating the floor opening for the stair

Findings

Missing Floor

Standing in the middle of the floor

Standing on the floor

Findings

Perspective view in Revit

View within VR headset

Findings

- According to the participants, VR technology offered a more accurate, easy-to-understand representation of how space looks, feels, and functions in real life.
- They identified flaws in their decision-making and thought processes relative to the course project.
- There was a significant difference in the decision-making and problem-solving skills of the pre-experimental and true-experimental students.

Findings

- The pre-experimental students indicated they thought VR would add more work for them to do which is why they did not choose it.
- After witnessing the capabilities of VR technology, they noted they had made the wrong decision; commenting, "They could see things in VR that they could not see in Revit that would have made a difference in some of their decisions relating to paint color, location of windows, choice of finishes, design flaws, and the size of the spaces."

Conclusion

The researcher concluded that VR technology can only support critical thinking and decision-making skills relative to the experience of the end user's knowledge base.

An individual with a vast amount of design experience should be able to utilize VR technology to influence decision-making with few oversights whereas a student learner can expand their level of creativity and design awareness.

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Thank You!!!

Scholarship of Design Research

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON CREATIVE THINKING IN EARLY DESIGN STUDIOS

Zahrasadat Hosseini
Oklahoma State University

Abstract

Artificial intelligence (AI) has started to revolutionize the design industry, including generating multiple design options, image recognition, creating visualizations, and optimizing design works. Rather than questioning AI's creativity, exploring how it can help designers become more creative is more important. Some researchers have discussed the integration of AI in early design education (Kavakoglu, et al., 2022; Tang, et al., 2022), but there is limited knowledge of how AI might affect creative thinking in early design studios. The design process is typically seen as a step-by-step process, with problem pre-structuring being a crucial element.

The primary generator is the concept that generates a solution before the conjecture stage, and understanding AI's effects on concept generation is essential. It is important to assess creativity in the design process rather than just the design product, and this can be done empirically using the concept of entropy. According to Kan et al. (2005), a higher entropy level suggests a more creative design process.

A mixed-method design was used to examine how Creative AI affects the design process during the concept generation phase. Forty students in early design studios were randomly assigned to two groups of AI and None-AI groups. They were given two design tasks to design two different pieces of urban furniture. For the first task, only the AI group was provided with the Midjourney application, a text-to-image generating AI to assist with concept development. As an additional benefit, this group has been allowed to use ChatGPT which is an AI chatbot to

get concept-generating assistance. Cognitive load measurements were taken using the NASA TLX questionnaire. Additionally, a protocol analysis was conducted on five randomly selected students' design processes from each group for both design tasks to identify creativity during the design process. Finally, both groups' design outcomes were evaluated by three design professionals who reviewed the 80 design outcomes. To assess the creativity of the final products, the reviewers used the Creative Product Semantic Scale (CPSS). The CPSS is based on a model that conceptualizes product attributes according to three dimensions: novelty, resolution, and elaboration and synthesis (O'Quin & Besemer, 1989). Participants who were allowed to use AI assistance displayed more creativity in their design works, according to the primary findings. Generally, the study aimed to explore how AI can impact design and design education.

Scholarship of Design Research

VISION TRAINING FOR DESIGNERS

Tiziana Proietti
University of Oklahoma

Abstract

Designers possess the unique responsibility of envisioning and crafting spaces and objects. Sensory perception plays a crucial role in their work, as it enables them to anticipate how their creations will influence users' experiences, behaviors, and overall well-being. Understanding the dynamics and limitations of perceptual processes is key to this awareness.

Throughout the history of architectural education, various attempts have been made to develop pedagogical methods that enhance the sensory abilities of young designers. Interestingly, some of these attempts drew inspiration from scientific principles. However, many focused primarily on using science to justify the aesthetic appeal of specific shapes and proportions, neglecting the broader issue of how the viewer perceives and experiences the built environment.

Renowned design schools have introduced such innovative pedagogical approaches since the early twentieth century. Notable examples include the Theory of Pure Design, which emphasized physio-psychology and conducted empirical studies to determine the visual appeal of different forms. The Bauhaus school, influenced by Gestalt Psychology, aimed to equip students with fundamental principles of perception to unlock their creative potential. Nicolai Ladovsky's "Space" course at Moscow's design school, Vkhutemas, merged perceptual psychology with architectural pedagogy and scientific methods. The Illinois Institute of Technology's curriculum featured Walter Peterhans' "Visual Training" course, which

investigated specific form properties to achieve aesthetic excellence under the guidance of Mies van der Rohe. The ULM School, founded by former Bauhaus students, integrated principles of perceptual psychology into their curriculum, emphasizing the significance of human perception in design education.

