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A Virtual Assistant on Campus for Blind and Low Vision Students

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"I want to make the most of my college experience...pass the courses I need to get into law school, make new friends, and travel. Maybe study abroad." These are the sentiments of one undergraduate student. These goals are not so different from those of hundreds of students attending college, yet, the mere fact she is blind creates a completely different perspective. This exploratory study seeks to learn how undergraduate students who are blind or have low vision (BLV), experience Aira, an augmented reality application, as a visual interpreter, in post-secondary settings. Semi-structured interviews illuminated three major themes: (a) accessibility impacts productivity, (b) incidental learning affects social interactions, and (c) sense of self. Theoretical conclusions are made on how Aira positively contributes to a complete college experience for students who are BLV, as outlined in the Seven Vectors of Identification Development (Chickering & Reisser, 1993).

Keywords: blind, low vision, augmented reality, post-secondary, college

The increasing diversity of students and faculty with disabilities and the ongoing evolution of disability in higher education, has brought attention to urgent policy issues at the campus, state, and federal levels. An integral step toward addressing these issues is to hear directly from minority individuals, deepening the understanding of the meanings ascribed to their own experiences. In this qualitative study, semi-structured interviews were conducted to learn how undergraduate students who are blind or low vision (BLV) experience Aira, an augmented reality application, used as a visual interpreter, in post-secondary settings (Aira, n.d.). Previously, the theory of identity

development, grounded in the psychosocial theory, has been used to frame the personal and interpersonal lives of college students from marginalized groups such as women, African Americans, nontraditional-aged students, and LGBTQ students (Chickering & Reisser, 1993). In this qualitative study, Chickering's (1969) theory was specifically selected to examine the identification development of students who are BLV, throughout their educational and social journey, to provide higher education professionals, disability support service personnel, and policy makers, important research to understand how BLV students feel about their overall education. The post-secondary experiences of BLV

students, highlighted in this study, emphasize the competence of individuals with disabilities and demonstrates how important inclusive, accessible post-secondary opportunities are for every student.

Literature Review

The following literature review describes the minimal research on augmented reality technology as support for college students with BLV, related educational rights and laws, and how Aira could positively contribute to a complete college experience for BLV students, as outlined in the Seven Vectors of Identification Development (Chickering & Reisser, 1993).

Augmented and Virtual Reality

The increasing popularity of augmented reality (AR) and virtual reality (VR) are completely reshaping the field of education, and more research is being conducted to identify the potential impacts these emerging technologies have on teaching and learning, especially for students with disabilities (Dieker & Lannan, 2018). Augmented reality and virtual reality both involve immersing a "real" person – hence the word reality – in an experience blended with technology. Augmented reality is technology designed to augment or improve real life experiences by providing enhanced access to relevant information. Eye-gaze controlled devices, internet searches based on GPS location, and barcode markers are all examples of augmented reality. VR is a highly sensory, fully interactive experience, allowing the consumer to become completely immersed in a virtual world. The Connect Project, for example, utilized a VR system to provide science instruction to students, with and without physical disabilities (Petrou, Sotiriou, Arvanitis, & Knight, 2009). By

using the Connect technology, students engaged in hands-on learning and conducted experiments otherwise not available in school. The findings showed minimal differences in the test scores of students with and without physical disabilities. Another study, conducted in 2013, with middle school students who were BLV, learned science by using a haptic device and a computer running specially designed, haptic-based applications, which allowed the students to interact with the material by touch. The results showed marked improvement on a posttest after using the AR devices (Darrah, 2013). Augmented and virtual reality are also being used to increase student social competencies. One such program is Kinful (2019), a social-emotional learning curriculum. This program creates virtual cultural exchanges designed to offer experiential opportunities and increase social emotional learning.

AR and VR for Blind or Low Vision

Researchers are making progress toward improving the accessibility of mainstream products, as well as discovering new technologies, bringing a wider array of assistive and accessible solutions to individuals with disabilities. Google Daydream is testing the use of spatial audio cues. Using a prototype of a virtual room with every object recorded and linked, a 3D audio laser pointing system is used to locate the item by sound and distance (Inclusivity of VR and AR Accessibility for the Visually and Hearing Impaired, 2018). Microsoft created the Canetroller based off the white cane, used as a mobility tool by people who are BLV, to detect objects in their environment. In a world of virtual reality, the Canetroller relies on haptic and audio feedback to simulate the world around the user in a virtual world, offering enhanced

learning opportunities and game-based applications (Inclusivity of VR and AR Accessibility for the Visually and Hearing Impaired, 2018).

