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Investigating the Potential of Augmented Reality in Creating a Sense of Place on College Campuses

Linda White

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INVESTIGATING THE POTENTIAL OF AUGMENTED REALITY IN CREATING

A SENSE OF PLACE ON COLLEGE CAMPUSES

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A Project

Presented to the

Faculty of

California State University,

San Bernardino

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In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Communication Studies

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ABSTRACT

This project examines how designing an augmented reality (AR) campus navigation app can improve college students' sense of place and connection with California State University, San Bernardino (CSUSB). To guide the design of the app, I engaged in qualitative research using a curated campus walk protocol that invited students to walk to their favorite place on campus and record their walk while narrating it.

My analysis reveals the larger patterns that students use to select favorite places and favorite routes to those places, as well as how space navigation may lead to the formation of a sense of connection with the campus through enabling community, evoking memory, providing opportunities for people- and nature-watching, and developing a sense of place ownership. Using the affordances of AR technology, this app will provide students with a broader view of places to explore on campus for navigation and to enhance each student's sense of community and belonging. The recommended features of the app would provide tools for building, place, and route discovery, as well as dynamic ways of discovering proximate places based on a student's location. This project highlights the potential of AR to enhance students' academic journeys and institutional ties, which is in line with CSUSB's mission of establishing a transformative educational experience for all students.

commitment to not just my success, but to the spirit of inquiry and learning that this project represents.

Each of you played a pivotal role in turning this vision into a reality, blending professional guidance, personal support, and shared wisdom into a tapestry of success. I am profoundly grateful for the collective journey we embarked on and the myriad ways you have enriched me personally and professionally. As a lifelong learner, I want to thank you all for being a part of this incredible chapter of my life.

DEDICATION

I dedicate this effort to my son, Ethan. Ethan, you've been my pride and joy since the moment I first laid eyes on you. To graduate with you here at CSUSB this spring together, with both of us getting our master's degrees, feels like nothing short of miraculous. How many mothers and sons achieve this feat the same year, and most specifically at the same university? I think it is quite a rarity. This journey has given me such joy, and the pride I have for the young man you have become is unparalleled. You have your whole life in front of you and I feel so privileged to witness your accomplishments from a front row seat!

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CHAPTER ONE:

INTRODUCTION

My older sister is an alumna of CSUSB. She graduated with her
bachelor's in psychology, clinical and behavioral, in 2003 and with her master's in
national security studies in 2007. She was a disabled student, and she had
difficulty navigating the campus, especially with her new classes each quarter.
She worked hard to be a good student, and she graduated as one of the top
students in her challenging master's program. My sister found herself on campus
at night trying to find the library for the first time with no one around to help.
These can be frightening moments for a student—wandering around in the dark
with all your school supplies, feeling vulnerable when you do not know where you
are going on campus. Feeling lost and overwhelmed makes one feel alienated
from a place. There are tools that could have made my sister feel a much greater
sense of belonging, confidence, and connectedness to the CSUSB campus. How
many other disabled students on campus feel the same way?

CSUSB has a student population of close to 20,000, with the majority of
students (86%) being from San Bernardino and Riverside counties (CSUSB,
n.d.). As a commuter school, it is challenging to find ways to connect and ground
students to their physical campus environment–whether it be for educational or
recreational events outside of classroom activities or for down time between
classes (Berkman, 2022).

Often, first year students come to the university from a small high school setting. The CSUSB campus must seem like a city to many of them. Anything that we can do as a campus to make students feel more comfortable and connected to all the CSUSB amenities would be a win-win situation.

Creating a sense of campus connection for the students is particularly important in the post-pandemic age, when students feel increasingly disconnected from the physical campus and struggle with stress. The pandemic has played a significant role in students being more virtually connected to college campuses since 2020 (Baston, 2021), thus further disrupting student connection with the physical campus. There is no doubt that the coronavirus crisis suspended, shattered, and necessitated the reorganization of the structures and routines of everyday life (Fuchs, 2020, p.382). For example, a 2022 university study investigated the effect of COVID-19 fear on the mental health of students. The study of 151 college students in Northern Michigan, a region severely affected by the pandemic, was conducted between January 17 and February 25, 2022. Sixty-three percent of students tested positive for COVID-19, with more females (69.7 percent) affected than males (50.7 percent). The study revealed that 95.7 percent of the students had moderate-to-severe mood disorders. A median score of 7.6 out of 10 indicates that the pandemic had a significant impact on the respondents' education. This disruption resulted in increased anxiety, stress, and decreased happiness, all of which were associated with modifications in learning quality. The study emphasizes the need to monitor

college students' mental health and learning difficulties post-pandemic due to its widespread impact (Hu et al., 2022). Creating ways for students to feel more supported and connected to campus is a path to helping with the anxiety and stress that students face on campuses today.

Creating meaningful school connections and fostering a sense of community can be a challenging endeavor, especially when it comes to developing a deep and lasting bond with a university campus. The campus itself is only one component of the connection that students have with their school. Many CSUSB students, alumni, and faculty feel a sense of community connection when one spots someone off campus proudly wearing a CSUSB sweatshirt, baseball cap, or displaying a CSUSB license plate frame. It serves as a conversation starter, creating a sense of camaraderie among individuals who share a common affiliation with CSUSB, even if they are strangers from different parts of the globe. This connection highlights the powerful impact of the university's presence beyond campus borders.

An academic institution has many assets. Some may think those assets are the buildings, the equipment that makes the institution run, and the technology used to facilitate learning. However, the real assets of any organization, including academic institutions, are the people that make up the organization. The faculty, the students, and the parents make up the community culture of CSUSB, and they all play an integrated role in the success of individual students as well as the institution as a whole. California State University, San

Bernardino (CSUSB) envisions itself as a transformative force in students' lives (CSUSB Strategic Plan 2023-28). Building upon this vision, the cultivation of positive, place-based emotional connections among students, visitors, and faculty becomes paramount to realizing a stronger school community connection as well as aligning with the CSUSB vision.

Keeping Students Engaged and Connected

Keeping students engaged and enrolled in university poses a significant challenge. Financial instability plays a role in 38% of students dropping out of college nationally, which presents an additional obstacle (Roberts et al., 2021). The first year of college is a pivotal one since 30% of students face the hurdle of dropping out in the first year (Roberts et al., 2021). The dropout rates affect all ethnicities and genders, and it is evident that we need to find a way to better
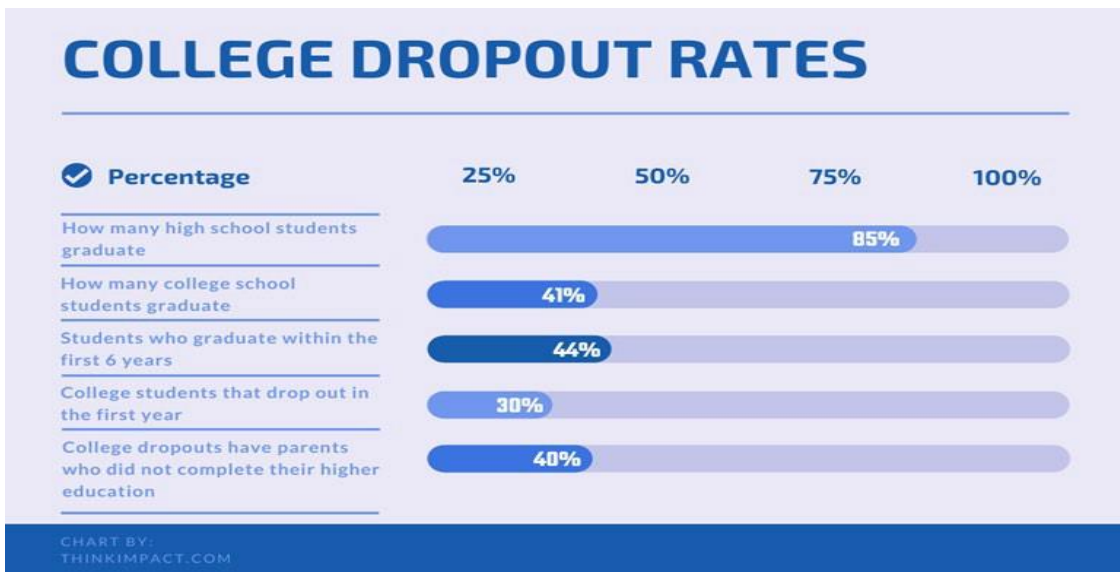
Figure 1. College Dropout Rates
Source: Roberts et al, 2021

engage students with the campus and the community. Statistics reveal that keeping students engaged and enrolled in university is a significant problem that needs to be addressed (Roberts et al., 2021).

First-Generation Students Face Unique Challenges

All college freshmen experience stress in their first year, but first-generation students (FGS) have a unique experience, especially in their first year at university. The definition of a first-generation student is an undergraduate student whose parents, neither of whom completed a 4-year baccalaureate degree (Gibbons et al., 2016). And it is important to note that 81 percent of CSUSB students are first-generation students (CSUSB, n.d.), including myself. It can be a culture shock for first-generation students to move to campus, and homesickness is a real emotion that comes up for them, especially since they often do not have a strong support network from their immediate family (Abbot, 2022).

One study about FGS and how they adjust to college highlights the barriers that FGS encounter when they transition to college (Gibbons et al., 2016):

1) *Money* – financial support from scholarships can be a game changer for FGS, but many do not know how to go about securing scholarships and their families do not have any direct experiences to share for support. Scholarships can be the motivation to pursue the dream of higher

education for many FGS.

2) *Family* – Often, FGS face parents who don't want to let go of their children by having them move out to live on a university campus. This lack of support is based on the parents or family members' lack of higher education experience themselves, so they do not know or have the emotional tools to support FGS during their time at school.

3) *Lack of information* – This applies to many areas of FGS attending college, including meeting the deadlines for applications and most particularly the financial support of scholarships, which should be at the top of every student's list. When FGS discover the loans available to them, some students go out and spend the money without understanding the terms of the loans and, most particularly, the interest that comes along with those loans. FGS do not always have a good understanding of the scholarships available to them as well as the application deadlines. Many FGS do not realize that you have to reapply each year for the scholarships (Gibbons et al., 2016).

CSUSB Students Feel Isolated From the Campus

The impact of the coronavirus on social interactions has taken a toll on human connectedness globally since 2020. It is widely acknowledged internationally, in various literature, that schools play a vital role in providing students with the opportunity to build relationships, a supportive environment for

routine and stability, and most importantly, the chance to nurture hope for their future (Kamenetz, 2022). The pandemic took much of that away. Being confined to the physical space of our homes with our family members changed the way the world interacted, beginning in 2020 and going well into 2022. We really have just begun returning to what we might call normal communications with face-to-face, maskless communication rather than mediating communication technologies in our everyday lives on a regular basis (Fuchs, 2020). This has impacted the way individuals connect with their college campuses.

CSUSB students are no exception. The following charts are from a CSUSB Information Systems Technology (ITS) survey from 2021. Among the students who participated on the CSUSB campus, 28% said they felt isolated from the campus community. Close to 10% felt they did not belong at the CSUSB campus. Moreover, this sense of isolation cannot be attributed to the transition to distance learning since roughly the same percentage (about 30%) felt isolated regardless of the modality of their courses.