Some of these pedagogical models continue to be employed in design schools worldwide. They typically involve studying a rich artistic and architectural background, as well as engaging in exercises focused on abstraction and composition. However, while these exercises provide a solid foundation, they have not been proven to enhance designers' perceptual skills significantly. They tend to prioritize design skills rather than perceptual skills and are often presented as one-time assignments without the need for ongoing practice.

Vision Training for Designers offers a method to develop students' perceptual abilities specifically in discerning properties of tectonic elements, including relationships between distances, sizes, and proportions. Special attention is given to the perceptibility of object proportions. Students explore innovative proportional instruments, participate in perceptual exercises, and develop new ones. This training is suitable for any designer seeking to understand how mastering specific sensory skills can enhance the quality and positive impact of interior design practice.

Scholarship of Design Research

CHILD-FRIENDLY SPACE (CFS) AND CHILDREN'S WELL-BEING IN THE REFUGEE CAMPS: A SYSTEMIC REVIEW CFS AND ITS PHYSICAL ENVIRONMENT IN RESPONDING WELL-BEING

Salma Akter Surma & Suchismits Bhattacharjee
University of Oklahoma

Abstract

A safe, secure, and productive place in an emergency shelter is critical in determining refugees' overall health and well-being (Ziersch & Due, 2018). Refugees, specifically children worldwide, experience multi-dimensional vulnerabilities, including anxiety, exploitation, trafficking, and economic uncertainty in the host country, transit countries (UNHCR, 2020), or even after being repatriated to a new country (Akter et al., 2021; Aldiabat et al., 2021). In response to the children's vulnerabilities and crises, humanitarian agencies have taken multiple initiatives to provide and protect the psychological well-being of refugee children. UNICEF proposed the concept of Child-Friendly Spaces (CFS) as one of the internationally recognized humanitarian aid initiatives for refugee children to address childhood vulnerabilities by providing safety and security (Parviainen et al., 2022).

The goal of CFS is to provide a space for playing and skills development, thus ensuring protection and psycho-social, physical, and economic well-being (Ager & Brückner, 2013; Kostelny & Wessells, 2013). Although this proposed concept of CFS acts as a baseline for humanitarian aiders across the world, it is rarely explored whether humanitarian aiders follow UNICEF's proposed design and planning recommendations or what is the variability or commonness of CFS in different theoretical and practical contexts for conceptualizing and designing CFS and reasons behind those.

Additionally, there is no measured evidence of how this concept of CFS has evolved over the years and where it is heading.

This study aims to conduct a systematic literature review to explore how CFS's physical and environmental design can ensure the well-being of children. As mentioned earlier, 10 evidence-based field studies and 20 scholarly published research articles have been systematically reviewed and analyzed to achieve the goal. Each study was reviewed concerning the potential protecting, promoting, and mobilizing impacts of CFS through a built environment lens. Findings revealed that all studies explored the effects of CFS on psychological well-being. Three studies documented pre-intervention baselines and substantial design flaws, making it difficult to strongly confirm change over time or link any change to CFS treatments. None of the studies explored UNICEF's proposed design and planning guidelines.

Moreover, how built environment professionals will promote and encourage further CFS development and connect to the UNICEF proposed child-friendly cities initiative was not found. Analysis suggests that more outstanding commitment to documentation and measurement of outcomes and impacts of CFS is needed with more standardized and rigorous measures of processes, outputs, results, and effects. Design evaluations must more robustly address the assessment of outcomes without intervention; children's engagement in evaluations must be maintained; and long-term follow-up study is essential for developing evidence-driven interventions. This study aims to raise awareness among multi-stakeholders, including, e.g. policy planners, designers, and governmental and non-governmental bodies, to perceive CFS through a built environment perspective.

Keywords: Child-Friendly Space (CFS); physical environment; well-being, refugees.

Scholarship of Design Research

POSITIVE LEADERSHIP TO SUPPORT HEALTH AND WELL-BEING FOR DESIGN STUDENTS AND FACULTY

Kristi Gaines
Texas Tech University

Introduction

Campuses are experiencing a mental health crisis as we navigate the post pandemic environment. Students, faculty, and staff report record levels of depression, anxiety, unhappiness, and stress. The science of happiness offers powerful insights to help people live more positive and engaged lives. Additionally, positive psychology and happiness studies provide a scientific approach to leadership in the classroom or workplace. Scientific evidence addresses reasons to strive for greater happiness. Happier people are more likely to have a stronger social support of friends, they are more creative and resourceful, and are more productive. Positive people are better supervisors and managers. They even earn more money. They also are healthier and live longer.

The purpose of this investigation was to utilize a scientific approach to the identification of the general principles of happiness and determine ways to promote an environment of wellbeing and satisfaction in students, faculty, administration, and staff. A secondary purpose was to identify practical strategies and activities that can be adapted for individual needs and interests to encourage a positive approach to attain happiness.