Students who are BLV are able to "see" and appreciate some of the masterpieces from around the world because of the innovative collaboration team of Geometry Prague, NeuroDigital Technologies, and the Leontinka Foundation. Using virtual reality technology, Touching Masterpieces is possible by wearing a pair of NeuroDigital's haptic gloves and an HMD, allowing individuals to explore famous sculptures such as Michelangelo's David, or the bust of Nefertiti, in complete virtual reality (Inclusivity of VR and AR Accessibility for the Visually and Hearing Impaired, 2018). This use of an array of AR and VR devices is important to understand because of the great impact and potential for the future of people who are BLV as they adopt technologies to better learn and navigate their world.

Postsecondary Education and Students with Disabilities

The number of students with disabilities pursuing a post-secondary education is rising (Wagner, Newman, Cameto, & Levine, 2005). Approximately one in 10 students enrolled in four-year institutions have a disability (Horn, Nevill, & Griffith, 2006; Newman, Wagner, Cameto, & Knokey, 2009). Sadly, the establishment of federal legislation concerning the rights to equitable educational opportunities has not changed the fact that many colleges and universities are not always prepared to provide the support or services students with disabilities need. The graduation rate for students with disabilities is only about 34% compared to 51% of students without disabilities (Newman et al., 2011),

confirming the need to improve services at the college level.

Researchers attribute several factors to the disappointing, aforementioned statistics. Based on the survey of grade level state assessment tests from the National Center for Educational Outcomes (University of Texas Permian Basin, 2017), the achievement gap in special education, in reading and math specifically, remained between 32% to 41%. These figures confirmed the insufficient academic preparation noted by Test et al. (2009), and the deficits in reading/writing, listening comprehension, and organization, evidenced by Reaser, Prevatt, Petscher, and Proctor (2007). Further, difficulty managing the demands of higher education, (Hong, Ivy, Gonzalez, & Ehrensberger, 2007) with substandard self-advocacy skills (Brinckerhoff, McGuire, & Shaw, 2002) also have affected post-secondary achievement. The challenges, however, go far beyond students' acquisition of skill sets. The negative attitudes towards people with disabilities perpetuate the false inadequacies of blind or low vision students. At the organizational level, a shortage of environmental, financial, psychological, and social support systems (Seidman, 2006), as well as insufficient programming and services (Tagayuna, Stodden, Chang, Zeleznik, & Whelley, 2005), means self-determination and self-advocacy skills have become even more critical.

In 2015, the Current Population Survey (CPS), conducted by the U.S. Census Bureau for the Bureau of Labor Statistics (BLS), surveyed approximately 165.5 million U.S. citizens between the ages of 25-64 in regard to the highest level of educational attainment achieved, of which approximately 8.7% were identified as

having a disability (Bureau of Labor Statistics, n.d.). According to this survey, roughly 19.3% of individuals with disabilities participated in some level of college below earning an associate degree, 9.9% earned an associate degree, and 10.5% earned a bachelor's degree. The 2018 version of the BLS recently released information from the 2017 CPS that reported both educational attainment and employment-population ratios among individuals with and without disabilities. Of the 255 million individuals represented, approximately 11.9% were identified as having a disability. Of this smaller population, the highest educational attainment levels achieved were reported as follows: 34.1% completed high school, 25.3% participated in some level of college or attained an associate's degree, and 17.7% earned a bachelor's degree or higher. Employment rates corresponding to each of the attainment levels in 2017 were 15.2%, 22.1%, and 27.6%, respectively (Bureau of Labor Statistics, n.d.).

