

# DEVELOPMENT OF AN IOS APP USING SITUATED LEARNING, COMMUNITIES OF PRACTICE, AND AUGMENTED REALITY FOR AUTISM SPECTRUM DISORDER

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## ABSTRACT

This paper presents the development process and framework used to construct a transportation app that uses situated learning, augmented reality, and communities of practice. Autism spectrum disorder (ASD) is a neurodevelopmental disorder that can cause social impairments as well as the limit the potential for the individual to achieve independence (American Psychiatric Association [APA], 2013). The use of technology to support learning in individuals with ASD has been well documented, however gaps exist in the pedagogical approaches that are being used. Future research opportunities into the pedagogical implications of this app are highlighted.

## KEYWORDS

Situated learning, communities of practice, augmented reality, authentic learning, autism spectrum disorder, intrinsic learning

## 1. INTRODUCTION

The use of technology is well documented for the enhancement of learning, with countless pieces of software, apps, devices, and tools available to help educate individuals. Recently there has been an increase in the number of tools developed for individuals with special needs as more and more iPads, iPods, and similar devices are making their way into the classroom. Many of these apps were developed for individuals with autism spectrum disorder as tools to increase communication or comprehension abilities, however the majority of these tools are developed for use within the K-12 system. Unfortunately, there appears to be a lack of tools developed for adults with autism spectrum disorder (ASD), creating a gap in resource availability. Additionally, tools that have been developed often use behaviourism as their primary approach to learning, which can lead to a stimulus response pattern, as opposed to the creation of new understandings (von Glasersfeld, 1989a).

This paper focuses on the development of an iOS transportation app that makes use of situated learning, augmented reality, and communities of practice. The app was developed and designed for high-functioning young adults and adults with autism spectrum disorder. The development of this app stems from a gap in available tools that facilitate authentic learning in individuals with autism spectrum disorder. The iOS application is currently being tested before use in a research setting; therefore this paper focuses on the development process of said application. The research question propelling this study is whether an app that makes use of situated learning, augmented reality, and communities of practice will increase intrinsic learning in high-functioning individuals with autism spectrum disorder.

## 2. CONTEXTUAL INFORMATION

### 2.1 Autism Spectrum Disorder

Autism spectrum disorder is a neurodevelopmental disorder that is typically manifested in childhood, and is sustained throughout the individual's life (American Psychiatric Association [APA], 2013). Individuals with autism spectrum disorder have persistent social impairments, including social-emotional reciprocity, non-verbal communication, developing and maintaining relationships (APA, 2013). These individuals may also have restricted and repetitive patterns of behavior, including motor stereotypes, strict following of routines, and resistance to change (APA, 2013). Autism is a spectrum disorder; some individuals may have extreme social impairments while others may have mild social impairments (APA, 2013). Individuals can also range from having no/mild to severe intellectual impairments (APA, 2013). Because of the range of intellect within the population, the design of this app and related study focuses on individuals who are high-functioning, those who have the ability to take transit on a semi-dependent or independent basis as well as those who are have technical competencies to use an iOS device. Individuals with ASD often have low adaptive skills, making planning and organizing very difficult (APA, 2013). This, paired with a low tolerance for change, as well as a high prevalence for anxiety and depression in the young adult and adult populations, makes it difficult for adults with ASD to achieve independence (APA, 2013).

One such area in which individuals may experience difficulties is using public transportation. Individuals with ASD who rely on transit, such as buses, streetcars, subways, and trains, may find navigating transit schedules particularly stressful or challenging. These individuals may employ the transit system to attend appointments, community functions, school, or work. As a consequence, they may have to rely on Community Support Workers, caregivers, guardians, or parents, which, in turn, impedes their sense of independence. This app has been developed to provide information to these individuals in a situated learning environment.

### 2.2 Situated Learning

Situated learning is used to form the framework for the design of the app; situated learning approaches learning as the construction of knowledge by the learner, rather than the transfer of information from one individual to another (Wehlage, Newmann, & Secada, 1996; von Glasersfeld, 1989b). Additionally, this knowledge is acquired actively by the learner and is gathered through their experiences within their authentic environment (von Glasersfeld, 1989b). When learners have an active role in their education, when they are responsible for what they learn, they are able to maintain a sense of ownership and control of their education (von Glasersfeld, 1989a). To achieve an authentic environment where learning can occur, it must be situated within a highly contextualized setting (Brown, Collins, & Duguid, 1989). The nature of these environments fosters learning as individuals are practicing in authentic situations with their own peculiar cultural practices (Brown, et al., 1989). By engaging in this highly contextualized and authentic environment, learners are able to transfer knowledge to new situations and settings (Brown, et al., 1989).

This pedagogical approach was a foundational component of the framework that supports the design of the app. The app is intended to be used by the individual out in the field as opposed to a laboratory or classroom setting. This, according to Brown, et al. (1989), is to ensure that the individual is immersed within the same contextualized setting that they will be experiencing, thus promoting transfer of learning (Lave, 1991). Learning within the same environment within which the app was intended to be used will be beneficial to individuals with ASD, increasing their potential to navigate transit systems independently.