Methodology

An initial literature review was conducted using keywords to define interrelated categories. This method assisted in the identification of more specific keywords that related to

happiness studies, positive psychology, positive leadership, and positive learning environments. The databases used were EBSCO Host, Google Scholar, PsycInfo, PsycArticles, Psychology and Behavioral Sciences Collection, Education Research Complete, Health Source, and University Libraries. Potential studies were identified from the review of articles and books. The studies were included if they were written in English and provided empirical validation on happiness studies, positive psychology, positive leadership, and positive learning environments.

Additionally, potential articles and books were identified by a systematic review of literature which lead to the categories of engagement, relationships, mission, development, timing and motivation. Finally, the reference lists for the included articles were inspected. Five books and eleven refereed articles were identified as meeting the criteria.

Findings

Due to greater levels of depression, higher education has experienced the mass retirement of Baby Boomers and seen a rise in leadership of Generation X and NeXters/Millennials in the workforce. As a result, the need to train a new generation of positive leaders has emerged. Years of scientific research shows that incorporating happiness strategies can provide benefits in the classroom and workplace including higher levels of productivity and reduced burnout. Additionally, this information can be incorporated into personal living and leadership to create happiness conducive learning environments.

This investigation focused on four goals: 1) to identify the practical considerations or themes that lead to general happiness, 2) to determine qualities necessary for positive developmental leadership, 3) to understand the qualities necessary to create positive learning environments, and 4) to identify processes for managing destructive (unhappy) behaviors. This presentation will provide practical guidance based on scientific research for ways to improve

personal happiness and happiness in the workplace and learning environments. Ways to manage undesirable and adverse behaviors will also be addressed. An overview of practical general principles will be provided with “happiness activities” to improve engagement, emotion, environment, motivation, timing and mission.

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Scholarship of Design Research

TOWARDS THERAPEUTIC LEARNING ENVIRONMENT: INVESTIGATING PUBLIC LIBRARY'S ROLE IN THE REFUGEE CHILDREN'S INCLUSION AND WELL-BEING

Salma Akter Surma & Suchismita Bhattacharjee
University of Oklahoma

Abstract

A therapeutic environment means acceptance, empathic understanding, and healing spaces against inequality and insecurity of space. A therapeutic learning environment refers to the knowledge of space, place, and atmosphere and how that may affect the users, also, how to stimulate the human senses to improve the overall user experience (Alrashidi, 2019). Public libraries are the single most universalized local community institution which can tie all people disregarding all individual traits (Brewster, 2014).

Providing education through manual and digital tools is the top priority for many libraries. Several research has begun to examine the effects of public libraries on well-being, attempting to pinpoint the characteristics that make them an indispensable part of communal life (Alstad & Curry, 2003). Though previous studies explored the library's capacity to offer digital learning, they have failed to define the innovative benefits of public libraries providing intrinsic and intangible qualities for all (Brewster, 2014). Few studies examine how library services can hasten people's well-being by delivering physiological, cognitive, and cultural inclusion (Holeton, 2020). Even previous studies have had difficulty defining the benefits of using public libraries for the refugees' children or forced immigrants, who are already jeopardized with anxiety, trauma, and insecurity in their new settlement country(Veil & Bishop, 2012).

The refugees in a new country face multicultural and dimensional vulnerabilities, including cultural barriers, language obstacles, accommodation, and livelihoods(Keddie, 2012). The public

library can contribute to these vulnerabilities by providing linguistic and extended facilities. The overarching goal of this study is to understand and analyze the effectiveness of US public libraries in serving refugee children, further reviewing what public library services refugees use, what services public libraries can provide to foster the development of socio-economic capital of refugees' children, and how? The study further examined the perception of users about how libraries can help strengthen their place of attachment and become resilient individuals. This study focused on about 10 public libraries in the Oklahoma City metro area to investigate the subject matter through observational methods and semi-structured interviews.

Findings from a pilot study conducted in one library revealed that the refugee community positively ranked the library's indoor space quality but negatively marked the library's acculturation capacity. Findings revealed that the lack of outdoor space, indoor cultural and personal spaces, and gender-specific color, light, textures, and multi-signage facilities could not heal the refuge community's mental trauma or attract them to connect with library facilities. The indoor spatial configuration and furnishing do not allow physically impaired people to follow ADA (Americans with Disabilities Act) rules. Highly prescribed library facilities are provided in the library, discouraging refugee children from integrating with the learning environment in the new country. Therefore, this study calls for attention to policy planners, architects, and interior design professionals, and stakeholders to consider public libraries as a hub of equity for building socioeconomic and human capital.

Keywords: Library, therapeutic, inclusion, refugee.

Scholarship of Design Research

DESIGN AT THE EDGE: WHAT IS INCLUSIVE DESIGN?