These data trends show the important financial effect a college degree can have on a person's future earnings. In 2016, the number of individuals with a visual disability (non-institutionalized), between the ages 21-64 years, in the United States who were employed full-time/full-year was 1,120,700 or 29.5% (National Federation of the Blind, 2019). In other words, of working age adults who reported significant vision loss, over 70% are not employed full-time. One way to ensure greater college access and employability of people who are BLV is potentially through the use of AR and VR. This paper focuses on one of these futuristic tools, Aira, by first summarizing a previous study. Current qualitative research is then presented on how Aira has impacted college life for seven blind or low vision undergraduates, concluding with an

interpretative phenomenological analysis (IPA) of their experiences.

Aira, An Augmented College Experience

Aira is an innovative service provided to people who are BLV, giving them access to experiences that are readily available to the sighted. Leveraging AR technology, Aira embedded a tiny camera in smart glasses that streams video to a dashboard incorporated with GPS, Google Maps, and services such as Uber (Aira, n.d.). Professional agents employed by Aira see the world from the wearer's vantage point, allowing for narrated navigation, text description, and more. Aira is a subscription-based service, but several colleges and universities have already established campus-wide networks, giving BLV students the autonomy to decide what, how, and where they need instant access to visual information.

To gain a better understanding of what effect Aira has on the quality of life for students who are BLV, an exploratory study was conducted. A total of 69 participants were interviewed before and after a three-month period experiencing Aira. The 28-item Impact of Vision Impairment-Very Low Vision Questionnaire, a previously validated survey for vision-related quality of life specifically for low vision individuals, was used (Nguyen et al., 2018). The results indicate Aira improves the quality of life for BLV individuals, by subscores in activities of daily living and emotional wellbeing, as well as a significant improvement in the total overall scores.

The research using augmented reality as assistive technology continues to advance, showing substantial potential for improved accessibility for individuals with disabilities; however, limited research has been conducted on the effectiveness. Therefore, further investigations involving

larger samples are needed to evaluate the associated benefits and risks.

Purpose of the Study

Attending a post-secondary program is more than a rite of passage. Throughout college, students experience individual growth in all areas, including intellectual, social, and emotional development. Based on the literature, adequate development begins much earlier and is contingent on multiple factors, starting with self-determination, defined as:

a combination of skills, knowledge, and beliefs that enable a person to engage in goal-directed, self-regulated, autonomous behavior. An understanding of one's strengths and limitations, together with a belief of oneself as capable and effective are essential to self-determination. When acting on the basis of these skills and attitudes, individuals have greater ability to take control of their lives and assume the role of successful adults in our society. (Wehmeyer & Schwartz, 1998, p. 2)

The Americans with Disabilities Act of 1990 and the Rehabilitation Act of 1973 proclaim equal rights and access for individuals with disabilities. If students have strong, self-determination skills, as well as a clear understanding of their disability and the accommodations they need when transitioning to college, they are more likely to have positive results (Test, Aspel, & Everson, 2006; Wehmeyer & Palmer, 2003). Specific self-advocacy skills, such as disclosing one's disability and persistently requesting accommodations, have been found to improve student success in higher education (Barnard-Brak, Lechtenberger, & Lan, 2010; Hurst & Smerdon, 2000). Utilizing tutoring labs and disability services, forming relationships

with instructors, and having a support system on campus are also important (Adams & Proctor, 2010; Getzel & Thoma, 2008).

Unfortunately, the data reflected in the literature confirms, having legal rights and the ability to advocate is not enough to ensure all students have the support needed to maximize their potential. Traditional resources do not provide real-time access to academic, social, and personal situations. Alternative assistive and general technologies are simple, but often overlooked as vital tools for empowering students with disabilities to succeed (Fichten, Nguyen, Barile, & Asuncion, 2007). Thus, the present study sought to investigate the experiences of blind and visually impaired undergraduate students, using Aira on a post-secondary campus, with the purpose of increasing awareness of the educational and social barriers faced by BLV students.

Method

This study was conducted using an IPA framework, developed and described by Smith et al. (1999). IPA is theoretically rooted in critical realism (Bhaskar, 2008) and the social cognition paradigm (Fiske & Taylor, 1991). An analysis of interview data is considered to be an acceptable method of understanding meanings individuals attach to personal experiences, representing how each perceives reality. Specifically, the ideographic case-study approach was chosen to closely examine the phenomenon of post-secondary students who are blind or have low vision, and the impact of AR as a virtual assistant. The IPA methodological approach allows for flexibility in the process, providing opportunity to examine the phenomenon through the lens of the researcher as a blind Ph.D. student, while holding to rigorous

procedures. Additionally, IPA promotes exploration of themes across cases with the purpose of developing a theory verses sharing in-depth descriptions (Smith, Jarman, & Osborn, 1999).