Figure 2. Rate Your Campus Experience
Source: CSUSB, ITS Survey, 2021
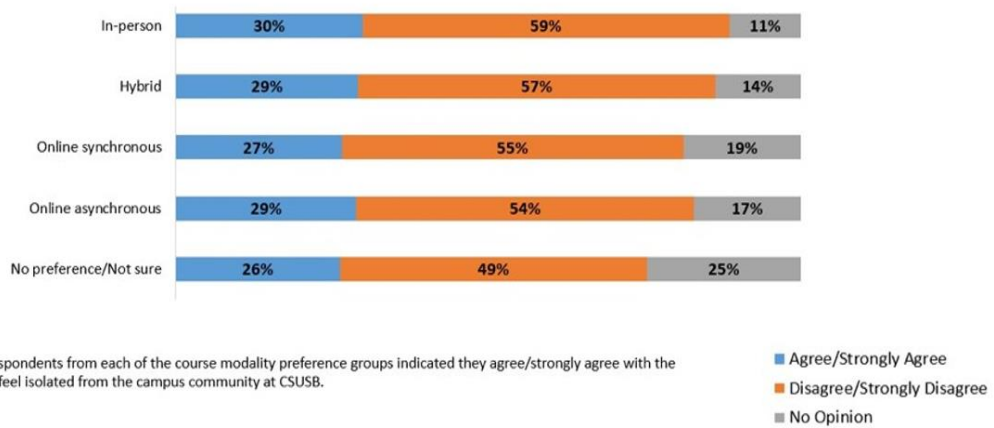
Figure 3. Percentage of Students that Feel Isolated from Campus
Source: CSUSB, ITS Survey, 2021

These problems need to be addressed. These students need to be reached and asked, "How can CSUSB better fit your needs of connectedness and community?" Having a better understanding of student needs will help address the issues of students feeling a lack of connectedness, and asking students how CSUSB can help to change their lack of connectedness could be the first step in changing that reality.

Project Objectives

The primary goal of this project is to further cultivate a sense of community among CSUSB campus citizens while they are attending the university by strengthening their connection with the physical space of the campus through the

use of augmented reality.

As elaborated in the literature review, the term augmented reality (AR) refers to a technology that combines computer-generated elements with the physical environment, such as virtual items, data, or visuals. This mixture gives the user an improved or "augmented" experience of reality. In contrast to virtual reality (VR), which submerges users in wholly digital surroundings, augmented reality (AR) superimposes digital content onto the actual world, usually with the use of smartphones, tablets, smart glasses, or headsets (Azuma, 1997).

To follow the user's surroundings and smoothly incorporate virtual components into their field of vision, AR technology relies on senses, cameras, and software. This might involve showing data, 3D models, animations, or interactive components that seem to be a part of the user's actual environment. Several industries, including gaming, entertainment, healthcare, architecture, navigation, and industrial training, benefit from the use of AR technology.

Finding tools that can help reconnect students physically to the campus by creating spaces that become their go-to places is key to my research. By exploring what makes certain campus spaces feel like meaningful places to students, the aim is to better understand how augmented reality technologies can play a role in enhancing and strengthening these connections. As Yi-Fu Tuan, a renowned geographer, has stated, "When space feels familiar to us, it has become place" (Tuan, 1977). How can augmented reality be leveraged to create a new sense of place and foster community connections on a college campus?

Research Questions

For this project, I will delve into the relationship between physical spaces, the sense of place they evoke, and whether extended reality technologies such as augmented reality can meaningfully mediate students' sense of space and space-bound social interactions that shape our campus community. Specifically, I am interested in the following research questions:

RQ1: What places on campus do students feel close to? How do they form social connections around those places?

RQ2: What features of an augmented reality app can help students increase their connection with the campus space?

The advent of augmented reality (AR) technology has opened up new possibilities for creating unique spaces on college campuses and fostering community connections among students. My research will explore the potential of an AR campus map application to enhance the sense of place and community on college campuses. I will draw on placemaking, social support, and mediatization theories to examine how AR technology can transform physical spaces into dynamic and interactive environments, encouraging students to develop a personal connection with the campus community.

Project Outcomes

The outcome of this project will be the beginning of a Vision and Scope document for the CSUSB AR Campus Map App (name to be determined). This

document will outline the essential components crucial for the creation of the new

mapping system. It will combine crucial business requirements, outline the

project's overarching objectives and performance standards, provide a brief

expression of the product vision, and provide a thorough description of the

project scope. This document is crucial for guiding project stakeholders, bringing

their visions into alignment, and defining the project's parameters. It will serve as

a fundamental point of reference to guarantee that project goals are clearly

defined and consistently met throughout the system development lifecycle.

An augmented reality campus map application has the potential to

mediatize campus traditions, events, and shared experiences, which would

strengthen the sense of community and belonging for all CSUSB students. The

app would take away any anxiety about questions like, will I make it to my new

class on time? Or where is the museum on campus? It would be much less

stressful to know you could rely on an app to get you from one location or activity

to another.

The application could also act as a mediating tool for the facilitation of

communication, collaboration, and social connections among students. In

developing the application, there is the ability to highlight campus landmarks,

historical sites, and hidden gems around CSUSB, encouraging the student

community to explore and engage with the campus surroundings.

My sister has shared with me that it would have been a total game

changer if she had had some type of mobile wayfinding tool to help her better

navigate the campus. Her eyes lit up thinking about an augmented reality campus

map application that could have helped her learn more about social events,

eateries, and restrooms around the campus. By creating the blueprint for an

immersive and engaging experience, I believe I can contribute to a stronger

sense of community, facilitate social interaction, and empower students to

navigate the CSUSB campus in innovative ways.

CHAPTER TWO:

LITERATURE REVIEW

I have extensively reviewed numerous articles and books related to my

project topic, focusing on the theoretical premises. Within this context, I believe

that the intersection of accounts of placemaking, social connectedness, and

mediatization theory (as applied to AR) provides a strong framework for

understanding how the design of an AR app could address student engagement

and connection in college environments. To narrow down the scope of my

research to what an app can achieve, I will posit three processes through which

students can develop a stronger connection with the campus: (1) better campus

navigation; (2) the identification of meaningful places; (3) an improved sense of

community.

On Navigating Spaces

The CSUSB campus is, first and foremost, a space to get from point A to

point B, therefore a space to be appropriated by navigating it well. As mentioned

earlier in my introduction, going to university can create anxiety for students

based on the knowledge that they will be encountering an unknown landscape,

especially with the shift from a small local high school to a large university

campus. First-year students will have many fleeting thoughts contributing to

these worries. Will I get to my class on time? How will I find the library or my

lecture halls? Many of us have been in this situation when navigating our way on

college campuses or even large building structures and grounds, such as healthcare facilities and large corporations. In college, it can definitely add stress to the day and, in some cases, frustration because of missed classes or meetings due to getting lost along the way. And it is not just from building to building; once in the building, how do you navigate the halls to find your destination? Having a tool for wayfinding in college can be an extremely valuable resource for a university campus. A wayfinding tool can also be used to find spaces that students will make into their own personalized places. Places that give students the confidence and security to feel at home when they are on their college campus.

In the pursuit of understanding her own student disengagement, Rebekah Nathan (a pseudonym for Cathy Small), an anthropology professor at Northern Arizona University, embarked on a compelling investigation. Observing the behavior of her students over several teaching years, Nathan became perplexed by the student detachment and lack of interest in the curriculum. Determined to explore more deeply into this issue, Nathan decided to immerse herself undercover as an incoming first year student at her own university. This covert endeavor aimed to examine the college student's experience and gain insights into what mattered most and least to students. The revelations she uncovered were surprising (Nathan, 2005).

Nathan covered many different aspects of contemporary college student life during her research, but I found one area in particular to be extremely

pertinent to my research–the difficulty navigating an unknown terrain with time schedules that are critical. Her initial school days were a bit like living out an academic, episodic adventure of *Survivor.* Adapting to the beginning of a school year requires great discipline and flexibility. How can you possibly plan for locating rescheduled classrooms at the last minute? This scene alone created tremendous stress in Nathan's life as she worked to find her classrooms, meet with professors after hours, and find her way to the library before closing to make sure she met homework deadlines. Having an augmented reality campus map application that included updates to class changes and mapping guidance to all classrooms could have helped Nathan strategically plan out her days, even in light of unexpected changes to her schedule.

Imagine the possibilities of turning spaces into places for students. When students come to university, they do not have any input on how the space around them is designed or created. Oftentimes, the landscape consists of buildings that were added over a period of years, sometimes decades, with no definitive connection to each other, which can be challenging for visitors, students, and faculty to navigate. This would all change if one could see the landscape of the campus using augmented reality technology as a wayfinding tool and much more.

Placemaking

For social geographers, "space," however, is a complex concept. I found

the teachings of Henri Lefebvre (1991) and Nigel Thrift (2003) on space to be very relevant to the possibility of new places for campus social construction and, most particularly, the production of space in a three-dimensional realm of social interaction. Nigel Thrift (2003), for instance, a key contributor to the theoretical premise of space and place, points out that social geographers understand space in four major ways, and there is a thread that runs through all of them:

1) *Empirical Constructions Space* is a physical space created by people using tools, techniques, and measurements. It principally employs the use of standardized measurement units and tools like GPS and GIS to coordinate and quantify space on a global scale. The fact that space is created by human efforts and technological advancements is a thread throughout all four ways.

2) *Unblocking Space* focuses on the interrelated flows and channels that connect different components. This includes local and international movements of people, things, information, and more. The central thesis emphasizes the intricacy of relationships by arguing that spaces are characterized by the dynamic interactions and circulations between constituents.

3) *Image Space* focuses on how images, visual representations, and media influence how we perceive space. It takes into consideration how images affect our mental maps of space and how they help us form perceptions and interpretations of the outside world.

4) *Place Space* acknowledges that places have emotional, social, and cultural connotations and explores the experienced and embodied components of space. It examines how environments affect our experiences, interactions, and connections and are not simply static containers. The main idea is that settings have a vital role in affecting how we relate to the rest of the world (Holloway et al., 2003).

The interplay of human actions, technological innovations, dynamic interactions, visual representations, and personal experiences in forming our understanding of the world around us is highlighted in the above four spaces. Together, these spaces offer a comprehensive collective view of how space is conceptualized and constructed.

Indeed, space could be described as a social product produced at the micro-social level in the course of everyday perceptions and appropriations (Fuchs, 2018). And just as Lefebvre presents his key ideas in *The Production of Space*, people create social space in every physical space they live in, which lends itself perfectly to the idea that students can create their own sense of place on campus. As Lefebvre states, 'each living body is space and has its space: it produces itself in space and it also produces that space' (Lefebvre, 1991; p. 170).

Memories created within a space are a fundamental aspect of placemaking, which involves shaping environments to evoke a sense of place and community (Othman et al., 2013). Here are a few ways memories can contribute to placemaking:

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- *Emotional Connection*: Memories formed in a space, such as personal experiences or cultural events, create emotional attachments to that place.

- *Community Building*: Shared memories and experiences in a space foster a sense of belonging and community. Events, gatherings, and traditions held in specific locations create a social fabric that strengthens community ties.