Natalie Ellis, University of North Texas
Panelists: Yeji Yi, and Ammara Faisal

Purpose and Relevance

The inclusive design model incorporates design solutions that meet needs related to gender identity, race, ability, age, neurodiversity, socioeconomic status, and culture and considers how these needs may intersect. Inclusive design creates healthier, safer, more accessible, more convenient, and more comfortable environments for everyone. However, the central problem is that there has been no consensus on how practitioners, researchers, and educators implement and measure inclusive design. It is necessary to understand how inclusive design is defined and measured to foster inclusive design standards.

Background

For context, as practitioners, researchers, and educators, we must understand how inclusive design is defined and measured to deliver inclusive design practices into our work. However, the understanding is daunting, considering how buildings have evolved from simple structures to complex systems that provide for the user's health, safety, and welfare. Today, all buildings constructed for human occupation are governed by building codes minimally. The International Code Council (ICC) regulates Residential and Non-Residential structures as a global source agency. Central to all available codes is that human life is preserved and that building and community design practices are reasonable and ecologically viable. Inclusive design exceeds ADA and Universal Design by integrating building codes, associated standards,

and guidelines into exemplary practices. Figure 1 summarizes code, standard, and guideline contributions to the built environment. Figure 2 provides a background of research contributions for developing an inclusive checklist.

Method

The presented panel discussion explores considerations necessary to develop future inclusive design guidelines usable for designers and practitioners through questions and audience engagement. Understanding the terminology would only make sense so we are all on the same page. Using the Americans with Disabilities Act (ADA), Universal Design theory and principles form the topic of holistic built environments. How have these two practices evolved and contributed to people's well-being to develop an Inclusive Design model? Much has been discussed, advocated, and even protested regarding inclusive design, but our central ideas of how this practice has been identified or defined and to develop a manner for its impact to be measured.

The following presentation is in response to exploring and implementing voluntary practice to best support maximized human opportunities in the built environment. The intent is to complete a review of research practice applications for the built environment by design professionals. As a result, the presentation discusses present design domains of building codes, standards, and rating systems integrated into 21st-century renovations and new construction projects. The panel discussion will summarize the current state of inclusive design integration in practice and provide a possible approach toward an inclusive design checklist to support design practitioners.

Conclusions

Future research will evaluate the contributions within commonly used rating systems to explore the opportunity to create inclusive and life enrichment for all people. Creating this bridge will contribute to breaking down the informational silos for design practice and academic researchers to work tandemly in the 21st century.

PowerPoint Presentation

How have ADA and Universal Design created a path for creating Inclusive Design and its understanding for 21st-century designers?

IDEC Southwest Regional Conference, November 3, 2023

Natalie Ellis, PhD, IIDA, LEED BD+C; University of North Texas
Ammara Faisal, PhD
Yeji Yi, PhD; the University of Oklahoma

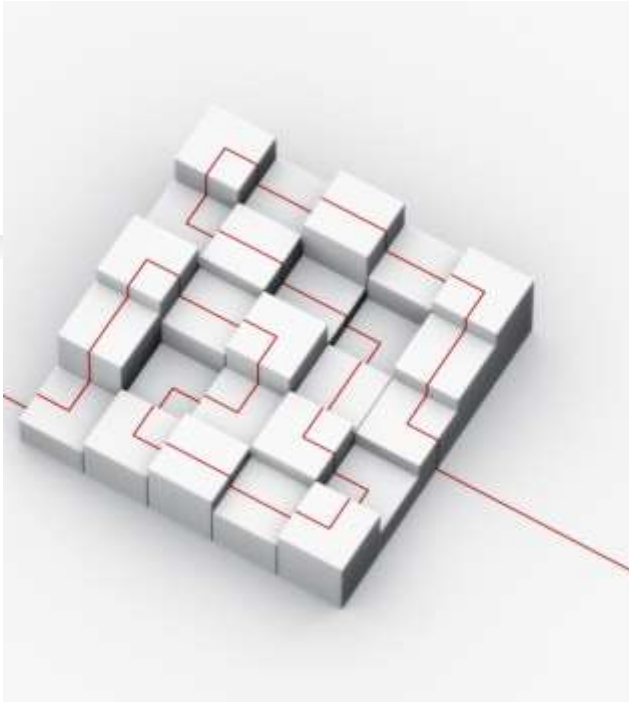
Problem

The **inclusive design model** incorporates design solutions that meet needs related to gender identity, race, ability, age, neurodiversity, socioeconomic status, and culture and considers how these needs may intersect

Inclusive design creates healthier, safer, more accessible, more convenient, and more comfortable environments for everyone.

However, **the central problem** is that there has **yet to be a consensus** on how practitioners, researchers, and educators implement, **measure, and define inclusive design**.

It is necessary to understand **how inclusive design is defined and measured** to foster inclusive design standards.



Planning and Comparison

Accessible Design
Americans with Disabilities Act, 1990

Accessible design is a process in which the needs of people with disabilities are specifically considered.

Accessibility sometimes refers to the characteristic that products, services, and facilities can be **independently** used by people with various disabilities.