Participants

To solicit a potential pool of participants, recruitment was done through convenience, purposeful sampling, and personal connections at conventions for the blind, on listservs, and through social media. A total of 14 students responded to the initial request. A short survey was conducted to gather demographic data and confirm inclusionary criteria: participant

identifies as blind or having low vision, current fulltime student at a post-secondary institute, and use Aira three or more times per week. The survey results eliminated three students, and one opted out due to scheduling conflicts, resulting in a total of nine participants, (six females, three males) attending college in four different states. This study specifically focuses on the individual experiences of the seven undergraduate students, as shown in Table 1, with inquiry into the connection to the Seven Vectors of Identification Development (Chickering & Reisser, 1993).

Table 1

Participants' Demographic Characteristics

<i>Participant*</i>	<i>Gender</i>	<i>State</i>	<i>Disability Type</i>	<i>Self-Described Level of Vision</i>
<i>Briana</i>	Female	TX	Junior	Blind
<i>James</i>	Male	FL	Freshman	Low Vision
<i>Maggie</i>	Female	NY	Freshman	Low Vision/light and shadows
<i>Rachel</i>	Female	FL	Freshman	Low Vision
<i>Richard</i>	Male	CA	Junior	Blind
<i>Rob</i>	Male	TX	Sophomore	Blind
<i>Shanda</i>	Female	FL	Senior	Blind

*Participant names pseudonyms

Procedures

Semi-structured interviews, lasting approximately one hour, were conducted via telephone to compensate for the long distances between the researcher and participants. Interviewee rights and purpose of the study were clarified at the start of each call, followed by a short conversation to establish rapport. Although

each interview began with the same open-ended question, "Please tell me how you experience Aira in your everyday life?" further discussion was participant guided to allow students to share their stories in their own words. If needed, the interviewer asked additional questions for clarification and elaboration.

The IPA process includes the researcher as an integral component of the process. Viewing their own experiences offers greater understanding, allowing the researcher to provide more in-depth descriptions. As a method of documenting personal experiences, the researcher kept a journal throughout the study, while also using the journal as a method of reflection to ensure participant experiences, emotions, and opinions remained separate from the researcher's (Wall, Glenn, Mitchinson, & Poole, 2004). Smith et al. (2009) identified previous researcher experience as a part of the interpretative analysis, thus considered in the overall findings.

Each of the interviews were audio-recorded and transcribed, while keeping any identifying information confidential. The analysis followed a concurrent process with periodic review and continual reflection (Smith et al., 1999; Creswell, 2003). The transcripts were read multiple times to gain complete understanding of the data. With increased familiarity, meaning units ("significant statements") or quotes began to provide insight into real participant experiences, as well as allowing for comparisons between different texts (Strauss & Corbin, 1998). The readings revealed significant words and phrases, which were identified and highlighted through "line-by-line" coding (Charmaz, 2006). Each of the meaning units merged into core themes, creating a broader picture, fully encompassing the phenomenon.

Findings

Although seven distinct vectors of Identification Development have been theorized, every student experiences each phase in a different sequence, rate, or intensity than others. More importantly,

the measurement of one's identification development can only be determined by the individuals themselves. The seven vectors are: (a) developing competence, (b) managing emotions, (c) moving through autonomy toward interdependence, (d) developing mature interpersonal relationships, (e) establishing identity, (f) developing purpose, and (g) developing integrity.

Like any student, the opportunities, experiences, and challenges, encountered by students with disabilities are as unique as the individuals themselves. The postulates that humans are unique beings is not new. Yet, the differences frequently shared about individuals with disabilities are based on the generalizations of the disability, not despite the disability. The personal experiences of each student factor into their own Identification Development. The importance of providing every student, regardless of diversity, adequate opportunities to grow within each phase of Identity Development cannot be overstated.