- *Heritage Preservation:* Historical memories preserved within spaces, like monuments, play a crucial role in placemaking. Memories shape how a location is perceived by both the inhabitants of the location and the visitors.

- *Identity Formation*: Memories help define the identity of a place. Whether through art, architecture, or stories passed down through generations, memories shape how a location is perceived by both the inhabitants of the location and the visitors.

I cannot help but think of the makeshift memorials that people create off the side of the road when they lose a loved one in an automobile accident. These spaces become significant spaces for people for years on end, no less important than a sacred burial ground (Döveling et al., 2018). These are just a few ways memories formed within spaces contribute significantly to placemaking by influencing emotions, fostering community, shaping identity, and preserving heritage. Understanding the interplay between memories and spaces is essential

for creating vibrant and meaningful environments (Othman et al., 2013).

By inhabiting physical spaces, students personalize them into their own unique places: "[p]lacemaking is the process of creating quality places that people want to live, work, play, and learn in' (Wyckoff, 2014, p. 2). Lefebvre speaks of social space as '…product and producer' (p. 142). If we break away from the physical boundaries of space and apply this theory to an app affordance, making spaces into places on campus without physical borders means enhancing a location with a material way for the user to capture social interaction, memories, and additional information—turning a "space" into a "place" (Hubbard &Kitchin, 2011).

Social Connectedness or Sense of Belonging

Scholar Benedict Anderson introduced the concept of imagined communities to describe the profound sense of unity experienced by individuals who may never meet but share a collective image of communion (Anderson, 1991). By understanding the power of emotional connections and the notion of imagined communities, we can unlock the potential for students to share lifelong campus connections, which contributes to the further realization of the CSUSB transformative vision.

Rovai (2002) contributed an overarching definition of connectedness as an outcome of his research in distance learning: the feeling of belonging and the creation of bonding relationships. When students connected via Zoom during the

pandemic, this assumption was undoubtedly once again put to the test. College campuses around the globe deal with that disconnect when teaching classes remotely, either synchronously or especially asynchronously (Fabriz et al., 2021).

Rovai (2002) lists persistence as a key area needing improvement, as students who have a strong sense of community are more likely to persist than those who feel isolated and alone. Rovai's research also demonstrated that students who report a stronger sense of community and campus connection are less likely to feel burned out as often as students who do not share in this connectedness.

There are many different definitions of a sense of community in literature. A few that stand out to me are, according to Rovai (2002):

- Feelings of membership and belongingness

- Shared socio-emotional ties

- Perception of similarity to others

- Acknowledged interdependence with others

- A feeling that members matter to one another and to the group

Student involvement theory posits that students with a higher level of involvement at an institution will have a higher level of institutional connectedness (Astin, 1999). Astin's definition of student involvement is "the amount of physical and psychological energy that the student devotes to the academic experience," (Astin, 1999, p.518). In other words, the more you put into it, the more you get out of it.

Developing a greater understanding of how students use space to connect to the "imagined community" of the campus is one of the areas of my research. Giving the students more experiential opportunities in which to get involved with the campus could be a road to a greater student community. Media are everywhere—print, electronic, and social. Perhaps giving students a mission to make the campus spaces their places is the journey to success we're looking to find, which is what I'm hoping to ferret out in my research.

Mediatization and Augmented Reality

We can certainly see how the media have continued to shape and influence our lives throughout the decades. And as we learn more from contemporary mediatization scholars such as Hepp, Hjarvard, and Lundby, we find the theory concept of mediatization is broad in scope, encompassing the long-term relationship processes between media change on one side and social and cultural change on the other (Hepp et al., 2010).

Dr. Marshall McLuhan, known for coining the phrase the medium is the message in 1964, was one of the first to theorize the importance of the medium in which we communicate. Exactly what does the medium is the message mean since McLuhan's words are a paradoxical statement. It seems clear that the message (the words) a person receives is the message. In other words, the content rather than the way it is delivered seems to be what is important. However, according to McLuhan, the technology (radio, telegraph, television,

letters, homing pigeons, telephone, etc.) that transfers the message is what changes society—it changes us as individuals.

McLuhan expands on that by saying in one of his lectures, "It doesn't much matter what you say on the telephone. The telephone, as a service, is a huge environment, and that is the medium. The environment affects everybody; what you say on the telephone affects very few. The same with radio, or anything else. What you print is nothing compared to the effect of the printed word" (ABC TV, 2015, 0:02:17).

It was pretty awe-inspiring to watch McLuhan's 1977 lecture on the internet (medium), while reflecting on how that medium has changed society. The internet has virtually changed the lives of each and every one of us. By shifting the medium to an augmented reality campus map app, it would change how people perceive the physical space around them on campus by integrating digital elements into their personal wayfinding experience (McLuhan, 1964).

Some researchers question the definitions in leading studies on the concept of mediatization, as they tend to fall into two principal categories: 'institutionalist' and 'social constructivist' traditions (Cerulo, 1996). Scholars often associate US-American culture as a media culture, which means that within American culture, media highly influence other institutions that are not specifically media institutions (e.g., religion, sports, and politics, to name a few) making institutionalists a group that has to conform to the rules and constraints put upon them by the media (Hepp, 2010).

Institutionalist Tradition: This category interprets mediatization as a process whereby non-media actors in society (such as companies, government, or religious institutions) have to adjust to and follow the guidelines, objectives, standards, and constraints established by media entities, especially major media organizations (Deacon & Stanyer, 2014).

Social Constructivist Tradition: In contrast, this view of mediatization sees it as a process influenced by advancements in information and communication technologies (ICTs). It stresses the ways in which these developing technologies affect the creation of culture and society and the way in which they are communicated (Deacon & Stanyer, 2014).

When developing an augmented reality (AR) campus map application, the theory of mediatization might be useful and significant for a number of reasons:

- *Understanding Media Influence:* Mediatization theory aids in the understanding of how media, such as digital and augmented reality (AR) technologies, shape and influence numerous facets of society, including how people perceive and interact with their surroundings. It brings to light how this technology might affect how people view and navigate the campus with the benefits of an AR campus map application (Liao, 2016).

- *Adaptation to Media's Rules*: The requirement for non-media entities (institutionalists), including educational institutions like universities, to

adapt to the rules, formats, and conventions of media are critical to consider from an institutionalist perspective within the mediatization thesis. Understanding these guidelines will help with matching the applications' features and content to best fit user expectations when creating the AR app for a college campus (Hepp, 2012).

- *Technological Change:* Mediatization Theory's social constructivist component emphasizes how rapidly developing technologies are shaping culture and society. One such technological advancement is augmented reality (AR) technology. This viewpoint can help developers understand the broader societal and cultural changes that AR technology might create and how those changes might affect how users view the campus environment (Liao & Humphreys, 2014).

- *User Experience:* Mediatization theory promotes thinking about how media and technology affect consumers' experiences. This involves considering how the design and functionalities of the app affect users' interaction with the campus, their sense of place, and their overall experience while exploring the actual environment in the case of an AR campus map app.

- *Content and Interactivity:* Mediatization Theory also discusses these two facets of media. Understanding how media content is created and how users engage with it might result in more useful and interesting

features when developing an AR campus map app (Liao, 2016).

- *Cultural and Social Implications:* Mediatization theory also supports exploring the broader cultural and societal ramifications of the usage of media and technology. This involves considering how the implementation of an AR campus map application may affect the communication habits, social interactions, and campus culture among students, faculty and visitors.

Updating David Harvey's 2005 typology of social space to include augmented reality requires a conceptual integration of the two. David Harvey's theory of the spatial fix and the concept of augmented reality can be connected in the following way.

Table 1: David Harvey's (2005) Typology of Social Space

	Physical space (experienced space)	**Representations of space (conceptualized space)**	**Spaces of representation (lived space)**
Absolute space	Physical locale	Symbols, maps and plans of physical locales	Locales as social spaces where humans live, work and communicate
Relative space (time)	Humans in a physical locale	Symbols used and meanings created by humans in physical locales	Humans as social actors acting in social roles
Relational space (time)	Social relations of humans in a physical locale	Language as a social and societal structure	Communicative practices that produce and reproduce social relations, sociality, and social spaces

Source: Fuchs, 2020

- *Physical Space*: This category remains unchanged from Harvey's original typology (Fuchs, 2020). It represents the physical environment in which social interactions and activities occur. Augmented reality overlays digital information onto physical space, enhancing the way people perceive and interact with their surroundings. This can include AR apps that provide location-based information or navigation.

- *Virtual Space:* In Harvey's typology, virtual space represents digital environments created entirely in the digital realm. Augmented reality, on the other hand, blurs the lines between physical and virtual spaces by superimposing digital content onto the physical world. Virtual objects and information become an integral part of the physical space, influencing how individuals experience and interact with their surroundings (Dwivedi et al., 2022).

- *Augmented Space:* This additional category for this typology specifically addresses the integration of augmented reality into social space. Augmented space encompasses the overlap between physical and virtual spaces made possible by AR technology. It includes the social interactions, experiences, and activities that occur within this hybrid space. Augmented space introduces novel ways of engaging with both physical and virtual elements, leading to unique social dynamics and possibilities for campus students (Bodenheimer et al., 2023).

By introducing the concept of augmented space, we can update David Harvey's typology to reflect the evolving relationship between technology, space, and society in the 21st century.

In short, mediatization theory offers a framework for thinking about the numerous ways that media and technology have an impact on society and culture. This theoretical perspective can assist developers in making an informed, user-centered, and culturally sensitive AR campus map application that is in line with the changing media landscape, user expectations, and the overall CSUSB vision of being a transformative force in students' lives (CSUSB Strategic Plan 2023-28).

No matter how one looks at it, society is highly impacted and reliant upon media technologies to provide information to serve their lives—whether that be for education, business, entertainment, sports, politics, religion, wellness, or societal engagement—and in essence, lives are shaped and changed by the experience. This is literally the definition of mediatization.

Many media studies scholars have been researching the explanatory power of the term mediatization, and they do see evidence of a complex combination of social changes relating to media influence. These researchers invite others to participate in the research on mediatization in order to further develop an understanding of the social and media changes within the history of modernity (Lunt & Livingstone, 2016).

Milgram and Kishino (1994) conceive of AR as a "midway" technology

between the so-called "real environment" and a fully digital world (a "virtual environment"). According to them, augmented reality (AR) extends beyond its technological underpinnings. Rather than being confined solely to the capabilities of technology, AR can be understood within a broader framework. Milgram and Kishino (1994) introduced the concept of the Reality-Virtuality Continuum, a spectrum that spans from the entirely real to the entirely virtual (Ariso et al., 2017).

At one extreme of this continuum lies physical reality, representing the unaltered physical world. At the opposite end is pure virtuality, encompassing entirely computer-generated environments. Between these poles exists 'mixed reality,' a space where the real world coexists and interacts with the virtual one. This mixed reality includes augmented reality (AR) and augmented virtuality (AV) (Skarbez et al., 2021).