Universal Design
Center for Universal Design, NCSU

Universal design is a broader concept defined by The Center for Universal Design at North Carolina State University as "the design of products and environments to be usable by **all** people, to the **greatest** extent possible, **without** the need for adaptation or specialized design."

Inclusive Design
Nussbaumer, 2011

Inclusive design is used to indicate **the inclusion of many**. One of the principal differences between universal design and inclusive design is that **all** people are at the heart of the design.

Inclusive design is planned, designed and built, managed, and used with **all** people in mind, and that everyone is involved in the planning.

Method

We will explore considerations necessary to develop future inclusive design guidelines. Understanding the terminology is required so we are all on the same page.

Exploring and implementing voluntary practice to support best maximized human opportunities in the built environment.

Our current intent is to complete a review of research practice applications for the built environment by design professionals and researchers.

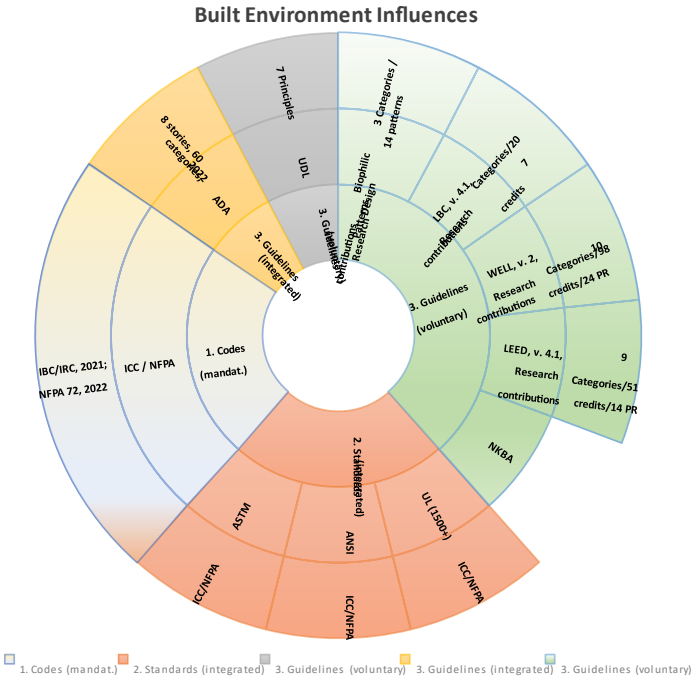
Design domains of building codes, standards, and rating systems integrated into 21st - century renovation and new construction projects.

The panel discussion will summarize the current state of inclusive design integration in practice and provide a possible approach toward an inclusive design checklist to support design practitioners.

Background

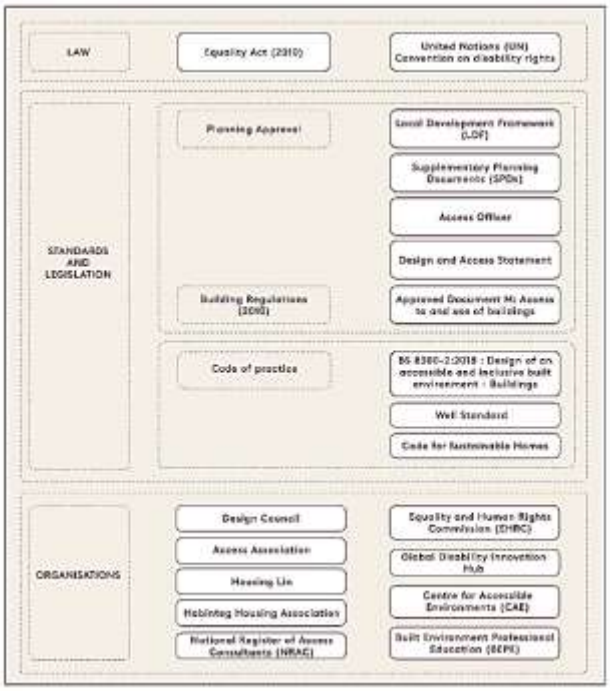
For context, as practitioners, researchers, and educators, we must understand how inclusive design is defined and measured to deliver inclusive design practices into our work. However, the understanding is daunting, considering how buildings have evolved from simple structures to complex systems that provide for the user's health, safety, and welfare.

Today, all buildings constructed for human occupation are governed by building codes minimally. The International Code Council (ICC) regulates Residential and Non-Residential structures as a global source agency. Central to all available codes is that human life is preserved and that building and community design practices are reasonable and ecologically viable. Inclusive design exceeds ADA and Universal Design by integrating building codes, associated standards, and guidelines into exemplary practices. **The following diagram summarizes code, standard, and guideline contributions to the built environment** .