The theme, accessibility impacts productivity, generated comments from all seven participants. Within this theme, two categories emerged: limited availability to assistive technology/accessible course material, and difficulty maintaining productivity and pace. The frustration was clear. Obtaining accessible material from professors in real-time, receiving braille material in a timely manner, and trouble keeping pace due to delayed material was definitely noticed. Below are comments that support this theme.

Maggie: "I rely on Aira to help with the accessibility of documents. My professors tend to send me PDFs, which you probably already know, aren't really accessible. At the beginning of the year,

I had to jump through so many hoops to figure it out.”

Interviewer: “What do you mean by “hoops”?”

Maggie: “To connect with Aira, we use this program called TeamViewer. The problem was that the school's Wi-Fi wouldn't allow me to download the program. So, I had to wait until I got home over a long weekend to download it. Now that I have the program, I can connect to Aira, and they can help me to convert the document. It kinda put me behind though.”

Within vector one, developing competence, student growth is in three areas: intellectual, manual skills, and interpersonal. When accessibility is compromised, students must work even harder to develop intellectual competence. Self-advocacy becomes critical, and certainly puts the process of developing interpersonal competence to the test.

Shanda: “Sometimes, I feel like I spend more time talking about accessible files, braille, or technology than I do my actual courses. I've gotten used to it, but after you've been at the same school for a while, you'd think the process might actually improve.”

Navigating the demands and schedule of college life for the first time can be daunting, and not having the material needed, frustrating. Briana shared, “for the most part, I prefer to use my computer, but math...that's where I depend on braille.”

Building student-professor relationships is an important element of higher education. The second vector, managing emotions, focuses on identifying, understanding, and exerting control over feelings and

emotions. Students must strike a balance between positive and negative emotions. I could hear Maggie's struggle: “Speaking up for what I need has been a challenge. I don't get upset easily, but, (emphasized) when I do, it's not pretty.” Richard, a junior who is majoring in chemistry, says, “Technology should be the one area we get right, but I'm still dragging my laptop around...to the lab, library, class. Even then, my professors still ended up asking me to work with a partner.”

Whether it was Briana's need to access her online course, or James wanting to sign into the gym, accessibility issues were the number one concern. Having Aira, though, has helped to mitigate the problems.

Rob: “Instead of trying to copy all of the notes during the lecture, I take a picture with my iPad, then I have an Aira agent help me get them into a better format.”

Rachel: “Sharing my computer with an agent is great! Looking at the photos for my history class is kind of fun. (Laughs) Sometimes, I have more to say about the photos than some of the sighted students in my class.”

For each student, although attending different schools, accessibility was a major concern. Accessibility isn't just about having “access.” If an accommodation is provided, but not the training or support to use it in a productive manner, then accessibility hasn't truly been provided. One student reflects, “There's an embosser in the office, but no-one there really knows how to use it.”

Students need access to the same resources available to all students. “I went to the math lab for help. There's JAWS in there (screen reader for the blind), but I need someone who knows how to use it

with the programs to do math. This is something you don't really know before you come to college. You have to learn a whole new set of programs on top of everything else."

Rachel: "On more than one occasion, I've had to explain to my professors about the testing process, and what they actually need to do. Sometimes, I'm not even sure it's worth all the trouble...I wear glasses, so they don't really get the whole blind thing. They think, wearing glasses means I just have some trouble seeing."

Maggie: "We get a lot of hand-outs. It's like he just forgets, you know? I've thrown away so much paper! (Laughs) We do a lot in groups and such. Having Aira helps me do more in real-time. I can read something passed out in class and discuss it with my group. I'm able to make comments and contributions without inconveniencing anyone."

Another major theme was related to how incidental learning effects social interactions. Spending time with roommates, friends, and in clubs was something all of the participants expressed interest in doing. They also shared how challenging it can be as well. "When I first came to school, I really didn't know anyone. They were all just talking and hanging out. It was sorta awkward." College is a time when students develop mature interpersonal relationships. For many, social interactions are largely influenced by nonverbal interactions. This is another area Aira can provide help.

James: "We all went out one night, and I decided to bring Aira along. The agent gave me some "great" descriptions! (inflection in his voice) I was able to tell if someone was

talking to me or not. In a crowd, that can be tricky sometimes."