### 2.3 Augmented Reality

In addition to providing an environment that is situated, the app needs to provide supports to the user in terms of navigation, location, and transit information. To do so, the app was built using augmented reality as a means of providing those supports. Augmented reality (AR) is defined as an environment that combines real and virtual information, is interactive in real time, and is registered in 3D (Azuma, 1997; Feiner, MacIntyre, & Seligmann, 1993). The use of AR supplements reality with information or tools that would not be available

in the physical environment (Azuma, 1997). Additionally, compared with virtual reality where users are immersed in a virtual world, AR allows the user to be present in the physical world (Azuma, 1997). Common examples of AR tools are Head Mounted Displays, such as Google Glass, Head Up Displays, which can be seen in military aircrafts and some automobiles, AR Apps and Games, which superimpose characters, graphics, text, or audio, into the physical world. Educational applications of AR can range from manipulating 3D geometrical objects (Kauffmann & Schmalstieg, 2003) to providing virtual models of objects (Azuma, 1997).

In this case, AR is used to supplement the environment by providing visual tools as well as auditory information to the user. This app makes use of this by providing turn-by-turn navigation to the user, GPS information, as well as auditory warnings for upcoming transit stops. Through the development process, the app went through a number of changes that reduced the amount of augmented reality that could be used within the app. This is discussed with more details in section three. The most recent model of the app contains auditory augmentation, providing the user with real-time transit information, as well as visual augmentation, in the form of visual cues.

## 2.4 Community of Practice

As previously discussed, individuals with ASD may have social and communication impairments, which can interfere with their ability to build and maintain relationships, as well as learn from peers (APA, 2013). As adults these individuals may also have poor psychosocial functions, including independent living and gainful employment (APA, 2013). This substantiates the need for peer interaction support, as well as in the community at large, as individuals with ASD often rely on caregivers and guardians for participation in these social interactions. This app is designed to facilitate legitimate peripheral participation, as discussed by Lave and Wenger (1991). During this process, an individual becomes a part of the community of practice by participating in ongoing activities, making use of scaffolds, and will eventually be able to help others, transforming from a 'newcomer' to an 'old-timer' (Lave, 1991; Lave & Wegner, 1991).

The app provides transitioning supports to the individual, as would an 'old-timer' within the community of practice. Lave and Wegner (1991) describe a community of practice as a domain where individuals share knowledge through active participation in the cultural practice. Due to the social impairments that individuals with ASD face, this app is designed to support these individuals to actively participate within the greater community.

## 3. APP DEVELOPMENT

The Transit App was built in conjunction with the Faculty of Education and the Faculty of Business and IT at the University of Ontario Institute of Technology. The app design was developed by a graduate student as a part of an ongoing thesis research project and was programed by three undergraduate students. Currently, the app is still in development, as it still needs to be tested before using it for the research project. The app has gone through many revisions over the development process, however the main purpose of the app is to provide supports to an individual with ASD as they navigate the Toronto Transit Commission (TTC), which is comprised of subways, light rail transit lines, streetcars, and buses. The basic structure of the app is to provide the user with transit schedule information, turn-by-turn navigation, as well as audio and visual indicators that inform the user that they are approaching the desired stop. To use the app, users will either type in their starting destination or use the current location as determined by their GPS signal. Following this they will enter the desired location, or search through previously selected destinations in the app's history. The app will then show a map of their desired path and when users select the 'Go' button, see Figure 1, the app will provide directions for the user. As seen in Figure 1, the directions provided indicate the time, location, route for the selected trip. These directions will update as the user arrives at each point, as well as make changes as necessary. These features were included to provide navigation support to increase the user's autonomy, transfer of knowledge, and participation within their community.

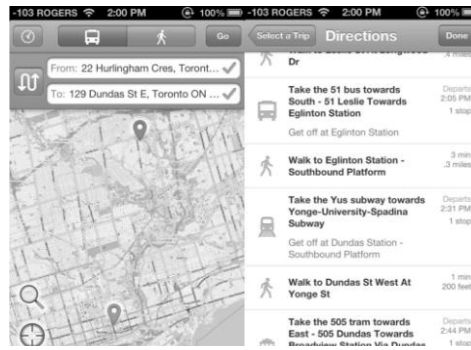


Figure 1. Screenshots of Transit App

Through the design process, a number of changes to the app had been made. Originally, it was desired that the app could provide opportunities for users to make amendments to the route, for example the user could tag a specific bus stop as always running late, or that the route typically has a nice driver. This was thought to enhance the community of practice by increasing participation of the user. However, this was not added due to server constraints. Additionally, original designs of the app had a timer that would indicate when the transit vehicle was set to arrive, however this would not be accurate due to a lack of GPS location of the specific vehicle. Although turn-by-turn navigation is still present in the current model of the app, it was originally planned to use the camera feature of the device to overlay these directions onto the physical world as depicted on the device's screen. This feature was not included due to developer limitations. There had been a number of issues during the design process, including the availability of the programmers due to their status of full-time students. Server problems and computer malfunctions also caused a number of delays.

#### 4. CONCLUSION

The aim of this paper is to highlight the design and development of an augmented reality app that uses situated learning and communities of practice to promote authentic learning in young adults and adults with autism spectrum disorder. This app promotes learning as knowledge construction through a social constructivist perspective (von Glasersfeld, 1989a). The design and pedagogy of this app provide practical applications that extend to other developmental and intellectual disorders, which provide future areas of research. The research applications of this app will be tested through an ethnographic study with the participation of young adults and adults with autism spectrum disorder as they navigate between locations using TTC and navigation directions provided by the app.

Currently, the app is still in the developmental stages with testing still occurring. The process of designing and developing an app has proven to be a longer experience for all students involved than initially thought with many changes and revisions occurring based on technological complications. However, this process has provided countless learning opportunities for these students, providing a large area for growth and development.

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