AR, within this framework, emerges as the integration of virtual elements into the real world. Notably, in AR, the real world dominates the user's experience, with digital information complementing the physical environment. On the other hand, augmented virtuality (AVE) involves adding real-world objects to primarily virtual contexts, where digital information predominates. This conceptualization broadens our understanding of augmented reality, emphasizing its position on the reality-virtuality continuum. It illustrates that AR is not confined to technology but is a pivotal point where the real and virtual converge, offering a unique and context-rich user experience (Milgram & Kishino,

1994).

The concept of mixed reality is illustrated by a simplified representation of the reality-virtuality continuum below (Ariso et al., 2017):
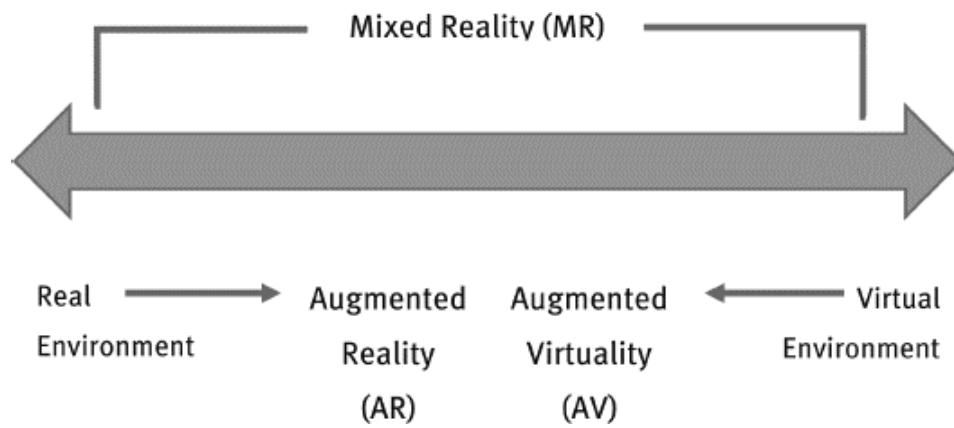
Figure 4. Reality-Virtuality (RV) Continuum. Milgram et al. (1994, p. 283)

Figure 5. Augmented Reality of Pachirisu Pokémon on My Desk While Writing

An easy way to describe augmented reality is to identify it with the most

downloaded game application in the world in 2016—Pokémon Go. In the game,

players can explore points of interest with their favorite Pokémon in a mixed-

reality space. Players can also interact with friends and their monsters in an

augmented reality space on their mobile device.

AR alters our experience of space. Heemsbergen et al. (2021) argue that

as media, AR should be understood as a form of relating "space" to "place"—on

par with how broadcast related one to many and social media related many to

many. By "space," the authors mean a physical environment rendered legible by

means of points of interaction (and therefore interest), or "object-moments of

spatial computing" (839). By "place," the authors mean the creation of contexts

for user experience. Further, Heemsbergen (2021) argues that AR actively

(dis)integrates organic perception and reintegrates it as computational

perception. This reintegration creates a different relationship with the

environment by highlighting certain features that would typically not be available

to human perception (e.g., UV radiation data, added as an information layer) or

replacing/blocking certain features: "…visual (dis)integrity speaks to the

properties and dynamics of naturalising the assumption that everything perceived

around [users] *is* mediated and offers specific forms of autonomy within that

environment." (Heemsbergen et al., 2021, p. 838). By replacing physical space

with computational space, AR redefines human agency by changing what actions

are possible in the space-time environment and creates "hybrid spaces" (e.g.,

Frith 2019) that combine the mediated perception of the physical space with

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additional computational objects that enrich a person's "narrative": historical

information, personal memories, traces of place-based activities.

I began my interest in AR campus map applications during the summer of

2022, when I developed a writing assignment paper for a CSUSB summer course

on mediatization and digital affects. Later, as a graduate fellow of the Extended

Reality for Learning Lab (xREAL), I experienced AR directly. The xREAL Lab has

created many different applications of augmented reality—from reconstructing a

space to enhancing organic perception using culturally relevant objects,

information layers, or creative juxtapositions (Popescu, 2023). A great example

of this is the CSUSB Augmented REALity Cody, a Cody designed in AR for each

of the six colleges at CSUSB. It is projects like these that will continue to bring

students into this world of exciting change and progress as this field expands into

many different applications.
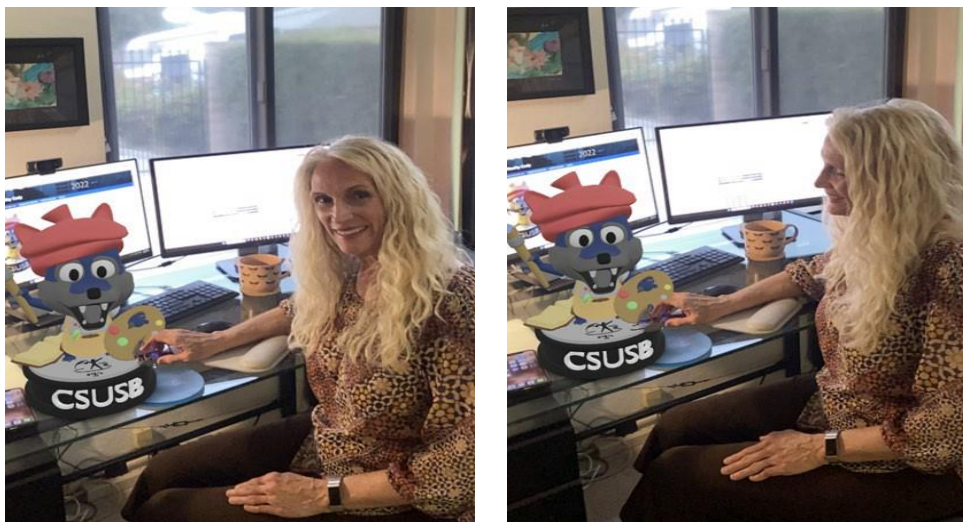
Figure 6. Cody AR. Credit: Francisco Casilla

An AR campus map application creates a virtual overlay of the campus physical environment, often referred to as a digital twin of the environment, so the user literally sees themselves walking around the campus with various buildings and key points of interest being displayed on their journey. This type of tool would enhance the campus experience by adding virtual layers of information and interactivity to a student's daily activities.

CHAPTER THREE:

METHODOLOGY

To answer my research questions, I originally intended to use a mixed-method approach that involved data collection through both an emailed survey to students and a curated campus walk diary with student volunteers. I planned to distribute a survey with both closed-ended and open-ended questions to campus students. Because of time and participant considerations, this approach proved impractical. Fortunately, I was able to place two open-ended questions in an omnibus survey on campus technologies run by the Information Technology Services (ITS) division on campus. The survey reached 496 CSUSB students by email in October of 2023. The two survey questions were:

1. What is your favorite engaging place on campus (i.e., a place where you like to engage with people, things, or technology)?

2. What do you like about that engaging place?

The answers to the two questions were extensive. I used the analysis of these responses to validate the results of my qualitative data analysis in the curated campus walk.

Curated Campus Walk Diaries

To understand how students develop connections to particular places on campus and how they experience those places, I implemented a *Curated Campus Walk Diary* study. Originally, I aimed for ten participants; I was able to enroll six volunteer CSUSB students (please see Appendix 1 for the protocol).

"Usability diaries" are a common method in app design. The idea is that users document their engagement with an artifact and describe their individual experiences. Here, the "artifact" is the space itself. Students selected two of their favorite places on campus, one for study and one for socializing, on two different days and they recorded a video commentary of the experience of walking to those places from the parking lot.

I analyzed the 12 videos obtained from the Curated Campus Walk Diaries using a coding strategy derived from grounded theory analysis. In her book "Constructing Grounded Theory" (2014), Charmaz introduces readers to constructivist grounded theory methodology, a method of theorizing in parallel with data collection and analysis that leads to the development of theory "from the ground up." Charmaz demonstrates how researchers can use grounded theory techniques to investigate and create theories based on empirical evidence through real-world examples and case studies. In my research, Charmaz's grounded theory approach provided an insightful coding technique to make sense of my qualitative data collected through the Curated Campus Walk Diaries.

Initial coding is the first step in grounded theory coding. Data segments are assigned labels that classify, summarize, and account for each data item during the coding process. "A code sets up a relationship with your data and with your respondents" (Bryant & Charmaz, 2007, p. 80). Using grounded theory coding, narratives, assertions, and observations are given an analytical context beyond the data's specific claims. The objective of coding is to make an

interpretative rendering that begins with coding and ultimately illuminates the studied life. Through the process of deciphering and interpreting data pieces, scholars acquire valuable insights and proceed further with their analysis.

The second major phase of coding discussed by Charmaz is engaging in focused coding, which is critical for data analysis and synthesis. The initial codes are refined into focused codes, allowing deeper analysis.

Lastly, memo-writing is the way to stop, focus, and analyze codes and data to define the links between them. This process helps in constructing analytic notes, interpretation of the categories created, and providing the understanding of the entire phenomenon being studied. (Charmaz, 2014).

In my analysis, I applied this process as follows. First, I reviewed all the videos and created codes to capture relevant fragments. Then, based on my observations of patterns, I consolidated the codes and used them to recode the entire material. For every instance pertaining to a code, I compared it to a previous instance, which helped me give meaning to the code and understand the broader theme behind it. All throughout this process, I wrote a copious number of memos capturing my observations about the patterns in the data. At the end of the process, I was able to make sense of how students are able to establish campus connections through relationships with the space around them. I used my analysis of the two open-ended survey questions to validate my qualitative analysis of the campus walk diaries and to provide more information about favored places on campus.

CHAPTER FOUR:

DATA ANALYSIS AND KEY FINDINGS

Curated Campus Walk Diaries

In the following, I refer to the students as B, BR, D, DR, P, and S. In the 12 videos analyzed, the students identified as favorite the following places: the fountain next to the Kinesiology Department, Einstein Bros. Bagels, the Neurodiversity Center, the Student Mentoring Center (the third floor in the Library), the Library, the third floor of the CGI Building, the Recreation and Wellness Center, the Pan-African Center in the SMSU North, and the SMSU North in general.

Choosing a Place

A favorite place is both a physical area and a complicated personal construct that endows that area with a meaning for each student.

First, that place has to fit neatly within the student's rhythm of the day and be accessible depending on weather conditions. The place has to be in proximity to the student's activity "nexus" (e.g., a building where most of their courses are), so it can be easily reached at designated times. For example, one of D's favorite places is Einstein Bagels, which he prefers because the distance from this place to the building where he has most of his classes is short and his time is limited.

Favorite places can vary from semester-to-semester as they are often discovered

depending on where the student secures work or has most classes. For instance,

one of P's favorite places this semester is the Neurodiversity Center because she

is working there.

Second, some of these places exhibit an "in-betweenness" adequate to

"interstitial time" (the downtime between one class and the next) when the

student, trapped between two mandatory activities, wants to do homework or

relax after a long day. For instance, D only has 15 minutes between classes, so

Einstein Bagels seems like an ideal place to pop in and out of. Similarly, B needs

a place to "linger" between his classes, so he chose a study room in the Library

as one of his favorite places. Sometimes the favorite place acts as a refuge, a

place to go toward which is different than the place one runs from (that is, the

classroom).

In the data, I saw two main reasons students favor places: place attributes

and the function that the place serves for the student.