Getting around a large campus, finding classes for the first time, as well as traveling around an unfamiliar city are concerns of many college students. For students who are blind or low vision, orientation and mobility (O & M) is absolutely essential. However, this is not typically a support that is provided by colleges or universities. "Usually, the staff from disability services will show me where my classes are. Other than that, I'm on my own." Another participant said, "When I ask for O & M, I was told that they do not provide personal assistants." Most participants stated, limited O & M services were available through vocational rehabilitation.

Another vector of identification development is moving through autonomy toward interdependence. Learning to navigate independently provides a sense of control. No-one wants to depend on others for everything. One participant stated, "I don't want friends who think they need to take care of me." Having opportunities to make independent choices is empowering.

Shanda: "Getting to places like Starbucks and ordering my own latte before meeting friends is such a great feeling of independence. I don't feel bad about asking the Aira agent to read the menu. If it were my friends, I would either ask the person at the counter, or just get something I already know I like."

James: "Even watching football is more fun because when I use Aira, I know what's happening as it's actually going on...I don't have to worry about getting around, now I just have to decide if I'm going or not."

The theme of sense of self closely aligns with the last three vectors of development: establishing identity, developing purpose, and developing integrity. A participant mentioned, "Ultimately, I want to get into law school." For many students, college is the bridge to a meaningful career and financial freedom, and a participant added, "There's a lot of misconceptions of what it means to be blind." Blind and low vision students want to be seen as the individuals they are, musician, video gamer, runner, and want to be viewed as independent and capable by both professors and peers.

Rob: "The ability to call Aira to get the information I need when I need it, means my work isn't dependent on someone else's schedule."

Richard: "Whether I'm doing my homework, traveling around campus, or hanging out with my roommate, I want them to just see me, you know, not as the guy who can't see, but the guy who plays the guitar and likes to surf. Aira helps me do things so I don't have to ask someone else...that's important."

Students need the autonomy to make decisions and follow through independently. "One of the best parts of college is having opportunities to make my own decisions." Problem solving, and decision making enable students to assume greater responsibility and control. Moreover, when students with disabilities show they can make things happen and manage their own responsibilities, the perceptions of others change, and expectations are raised. People with disabilities have emphasized that having control over their lives, instead of having someone else make decisions for and about them, is important to their self-esteem and self-worth (Ward, 1996).

Limitations

By conducting phone interviews, rather than face-to-face meetings, personal connections were limited. Additionally, member checking was not employed as a method for increasing trustworthiness of the interpretations (Creswell & Miller, 2000). However, using an open-ended and flexible format allowed participants' stories to be told naturally. Multiple interviews were conducted, and participant comments were compared within the context of the others to understand how participants "make meaning" of their experiences (Seidman, 2006). Finally, all participants came from 4-year schools. Therefore, further research is needed to gain better understanding of how Aira is experienced in different types of school settings and to determine if the experiences found in this small sample of seven students exists in a larger group or a different group of students.

Conclusion

Chickering's (1969) theory of identity development, grounded in the psychosocial theory, is often used to examine the personal and interpersonal lives of college students. Other researchers have used this theory to also understand the experiences of college students from other groups such as women, African Americans, LGBTQ, and nontraditional-aged students (Chickering & Reisser, 1993). Hearing the thoughts and feelings experienced by blind or low vision students, directly from them, can increase understanding of the meaning they ascribe to their experiences. The awareness of the educational and social barriers faced by BLV students, in post-secondary settings, provides higher education professionals, disability support service personnel, and policy makers, important research to

explore how BLV students feel about their overall education.

With increasing diversity of students with disabilities and faculty members and the ongoing evolution of disability in higher education, urgent policy issues at the campus, state, and federal levels need to be developed and addressed. The top concerns indicated by this study are closely related to funding and budgeting. The consistency or standardization of disability services, including personnel training, and

increasing the inclusion of people with disabilities in future research initiatives is critical to student's success. Application of Chickering's (1969) theory to future studies will potentially clarify which inclusion strategies are most effective for the BLV population. These efforts will foster a deeper understanding, showing the competence of individuals with disabilities, helping educational professionals to develop inclusive, accessible post-secondary opportunities for all.

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