Codes, Standards, and Guidelines

Codes, Standards, and Guidelines



Inclusive design in interior design education

In **academics** - aware of the benefits of inclusive design

However, implementation can be

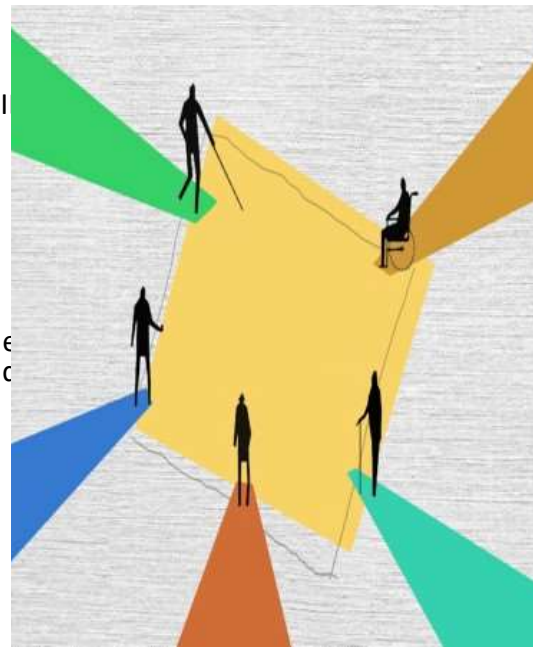
CHALLENGING

<u>QUESTIONS</u>:

1. Do we understand how inclusive design is different from universal design?
2. How are you implementing inclusive design principles and strategies in your academic teaching and pedagogy?

Inclusive design in practice

The architectural design community's adoption of the I approach is ***Limited (Zallio and Clarkson, 2022).***



Group Discussion QUESTIONS:

3. Why are practitioners' adoption of the ID approach limited?

4. How are they implementing inclusive design strategie in their practice? Is it different from studio teaching and learning?

FINDINGS:

a. due to their ***limited*** *awareness* of design inclusivity and diversity

b. the ***lack of holistic tools*** for inclusive design implementation in the built environment

Inclusive design in practice

The architectural design community's adoption of the ID approach is ***LIMITED***

Group Discussion QUESTIONS:

5. What tools are design professionals using to measure ID?

FINDINGS:

a. Need to promote a **diversity and inclusion culture** among stakeholders.

b. Need to **consciously design future-proof buildings** that assure inclusion, diversity, equity, and accessibility (IDEA) to all occupants.

c. Moreover, using a **pre-and post-occupancy evaluation tool** targeting IDEA in all design stages is imperative and beneficial

Which aspects should be included in the **inclusive design guidelines**?

What we have done

Extreme user-centered design: Designing for extreme users can satisfy the averages and potentially broader users.

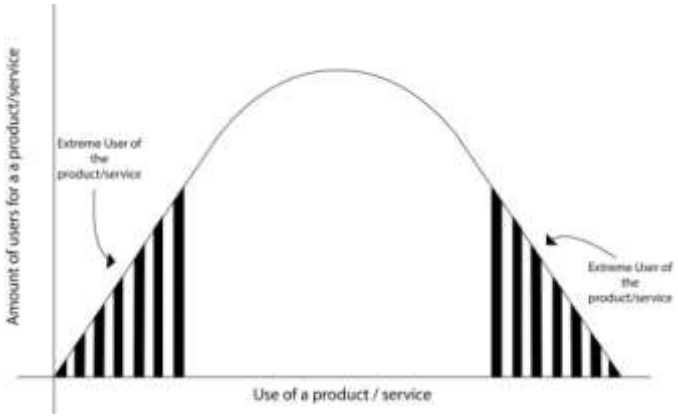


Image source: Extreme users. (2023, October 20). In *Wikipedia*. https://en.wikipedia.org/wiki/Extreme_users

Which aspects should be included in the **inclusive design guidelines**?

A systematic review of design for people with intellectual and developmental disabilities

SEARCH STRATEGY

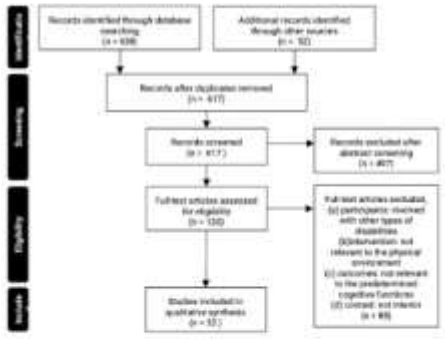
Database:
EBSCO, ERIC, ProQuest, PsycINFO, MEDLINE, CINAHL, Consumer Health Complete, Psychology and Behavioral Sciences Collection