Place Attributes: Qualities and Affordances

The place may be favored because of its attributes, such as the sensory

experiences it engenders (e.g., the bright colors of the furniture, comfort, its quiet

qualities) or it may be favored for its affordances (whether it has food, scantrons,

a nice view, or clean bathrooms). For instance, P shared that she enjoyed the

fairy lights of the Neurodiversity Center, as she feels "the super small space is

inviting, warm, welcoming, all that good stuff. It's completely different than any other space on campus." For S, the fifth floor of the Library is comforting because it is "quiet" and because she likes the colors of the carpet.
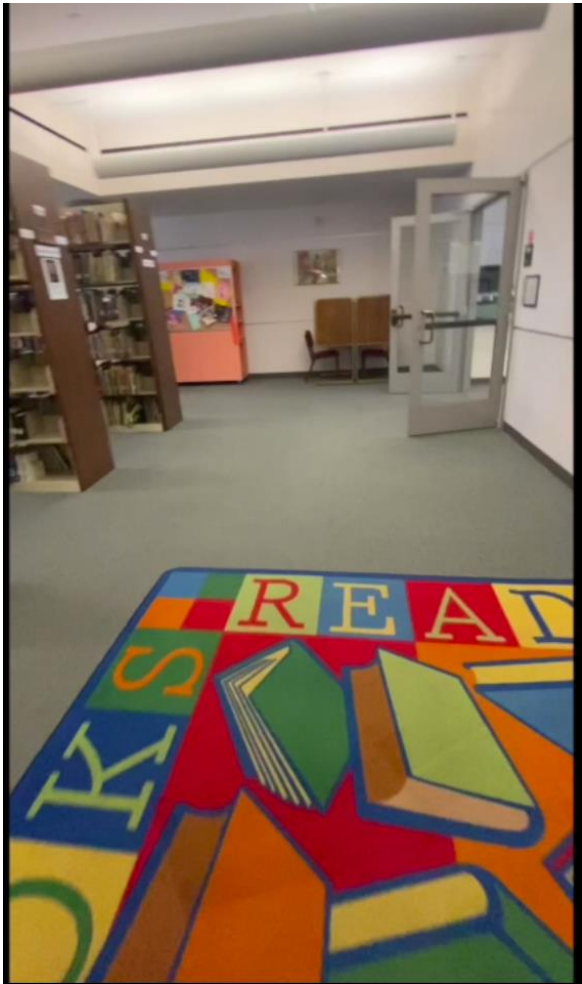
Figure 7. S's First Favorite Place

Similarly, for BR, the third floor of the CGI building is a favorite place because of the furniture, which is "comfortable."

Figure 8. BR's First Favorite Place

For D, one of his favorite places provides a refuge from the warm weather by being "cool" because of a little fountain:
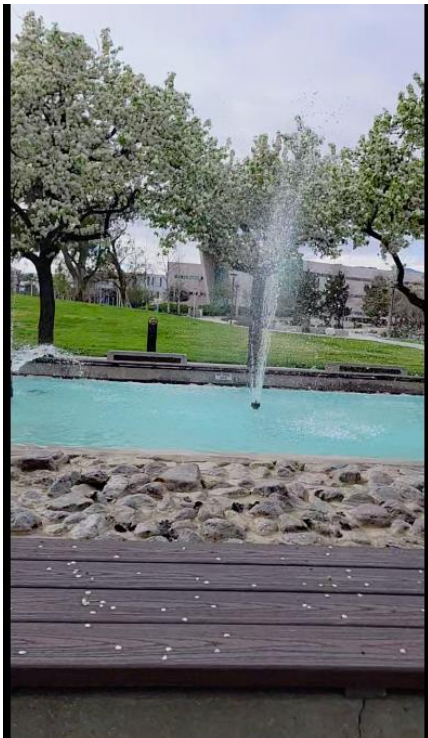

Figure 9. D's First Favorite Place

As we see from these examples, all three places exhibit qualities that appeal to the senses: visual appeal, hearing, or tactile senses. In contrast, place affordance pertains to what the place can provide for the student, including food, a particular type of social interaction, "things to do," or clean bathrooms. Place affordances is described by B when he visits the Pan-African Center, "You are able to get scantrons, snacks, and you are able to print things."

Place Functionality

A place may be favored because it plays various functions for students. The place could be a spot for quiet reflection and seclusion or, quite the contrary, a place to meet people. A place could have an emotional impact that the student desires at a particular time. Finally, a place could be favored because it is appropriate to the actions that the student wants to undertake.

Some places are favored because they attract the "right" number of people, depending on the student personality. For D, he favors the place with the fountain because it is secluded (the two people he found on the day he recorded his diary were "the most I've ever seen here"). Similarly, B likes the Library because it isolated him from people: "I'm not much of a socializer during times that I have classes because usually I have an assignment that's due and some sort of anxiety builds during that time, so I'm not in much of a mood to socialize." In constrast, DR likes the SMSU North because there, she finds people with whom to socialize. Finally, BR likes new buildings because they have "just enough people": a few, but not too many. BR concludes: "I like that there is

always different people in here, so if I feel like having a conversation with someone, I can do that…Newer buildings attract a different 'crowd.'"

One of the most frequent reasons governing the choice of place or the choice of route to the place is because they produce an intended emotion in the student, typically one of calm and peace. S likes the third floor of the CGI building because it is "serene" and "scenic." For B, the Pan-African Center has a "homey" feeling, whereas the path to his first favorite place produces a sense of "peace." For D, the choice of where to park is deliberate to engender calm: "Having the mountains near where I park is really nice because every time I exit the building, I also get to see the mountains, which brings me peace and it is almost therapeutic for me..." Finally, for P, the Neurodiversity Center is "…inviting, warm, welcoming, all that good stuff."

Finally, the place has to be appropriate to the actions that the student intends to take, typically studying or socializing. Often, the appropriateness of the place is expressed through contrast with places that the student does not favor. For example, D doesn't favor the Library because "there is a cacophony of keyboards typing, plus the whispering sounds, which does not equal a good place to work" (compared to his favorite bagel place on campus). Because of this, he finds it "annoying" to be in the Library. Similarly, the Food Court is "way too busy to get any meaningful work done," as opposed to Einstein Bagels, where there are no interruptions or loud voices.

Students may favor places because they combine several attributes and functions, thus becoming "hybrid" places. These places are not one-purpose only. In fact, some places are favored because they have multiple functions, such as offering a place to study and a view. An example of hybridity is how S connects with the third floor of the Center for Global Innovation in two ways – she likes to study there as it is quiet and peaceful, but also it is an opportunity for her to connect with nature. "I can hear the birds singing while looking out at the mountains." She continues, "I think this is the closest I can get to still being outside and still being a diligent student."

Figure 10. S's "Hybrid" Place

Together, place attributes and place functionality combine to provide a certain "vibe," as described by BR when referring to SMSU North:

"I like this area because of the vibe. There is music playing and there's the view, there's food downstairs when I need to get something to eat, there is (*sic*) plenty of places to sit in here, you can sit outside, I've sat outside before… If I'm working or doing some homework, I like to come up here and sit down" (BR, second favorite place).

Choosing a Route

The route students take to their favorite place is equally important, and its choice is equally deliberate. In the data, I saw three patterns describing how participants chose their route, which resulted in three types of routes: the scenic route, the social interaction route, and the efficient route.

The scenic route is a route that may take longer than other pathways to the favored place, but it is a route that the student prefers because it is closer to nature. For example, S "loves nature and the birds" and for that reason she loves navigating her favorite walk in the morning because there are birds and bunnies; she loves it when "nature is naturing you get to see really cool, like beautiful sights."

Some routes are chosen specifically for the possibility of social interaction along the way. For example, DR's pathway is through the CGI building because exploring the building is "a pleasurable activity, as well as looking at new people and engaging in new interactions." BR, too, chooses routes that go through buildings; she likes to go through areas with activities because she likes their "liveliness." For D, although he chooses the "scenic" route, the route also affords interaction with friends and professors.

The efficient route is by its nature the fastest, most efficient way to get from point A to point B. For example, BR's choice of route is very utilitarian – she takes the elevator as it is "the quickest way and it's just easier." Another example

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is P who takes the fastest route to the Student Recreation and Wellness Center as she has an instructor-led class that she doesn't want to miss. In this setting, the predominant reason to choose this pathway is not what it affords, but as a means to an end (reaching the favorite place the quickest).

Establishing Campus Connection

The choice of places and pathways through the campus is only one way to establish campus connection. Other ways were expressed more subtly in how students talked about their favorite places: in the context of habitual action, by referencing community, by invoking the memory or the future of the campus, by closely watching the campus, and by caring for the chosen route.

A space becomes a place through habitual action. The place has to have the required characteristics to accommodate the activities that the student does repeatedly, but it also becomes the designated place where the student performs those activities. This way, the student appropriates the place. This is a common thread in what I observed, applicable to both the place and the route to the place. Once a student develops their route for their schedules, they seem to stick to it on a regular basis creating "their" places, "their" routes, etc. Student D always goes to the same place when he has time and he has been doing this for the past couple of years while attending CSUSB. Student S has a place in the Library that she claims as "hers" and is so identified. She refers to it as "my typical spot." For DR, too, her choice of where to park and the subsequent route

are always the same. Through habitual action, students establish ties to their favorite places and the routes that take them there. These ties become a sense of ownership that the students feel about the campus when they refer to places as "mine." S says, "my favorite walkway." BR is "very particular about which chair she sits in." D calls Einstein Bagels, "my bagel shop." This is a theme we hear throughout the walks.

When you frequent a campus location, you develop a sense of community with the people there. Spaces become places because they attract the people with whom you develop close ties. Many of the students have ties with the various Centers on the campus because of the sense of community they invoke when going to them. P picked the Neurodiversity Center because it is a "welcoming environment; it's kind of a space for neurodiverse students to go. They can learn, conversate, study, get some sensory items, fidgets, and it's just a welcoming space." B expresses that about the Pan-African Center, "I have some friends here on the regular. It is a place where you gather with friends." P formed a "sense of community" with her Pilates class students. P also selected the Recreation and Wellness Center because she had developed community with her pilates class. In fact, she declared that she chose CSUSB precisely for this center!

Places also carry memory. As I learned from my readings, Othman et. al. (2013) describes how memory association is a key aspect of placemaking. Memories shape environments to evoke a sense of place and community.

Student DR "likes the CSUSB letter sign" because she loves looking at how the campus "continues to expand." She likes the new, blue pavement because she remembers that it was grass there and notes the changes (which for her means that the campus is growing).