Search Term:
((intellectual disabilit*) OR (Autism)) AND environment* AND design

Restrictions:
- Peer-reviewed
- Publication date between 1990 and 2020

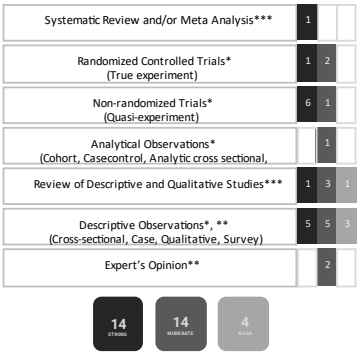
Inclusion Criteria:
- Participants: intellectual disabilities, autism
- Intervention: physical environmental design
- Outcomes: adaptive/problem behaviors
- Context: the interior of learning/living/healthcare environment

STUDY SELECTION PROCESS

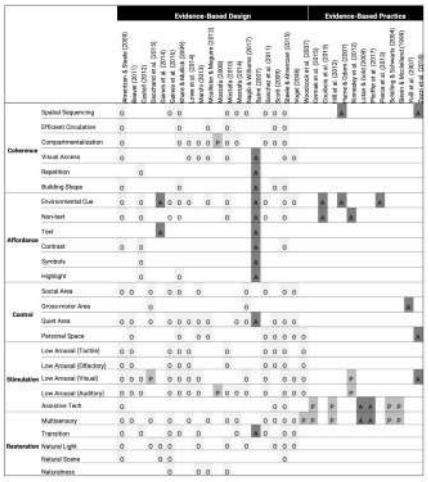


PRISMA flow chart

STUDY QUALITY ASSESSMENT

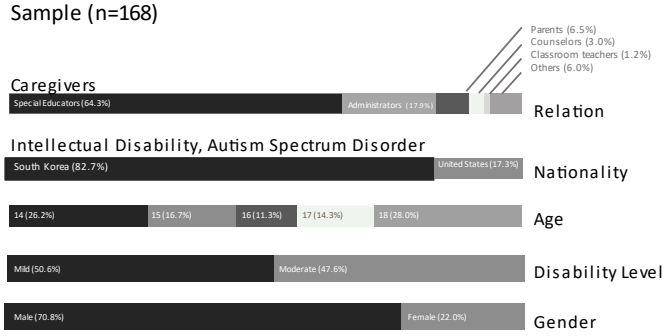


Which aspects should be included in the **inclusive design guidelines**?



Note. O – mentioned in the literature, but associations have not been addressed
A – design strategies associated with adaptive behaviors
P – design strategies associated with problem behaviors

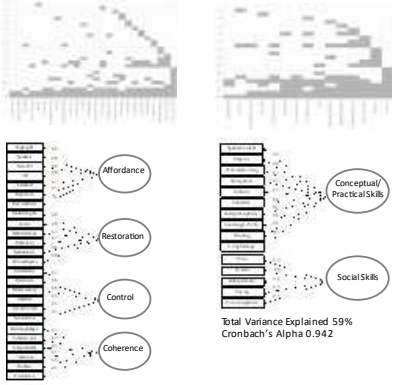
Statistical testing of systematic review result
Sample (n=168)



Which aspects should be included in the **inclusive design guidelines**?

IV MEASURE
Environmental Evaluation (EE)

DV MEASURE
Performance Measure (PM)



Total Variance Explained 51%
Cronbach's Alpha 0.897

Total Variance Explained 59%
Cronbach's Alpha 0.942

Hypothesis
Among people with IDD, a set of enabling design features is positively related to their adaptive skills when personal factors are controlled.

Pooled R square = 0.278,
adjusted R square = 0.276,
pooled F (2, 90.13) = 25.363,
p < .001,
power = .979 at effect size of 0.15, α = 0.01

Design Guidelines for People with Intellectual and Developmental Disabilities

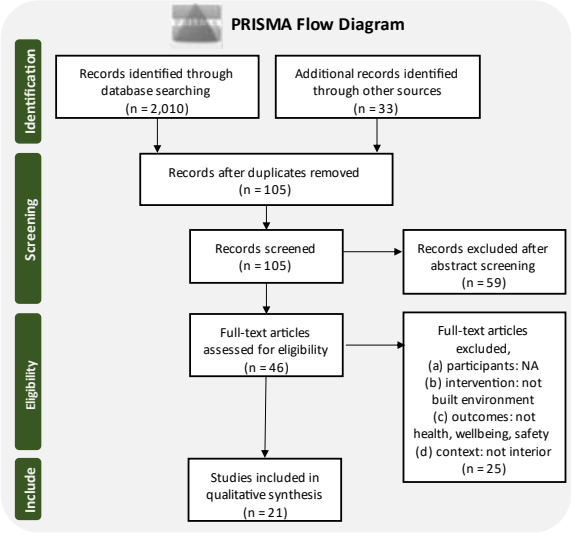
Health Environments Research & Design Journal, Vol.16(4)
Social Science & Humanities Open, Vol.7(1)