Figure 11. DR's View of the CSUSB Sign

Watching as part of navigating the campus also establishes a connection. As students follow their route, their gaze ties them to people and to nature: students people-watch and nature-watch. Thus, DR deliberately chooses to walk through the Center for Global innovation rather than walking around the building because she enjoys "looking at new people and engaging in new interactions." D observes: "people do tend to just be looking at their phones more than anything, not looking at where they are going not taking in what's around them." Part of the reason why S feels attached to the campus is because of its beauty: "I love nature. I love when the birdies are singing their songs and doing their chirps, it's

like... I can't get enough of them honestly."
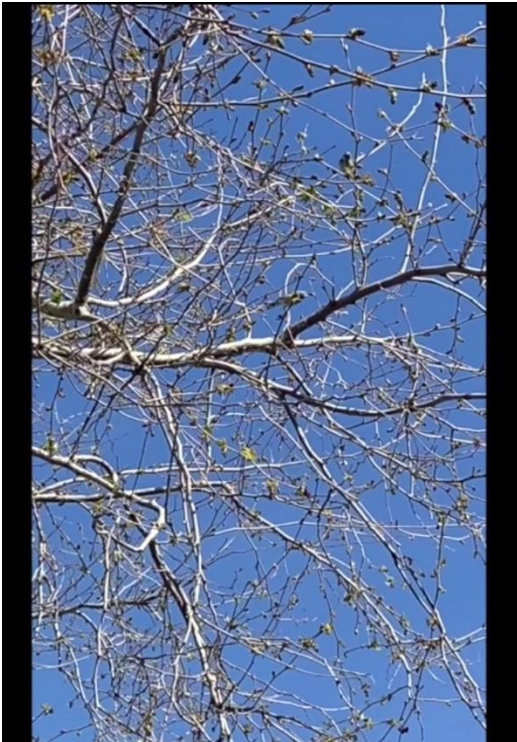
Figure 12. How S Nature-Gazes

Forming a campus connection also forms a sense of pride that the students exhibited in their videos. Without even commenting, I watched D pick up any litter he encountered during his walk to his location. I watched Student P walk up the stairs four floors to the Neurodiversity space "because the director of the center wants her interns to be aware that there is only a limited number of elevators and they should have them available for those who need them."
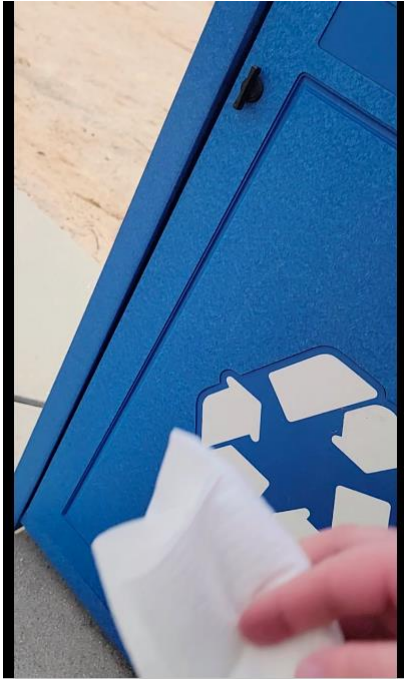
Figure 13. D picking up the trash

Through these strategies, students take further ownership of places and pathways, as indicated through the use of the possessive pronoun "my": "my" place to study (in the Library), "my" chair, "my" way, "my" bagel shop. Students develop strong campus connections, influenced by community ties, memories, and the personal engagements they experience with their favorite places. Observations of student behavior, such as care for the campus and sense of ownership, reinforces these connections, emphasizing the campus's role in shaping student identity and experience.

Emailed Survey: Analysis and Validation of Findings

As mentioned previously, I was able to ask two questions in a comprehensive survey run by the ITS division on campus. This emailed survey was sent campus-wide to 496 students, some of whom provided more than one answer. In total, I received 588 unique responses to my questions. Following are the two tables revealing the data results. The category "Other" in the table below combines places only mentioned once.

What is your favorite engaging place on campus?
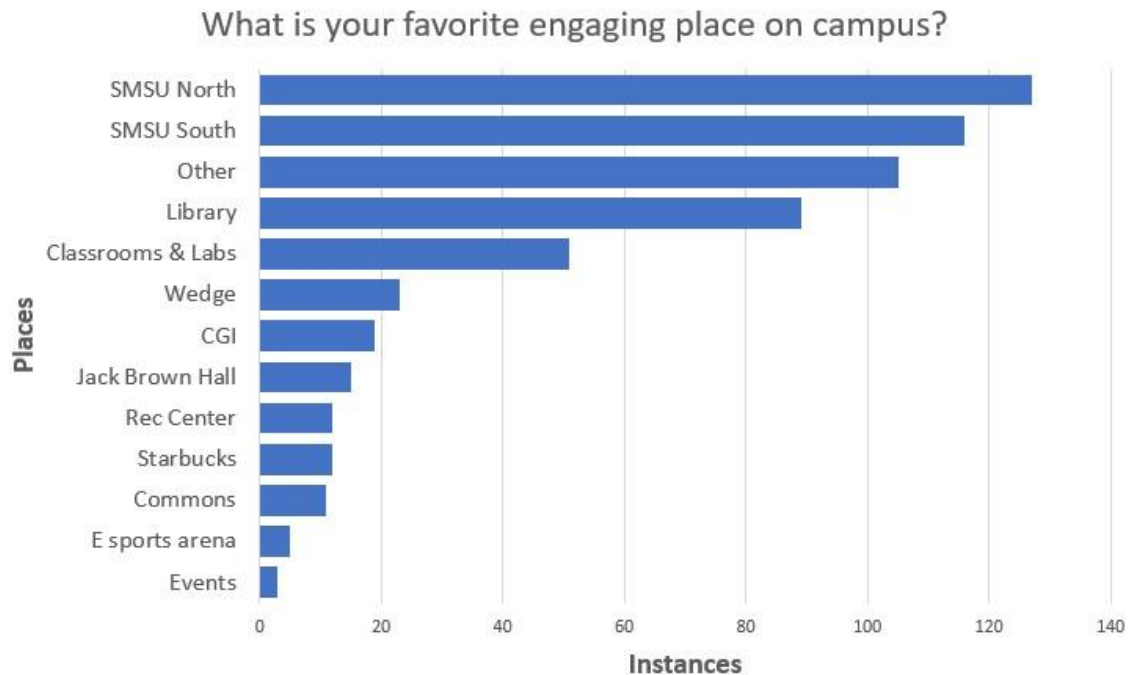
Figure 14. Responses to Question 1 - Favorite engaging place

By far the most frequently favored places with responses from close to 20 to over one hundred are: the SMSU (North and South), the Library, various

classrooms, the Wedge of the Library, and the CGI building. Many of these places were also mentioned by the students who underwent the campus walk.

In terms of reasons to favor these places, there were a variety of responses that I had to combine into categories. I grouped the answers displayed below by similarity and obtained six categories: social interaction, participation in social events, space qualities, space of reflection, convenience, affordances. The distribution of answers is presented in Figure 15 below and the codes in Table 2.
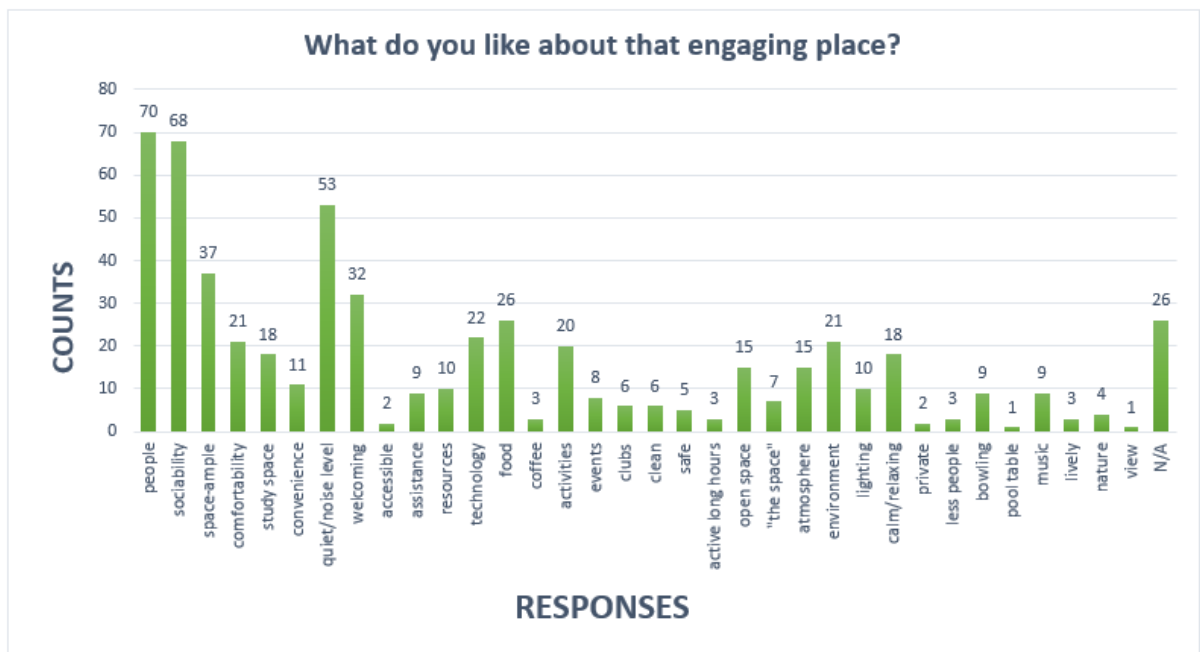
Figure 15. Distribution of answers to the question about the reason to like a place

Table 2: Reasons for Liking a Place

SOCIAL INTERACTION Answers: • People • Sociability • Lively	SOCIAL EVENTS/ACTIVITIES Answers: • Events • Clubs • Bowling • Pool table
SPACE QUALITIES (nice to dwell in) Answers: • Space (ample) • Comfortability • Welcoming • Clean • Safe • Open space • Atmosphere • Environment • Lighting • Nature • View	CONVENIENCE Answers: • Convenience • Accessible • Active long hours
QUIET/STUDY/SPACE OF REFLECTION Answers: • Quiet/noise level • Calm/relaxing • Private • Less people	AFFORDANCES Answers: • Assistance • Resources • Technology • Food • Coffee

As we see from the table above, these groupings perfectly match some of the

reasons that the six participants in the campus walk provided. The one difference

from the patterns I observed in the qualitative data analysis of the video diaries is

the importance provided to campus events and activities that could take place in

the favored places. This difference might have to do with the fact that the six

participants in the campus walk were more attuned to places of study rather than

places for social engagement.

CHAPTER FIVE:

TOWARDS DESIGNING A CAMPUS NAVIGATION

APP – VISION AND SCOPE

The development of an augmented reality (AR) campus map application would revolutionize how students navigate the CSUSB campus. Not just when outside the campus buildings—but also while inside the buildings navigating to various classes, events and labs. The primary business goal would be to increase CSUSB students' sense of campus belonging by allowing them to navigate the campus via an intuitive, real-time navigation environment (Wiegers & Beatty, 2013). To reiterate, I am not proposing to design and implement an app, but to use empirical data to develop a research-informed vision and scope for the AR campus map application.

Objective

The objective is to develop an AR campus map application that provides seamless navigation, points of interest identification (as well as immersive learning about the points of interest), and relevant campus information overlayed onto the real-world environment. The application needs to be:

1. Complete

2. Accurate

3. Cross-platform (accessible on all types of mobile devices)

4. In the context of this project, tailored to the needs and interests of CSUSB students.

Vision

The application will cater to all stakeholders' diverse needs, making their time at CSUSB a much more enjoyable experience while ensuring that they experience the best possible navigation efficiency.

The AR map accuracy is critical to ensure that users reach their destinations, from point A to point B, efficiently and safely which creates a user experience that keeps the app in use and widely downloaded.

The AR campus map app will be designed to work on all mobile platforms in order to be accessible to the broadest population of student users. This is also the most cost-effective approach to application development rather than creating separate apps for each platform. Cross-platform compatibility ensures that users can navigate effectively on the app regardless of their device or operating system.

The CSUSB AR Campus Map App will be designed to provide students with:

- Student-Centric Navigation: Students can personalize the app based on their class schedules, extracurricular activities and their campus favorite places providing the students with an optimized user experience.

- Integration with Campus Student Services: Various campus activities can be included such as academic calendar integration, event notifications and class cancelation.

- Points of Interest: Specific points of interest on the campus will be shared. Lecture hall and class updates can be accessed. Student center information can be found. Dining options can be updated and shared. Recreational facilities can share any promotions or events. All of these points of interest will add to the depth of the student engagement with the campus amenities.

Features

The key stakeholders are the CSUSB students. Additional stakeholders include: CSUSB visitors, other members of the CSUSB campus. From my data analysis, it is possible to identify several features that the app would require.

Table 3: App Features

Major Features	Feature Dependency	Functions	Motivation
FE1: Discover buildings and landmarks		This feature will enable the user to identify buildings based on pre-defined characteristics	Students identified buildings they favored for different reasons ("vibe," their newness, activities available in the building proximity to nature…)

		View activities	Shows the user a list of activities that could take place on campus	Students indicated that one reason they choose a "hang-out" building such as SMSU North is because of the activities that take place there
		Filter buildings by activities	Enables the user to identify the buildings where certain activities take place	This function will enable students to locate only the buildings where desired activities take place
		Learn building/landmark history	Upon selecting a building, the user will be able to see an extra layer of information showing the building's past (e.g., images, sounds, narrative)	Students build connection with the campus by comparing the past with the present
		View on map	This function shows the location of the building/landmark on the campus map in the traditional view	Enables navigation
		View in AR	This function shows a 3D view of the building transported into the user's personal space	Provides connection beyond physical reality

FE2: Discover places in buildings		Enables the user to discover places on campus that fulfill certain characteristics	Students have particular places that they favor
	View characteristics	Shows a list of place characteristics of relevance to the student	My research shows that certain place characteristics (namely, qualities and affordances) matter to students
	Filter by characteristics	Enables the user to identify only those places fulfilling a certain characteristic	Different students are attracted to different place characteristics, as demonstrated in my research
	View in building	Shows the location of the place in the building, on the map	This function allows the user to navigate to the particular place using the campus map
	View in AR	Shows a 3D view of the place transported into the user's personal space	Provides connection beyond physical reality
FE3: Discover pathways		Enables the user to plot a path through the campus	Students care not only about destinations, but also about what they see along the way

	Input starting place/destination	Allows the user to indicate which route the app should plot based on the starting point and the end point	This function aids navigation by providing route options in the manner of Google Maps
	View route characteristics	Enables the user to view possible route characteristics and route options	My research shows that students select a route based on proximity to nature, social interaction, or efficiency
	Filter by characteristics	Enables the user to filter possible pathways depending on their desired characteristics	Students have the opportunity to select different routes depending on time or weather
	View on the map	Shows a plot of the selected pathway superimposed on the campus map	Helps navigation
	View in AR	Shows a 3D view of the route with its context characteristics (proximate buildings, nature, etc.)	Students choose their pathways based on their surroundings and social opportunities
FE4: Discover		Enables users to share their location dynamically and	My research shows that proximity matters because

proximate places		discover places in proximity to that location	students need a place to go during "interstitial time"
	View characteristics	Shows a list of place characerics of relevance to the student in that particular moment	Shows all the characteristics that a student finds relevant
	Filter by characteristics	Enables the user to identify only those places fulfilling a certain characteristic	Dynamically enables the student to select a place in real time depending on the student mood and location
	View in the building	Shows the location of the place in the building, on the map	Aids navigation
	View in AR	Enables the layering of information of relevance to the student in that particular moment	Dynamically enables the student to see more information about a place depending on mood and location

The following figure shows the feature tree of the application, as described in

Wiegers & Beatty (2013).

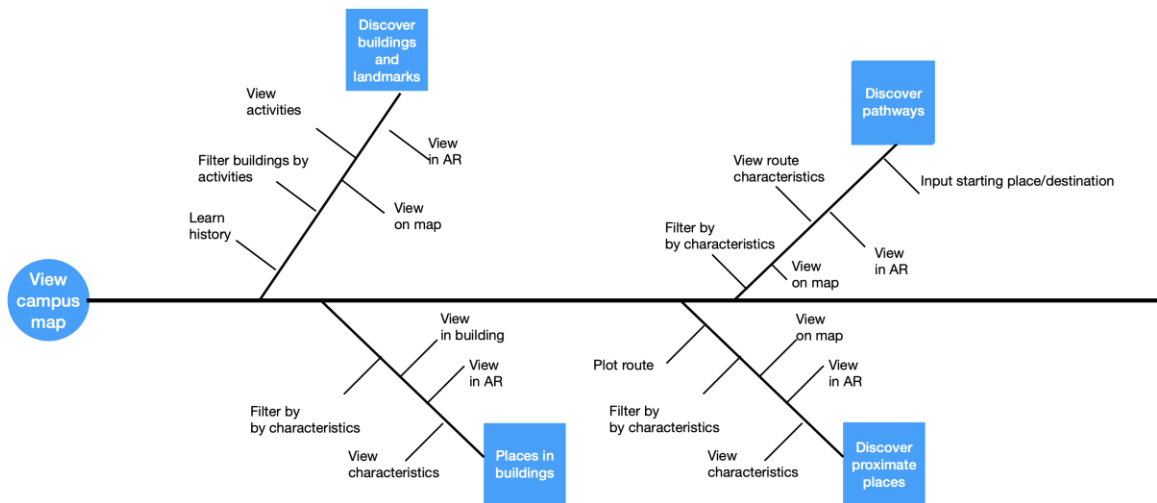*Figure 16. Feature Tree of the CSUSB AR Campus Navigation App*

Success Criteria

The assessment criteria could include:

1. User engagement: number of students engaging with the application within a month; average time/user/day spent on the application

2. Qualitative user feedback regarding user experience with the app

3. Number of app downloads

4. Survey with users regarding the impact of the app

CHAPTER SIX:

DISCUSSION, LIMITATIONS, AND CONCLUSION

My findings illustrate the subtle and complex processes involved in the social construction of place which involve not only developing connections with favorite places by qualities, affordances, and place functions, but also the careful selection of a scenic, social, or efficient route. My analysis reveals how the social construction of place through space navigation creates a sense of connection with the campus through shared commitment to community, tapping into space history through memory processes, creating opportunities for people- and nature-watching, and ultimately developing a sense of place ownership.

Within the framework of David Harvey's (2005) typology, I found that students work with both conceptualized and lived space. They conceptualize space by creating places and navigational pathways that fulfill different needs, whether sensory or driven by activities or by caring for the space around them. They create lived-in space by developing networks of friendships that are space-bound (e.g., particular centers) or by engaging in activities that specifically connect them with people, whether through social interaction, or people-watching.

AR media could enhance these experiences in three different ways (Lefebvre, 1991):

- **Perceived Space (Spatial Practices)**: AR directly alters our sensory perception of space by overlaying digital information onto the real world,

thereby modifying how spaces are navigated and interacted with in real-time.

- **Conceived Space (Representations of Space)**: AR can be used to conceptualize and plan spaces before they are physically altered, offering a tool for architects, planners, and developers to visualize changes and impacts.

- **Lived Space (Spaces of Representation)**: AR enhances lived experiences by blending digital and physical realms, creating immersive environments that can alter emotional and social interactions within a space.

Beyond my theoretical framework and developing the app vision, there would need to be further data analysis with the implementation team (which is yet to be determined) to determine the next steps. It will be important to address privacy concerns related to location tracking and data collection when developing the application. Scalability and long-term sustainability of the app also needs to be addressed, which would include maintenance, updates, and integration with campus infrastructure.

There are also certain challenges associated with the development of the application.

1. *Technical Challenges:* Augmented reality applications are computationally intensive due to the use of complex algorithms, which can create performance issues on devices with limited processing power (Gillis, 2022).

2. *Implementation Challenges:* Complex AR-based navigation systems can

be difficult to implement and require significant development time (Bragg, 2021).

3. *Data Security:* There are risks associated with data breaches and privacy violations when storing and processing user location data in applications (Maayan, 2023).

4. *Security Vulnerabilities:* The application can be open to malicious actors' exploitation due to security weaknesses including outdated software components or inadequate security measures (CodeSee, 2024).

5. *User Privacy Issues:* In addition to the security issues above, the dynamic mode of the application allows students to share their exact location with the app in order to discover proximate places, thus violating user privacy. Although we can limit this privacy breach by implementing this mode as an opt-in only feature, GPS location comes with specific privacy concerns, such as the ability of the school to determine whether the student is actually on campus or not. Clear rules of data access will have to be established and implemented in order for this modality to preserve student privacy. The app will further prioritize user privacy by anonymizing the gathered data and putting in place stringent access controls for all data in order to allay these concerns. However, it is crucial to understand that all AR apps collect data about a user's environment.

6. *User Experience Issues:* Inaccurate mapping data or shoddy AR feature design could irritate and dissatisfy users of the app (Gillis, 2022).

7. *Legal and Regulatory Compliance:* The application needs to be compliant with data protection laws, and it can run into litigious issues with privacy and intellectual property rights (Cuni-Mertz & Jung, 2021).

No one can guarantee a specific return on investment from the implementation of a new software application; however, it is possible to use theoretical knowledge, empirical data, and analytic reasoning to understand how a clear project scoping could benefit the xREAL team in their development process of an augmented reality campus map application (Wiegers & Beatty, 2013). I can foresee additional research with CSUSB faculty and staff enabling more input about how they would use an AR map personally, and perhaps for in-classroom learning.

To ensure that the sense of place created by the AR campus map application is accomplished without diminishing the sense of connection that students already have established with the campus, ethical considerations will be essential. First, there is something to be said about creating a technological solution to improve the navigation of the campus space that itself could be improved. For instance, the campus as a physical space should offer navigation possibilities to all people, including those with disabilities. It should not be an app's role to plot a route friendly to people with disabilities; rather, the entire campus should present routes for all people. Before investing in such an app, we would need to ensure that the physical infrastructure continues to be improved and updated. For instance, it should not be the case that buildings are left without

working elevators so students have to take the stairs to leave the elevator for those who need it the most, as I found from my campus diaries. My disabled sister, whom I mentioned earlier, would have needed a working elevator; she would have trouble visiting the campus today as a retired alumna! No amount of "technological solutionism" (Morozov 2013) can cure campus neglect.

Second, many accessibility concerns apply to the app itself. Immersive media are visual-centric and take it for granted that they are for the sighted. However, there are many students that are visually impared or do not have the required mobility to manipulate certain AR functions. For that reason, the app will have to implement accessibility standards and alternative means of providing services, such as audio or haptic guidance.