Component 1: Affordance The design that assists users to adequately use a space or object according to its function.
1.1. Text: Text is written at a lower secondary education level with a recognizable font (sanserif font), size and spacing.
1.2. Highlight: Important signage/labels information is highlighted (e.g. bold text, illumination, perpendicular installation , etc.)
1.3. Non-text: Non- text components are used in environmental cues (e.g. concrete figures, numbers, symbols, colors, etc.)
1.4. Symbols: Signage/labels with symbols (e.g. arrows) are designed and placed in a way that enables a direct, clear interpr etation for the student.
1.5. Contrast: Color contrast is apparent between background and content, or between colors in the content.
1.6. Repetition: There are navigational aids present for the student in a cohesive way (e.g. consistent color coding, graphic s, etc.).
1.7. Environmental Cue: The environmental cues – e.g. signage, landmarks, visual instructions, etc. – are appropriately located at decision -making points.
Component 2: Restoration The environment that supports users to cope with stress.
2.1. Natural Light: The student is provided the opportunity to natural light.
2.2. Low Arousal (Tactile): Indoor temperature is consistently controlled.
2.3. Natural Scene: The student is provided the opportunity to natural scenes.
2.4. Low Arousal (Olfactory): Indoor air quality is consistently controlled.
2.5. Naturalness: Natural features are found inside of the building (e.g. materials, artwork, plants, etc.).
2.6. Personal Space: Expanded personal space is allowed for the student (e.g. wide hallways, workstations, etc.).
Component 3: Control The environment that enables users to choose or regulate their social interaction by their needs.
3.1. Gross-motor Area: Gross motor skill areas are provided with easy access for the student (e.g. large open space with high ce ilings, slide, swing, climbing, etc.).
3.2. Quiet Area: Quiet rooms (or areas) are located separately from the primary social areas while remaining in the proximate distance.
3.3. Multisensory: Multiple physical setting options are provided for variation in sensory condition and easy access (e.g. senso ry rooms; high vs. low stimulus zones; containment vs. openness; with vs. without background sound; etc.).
3.4. Low Arousal (Auditory): Noise is controlled by the remote placement of noise sensitive spaces from spaces known to be no ise producing.
3.5. Assistive Tech: Assistive technology is used to control the environment (e.g. electrical appliances controller, blind co ntrols devises, virtual assistant, etc.).
3.6. Social Area: Social areas are provided with easy access for the student (e.g. general purpose, dining areas, niche/alcove w ithin corridor, etc.).
3.7. Low Arousal (Visual): There is no visual clutter (e.g. excessive colors, patterns, or flickering lighting).
Component 4: Coherence The design that helps users reduce cognitive overload and organize the context of environments.
4.1. Building Shape: The building's shape is simple (e.g. the minimized number of floors, corners, intersections, and length of hallways).
4.2. Compartmentalization: Each room (or area) has a single function and is defined with a clear boundary.
4.3. Transition: Distinctive sensory zones – e.g. high or low stimulus - are connected with transition areas to recalibrate stud ents' senses.
4.4. Routine: Spaces are sequenced by logical order (e.g. a sequence of activities, routines, sensory characteristics, etc.).
4.5. Efficient Circulation: The students' major routes are direct and short (e.g. from entrance to a classroom, a classroom t o restrooms, external play areas, etc.).

Which aspects should be included in the **inclusive design guidelines**?

Project in progress

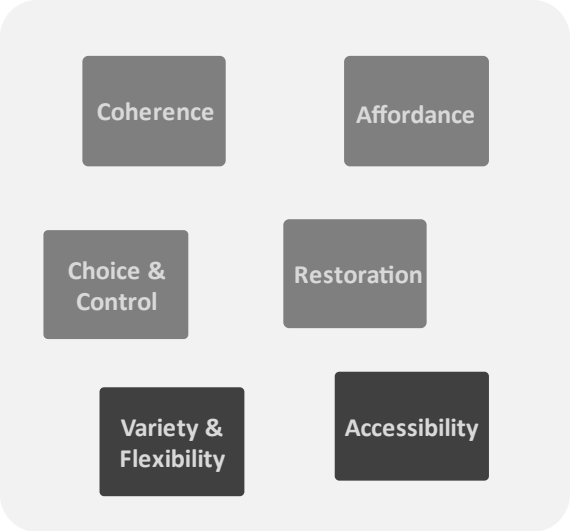
- Designing for extreme users can satisfy the averages, however, does not mean **designing for all**.
- The second round of systematic review of inclusive design.
- Inclusion Criteria:
  - Participants: no restriction
  - Intervention: physical environmental design
  - Outcomes: health, well-being, safety
  - Context: the interior of the built environment



Which aspects should be included in the **inclusive design guidelines**?

Project in progress

- Which items should be
  - kept
  - modified
  - deleted
  - added – post it
- Your input is valuable!!



Conclusion

Future research will evaluate the contributions within commonly used rating systems to explore the opportunity to create inclusive and life enrichment for all people.

Creating this bridge will contribute to breaking down the informational silos for design practice and academic researchers to work tandemly in the 21st century.

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