Third, I observed how students create a connection to the campus by invoking the lived memory of the place. This form of connection evokes an indigenous, non-Western ethos of establishing social connections within and through the environment. Indeed, such scholars remind us that "social connection is mediated through a shared commitment to the environment, questioning whether social connection is even possible without a material connection to land" (Lechuga et al., 2023). It is important to remember that the campus was built in 1965 and sits on the territory and ancestral land of the San Manuel Band of Mission Indians (Yuhaaviatam). If students connect to history by observing the visible change in landmarks and buildings, it would be important to consider how a larger span of history, reconnecting students to the land on which the university sits, could be

incorporated into this application.

Fourth, in my research I discovered that some students value seclusion and prefer quiet places without many people. However, this app, if successful, will increase traffic in those places, leading to results that are opposite to those intended for those students. More advanced versions of the app might want to incorporate additional information about traffic to locations at particular times of the day or to signal to students that those spaces are designed to encourage retreat and seclusion and, therefore, some norms of the place need to be respected. A second concern is how such a map could be manipulated to direct traffic to particular places. For instance, I can imagine how various event organizers might want to broadcast their events through the app and show students how to get there, thus ensuring that students can find those locations. However, this scenario raises the question of who gets access to the map and who doesn't and what the rules are for granting access to the app. Relatedly, it should be noted that the students who use the app are, in a sense, a "captive audience" that becomes particularly vulnerable to ads or various "nudges" that prompt students to visit a certain location. Before deploying the app, the campus will need to agree on ethical ground rules of what the university can and cannot do with the app.

Additionally, this study does not delve into the broader societal implications of AR technology, such as its potential to impact personal privacy in various contexts beyond the campus environment. Future research should explore these dimensions comprehensively, considering the ethical and privacy

aspects of AR applications in diverse settings.

Looking back at Lefebvre's key ideas shared in *The Production of Space,* we have learned that people create social space in every physical space they live in, which lends itself perfectly to the idea that students can create their own sense of place on campus. And my research demonstrates that this is definitely the case. My hope is that students will have an even greater sense of place on every college campus in the future.

APPENDIX 1:

CURATED CAMPUS WALK PROTOCOL

APPENDIX 1: Curated Campus Walk Protocol

Instructions for the curated campus walks

1.   Think about what you feel are your top two favorite places on campus for study and social interaction. Consider why those are your favorite places and how you reach them on campus.

2.   For each favorite place, do the following: Starting from where you parked and taking the route you usually take to get to your favorite place, walk there. Use the video recording function of your mobile phone to record your path and a running commentary of why you chose that place: what makes it a favorite place on campus, why is it attractive for you, why you chose that particular path to reach it, and what attracts your attention as you are walking there. Keep the recording going until you reach your destination.

3.   Upload your recording to my Google Drive (link to come).

4.   Record your walk to your two favorite places on two different days.

APPENDIX 2:

CODEBOOK

APPENDIX 2: Codebook

Code System

1 CHOICE EXTERNALITIES
1.1 TIME
1.2 WEATHER
2 CHOICE PATTERNS
2.1 PROXIMITY
2.2 IN-BETWEENNESS
2.3 HABITUAL ACTION
3 QUALITIES OF THE ROUTE
3.1 SOCIAL INTERACTION ROUTE
3.2 SCENIC ROUTE
3.3 EFFICIENT ROUTE
4 CAMPUS CONNECTION
4.1 COMMUNITY
4.2 NEWNESS
4.3 OWNERSHIP
4.4 MEMORY
4.5 PEOPLE WATCHING
4.6 CENTER
4.7 NATURE WATCHING
4.8 CARE FOR THE ROUTE
5 REASONS TO FAVOR A PLACE
5.1 HYBRID PLACE
5.2 PLACE ATTRIBUTES
5.2.1 PLACE AFFORDANCE
5.2.2 QUALITIES OF THE PLACE
5.3 FUNCTION
5.3.1 MIX OF PEOPLE
5.3.2 NUMBER OF PEOPLE
5.3.3 SECLUSION
5.3.4 SOCIAL INTERACTION
5.3.5 EMOTIONAL IMPACT
5.3.6 FIT WITH ACTION

1 CHOICE EXTERNALITIES

Parent code - External factors affecting choices

1.1 CHOICE EXTERNALITIES >> TIME

Participants identify a time when they go to "their" place. The time of day seems to make the place "theirs"

1.2 CHOICE EXTERNALITIES >> WEATHER

How weather impacts the choice of route or place (something that plays into the decision of where to go or which route to take)

2 CHOICE PATTERNS

Parent code – general rules for choosing a place

2.1 CHOICE PATTERNS >> PROXIMITY

Place is close to something else

2.2 CHOICE PATTERNS >> IN-BETWEENNESS

Place is easily available in-between activities

2.3 CHOICE PATTERNS >> HABITUAL ACTION

activities that a student does repeatedly

3 QUALITIES OF THE ROUTE

Parent code – what qualities the route has

3.1 QUALITIES OF THE ROUTE >> SOCIAL INTERACTION ROUTE

A route that connect the student with other people

3.2 QUALITIES OF THE ROUTE >> SCENIC ROUTE

The route is "scenic" (it connects the student with nature)

3.3 QUALITIES OF THE ROUTE >> EFFICIENT ROUTE

The route is the fastest between two points

4 CAMPUS CONNECTION

Parent code – ways to form connection

4.1 CAMPUS CONNECTION >> COMMUNITY

When the student indicates a sense of community that happens in their favorite place

4.2 CAMPUS CONNECTION >> NEWNESS

Observing what is new on campus (whether buildings or "things" like the CSUSB sign)

4.3 CAMPUS CONNECTION >> OWNERSHIP

when a student references a place as "mine"

4.4 CAMPUS CONNECTION >> MEMORY

Observations about what used to be in a particular spot

4.5 CAMPUS CONNECTION >> PEOPLE WATCHING

When the participant references what the people around them are doing

4.6 CAMPUS CONNECTION >> CENTER

When students identify a center they are attached to

4.7 CAMPUS CONNECTION >> NATURE WATCHING

The student mentions the beauty of "nature"

4.8 CAMPUS CONNECTION >> CARE FOR THE ROUTE

Certain behaviors that indicate caring for the route (e.g., picking up litter)

5 REASONS TO FAVOR A PLACE

Reasons to like a place

5.1 REASONS TO FAVOR A PLACE >> HYBRID PLACE

The place fulfills different functions at the same time or at different times

5.2 REASONS TO FAVOR A PLACE >> PLACE ATTRIBUTES

Parent code - Aspects of the place

5.2.1 REASONS TO FAVOR A PLACE >> PLACE ATTRIBUTES >> PLACE AFFORDANCE

What the place offers in terms of amenities (e.g., clean bathrooms)

5.2.2 REASONS TO FAVOR A PLACE >> PLACE ATTRIBUTES >> QUALITIES OF THE PLACE

Things like comfort, color - how the place fulfills sensory needs. The qualities have to belong to the place itself, they have to belong to its "vibe" -- a code included here.

5.3 REASONS TO FAVOR A PLACE >> FUNCTION

Parent code – the purpose that the place serves

5.3.1 REASONS TO FAVOR A PLACE >> FUNCTION >> MIX OF PEOPLE

Favoring a place because of the kinds of people to be found there

5.3.2 REASONS TO FAVOR A PLACE >> FUNCTION >> NUMBER OF PEOPLE

Favoring a place because of the amount of people to be found there (e.g., lots of people, „the right number of people")

5.3.3 REASONS TO FAVOR A PLACE >> FUNCTION >> SECLUSION

a place to get away from people

5.3.4 REASONS TO FAVOR A PLACE >> FUNCTION >> SOCIAL INTERACTION

A place where the student can interact with other people

5.3.5 REASONS TO FAVOR A PLACE >> FUNCTION >> EMOTIONAL IMPACT

The place has a certain emotional impact on the student

5.3.6 REASONS TO FAVOR A PLACE >> FUNCTION >> FIT WITH ACTION

The place that fits with the action the person wants to take

5.4 REASONS TO FAVOR A PLACE >> CONTRAST

Places that are favored because they represent a contrast with other places (presumably where the student spends more time)

APPENDIX 3:

IRB APPROVAL LETTER

December 11, 2023

CSUSB INSTITUTIONAL REVIEW BOARD
Expedited Review
IRB-FY2023-367
Status: Approved

Prof. Mihaela Popescu and Linda White
CAL - Communications
California State University, San Bernardino
5500 University Parkway
San Bernardino, California 92407

Dear Prof. Mihaela Popescu and Linda White:

Your application to use human subjects, titled "Investigating the Potential of Augmented Reality in Creating a Sense of Place on College Campuses" has been reviewed and approved by the Institutional Review Board (IRB) of CSU, San Bernardino. The CSUSB IRB has weighed the risk and benefits of the study to ensure the protection of human participants. The study is approved as of December 11, 2023. The study will require an annual administrative check-in (annual report) on the current status of the study on December 11, 2024. Please use the renewal form to complete the annual report.

This approval notice does not replace any departmental or additional campus approvals which may be required including access to CSUSB campus facilities and affiliate campuses. Investigators should consider the changing COVID-19 circumstances based on current CDC, California Department of Public Health, and campus guidance and submit appropriate protocol modifications to the IRB as needed. CSUSB campus and affiliate health screenings should be completed for all campus human research related activities. Human research activities conducted at off-campus sites should follow CDC, California Department of Public Health, and local guidance. See CSUSB's COVID-19 Prevention Plan for more information regarding campus requirements.

If your study is closed to enrollment, the data has been de-identified, and you're

only analyzing the data - you may close the study by submitting the Closure Application Form through the Cayuse Human Ethics (IRB) system. The Cayuse system automatically reminders you at 90, 60, and 30 days before the study is due for renewal or submission of your annual report (administrative check-in). The modification, renewal, study closure, and unanticipated/adverse event forms are located in the Cayuse system with instructions provided on the IRB Applications, Forms, and Submission Webpage. Failure to notify the IRB of the following requirements may result in disciplinary action. Please note a lapse in your approval may result in your not being able to use the data collected during the lapse in the application's approval period.

You are required to notify the IRB of the following as mandated by the Office of Human Research Protections (OHRP) federal regulations 45 CFR 46 and CSUSB IRB policy.

- **Ensure your CITI Human Subjects Training is kept up-to-date and current throughout the study.**
- **Submit a protocol modification (change) if any changes (no matter how minor) are proposed in your study for review and approval by the IRB before being implemented in your study.**
- **Notify the IRB within 5 days of any unanticipated or adverse events are experienced by subjects during your research.**
- **Submit a study closure through the Cayuse IRB submission system once your study has ended.**

The CSUSB IRB has not evaluated your proposal for scientific merit, except to weigh the risks and benefits to the human participants in your IRB application. If you have any questions about the IRBs decision please contact Michael Gillespie, the IRB Compliance Officer. Mr. Michael Gillespie can be reached by phone at (909) 537-7588, by fax at (909) 537-7028, or by email at mgillesp@csusb.edu. Please include your application approval number IRB-FY2023-367 in all correspondence. Any complaints you receive regarding your research from participants or others should be directed to Mr. Gillespie.

Best of luck with your research.

Sincerely,
King-To Yeung
King-To Yeung, Ph.D., IRB Chair
CSUSB Institutional Review Board
KY/MG

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