Autism XR: Web-based Augmented Reality Intervention for High School Students with Autism to Improve Social Communication Skills

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ABSTRACT

Autism XR is a collaborative project that utilizes web-based augmented reality interactive content to help teach students with autism how to improve social communication and behavior. The functional web application was created to assess the effectiveness of teaching greeting skills through mobile devices to 4 high school general education students with autism attending vocational programs. The treatment package included a training component with the Android mobile device combined with generalized reinforcers when the participant successfully demonstrated the vocal greeting in the classroom. The dependent variable in the study was initiating a greeting to staff which was composed of 2 primary components (vocal greeting and looking at staff) and 1 secondary component (nodding and/or smiling). This study utilized a 5-point Likert-type rating scale of 0 (no vocal greeting) to 5 (vocal greeting, looking, and nodding and/or smiling). Results showed that the intervention improved each participant’s level of performance with a greeting. Since this study did not achieve research design standards as established by the What Works Clearinghouse (WWC), future studies are required. However, probe data indicated response maintenance after the intervention ended.

CCS CONCEPTS

- Human-centered computing → Mixed / augmented reality; Web-based interaction; Scenario-based design; Computing methodologies → Machine learning; Neural networks; Animation; • Applied computing → Interactive learning environments.

KEYWORDS

autism, AR, augmented reality, web XR, facial recognition, spatial detection, voice recognition, eye contact monitoring, expression/ emotional recognition, TensorFlow, AI

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1 INTRODUCTION

Over the past few decades, an abundance of research demonstrate that individuals with autism have difficulties in social interactions, communication, and perspective taking[Association 2013]. Due to social impairment, many of these students feel lonely and more social dissatisfaction compared to the typical peer[Bauminger and Kasari 2000]. In the general education setting, children with autism struggle with the simplest of social skills, such as, greeting others, looking at people when speaking to them, engaging in reciprocal conversations, and developing meaningful friendships[Morrison et al. 2009]. Even with average to above average intelligence, these children struggle in navigating through social situations which often leave them unsure of what to say or do and feeling frustrated[Didehbani et al. 2016].

With the fundamental shift of educating students with disabilities in the general education setting, educators need to think differently on how to deliver educational programming and instruction[Reynhout and Carter 2006]. Research is now focusing on utilizing visual supports in teaching students with autism through augmentative communication devices, interactive and intelligent visual schedules, and mobile personal devices[Hayes et al. 2010]. Researchers are developing virtual reality formats[Abirached et al. 2011] and mobile applications to assist students with autism in social communication[Escobedo et al. 2012].

2 EXPERIMENTAL CONDITION

2.1 Design

A multiple baseline design across 4 participants replicated across 30 sessions was utilized to assess the relative effects of augmented reality technology, 3d modeling & animation, programming languages, and mobile devices to instruct how to initiate greeting to staff.
2.2 Baseline & Intervention
Observational data were recorded on the dependent variables during baseline which was collected over a 6 week period using event and duration recording. Treatment started for participant 1 during week 2.

Prior to treatment, each participant was individually instructed on how to operate the Android device and training modules until the participant showed mastery of using the device. Each participant was provided with the option to select which item(s) would be awarded as the reinforcer.

2.3 Maintenance
Multiple maintenance probes were conducted for participants 1, 3, and 4. A single maintenance probe was conducted for participant 2.

2.4 Interobserver agreement
Interobserver data (IOA) was collected for each participant using total count IOA to denote agreement between the 2 staff observer’s rating.

2.5 Treatment Integrity & Social Validity
Treatment integrity was collected during baseline and treatment phases during each session.

Social validity data was collected from participants and teaching staff on 5 questions related to the effectiveness of the intervention.

3 RESULTS
Figure 1 shows that on a Likert scale of 0 (no vocal greeting) to 5 (vocal greeting, looking, and nodding and/or smiling), teaching staff rated participant 2 as showing an increase in greeting once the intervention was implemented.

![Figure 1: Web-based Augmented Reality Intervention to Increase the Level of Greeting in High School Student with Autism](image)

With treatment, participant 2 showed an immediacy of effect, with 100% of non-overlapping data (PND) across conditions, indicating a highly effective treatment. The level of rating for participant 2 was 5. IOA data for participant 2 was collected for 32% of data across conditions with 100% agreement. A procedural checklist completed by the teacher for both conditions showed 100% treatment fidelity.

Regarding treatment data for participants 1, 3 and 4, data is completely unreliable due to inaccuracy of recording data on incorrect forms. However, probe data was collected approximately 6 weeks after the study and showed response maintenance with 100% IOA achieved.

Social validity data indicated that overall, participants enjoyed learning socials skills through the mobile device. High social validity ratings were also obtained by teachers on their assessment related to student outcomes.

4 CONCLUSION
The results offered preliminary support for using web-based augmented reality technology accessed through mobile devices to teach social skills to high school students with autism. Our study indicated the effectiveness of a multicomponent package using a mobile device to deliver social skills training. One strength of this study was the ease of the participant to access social skills training independent of a teacher’s direct instruction.

5 LIMITATIONS
There are several limitations of this study. In our study, the primary researcher was working full time as a teacher consultant and was only able to secure the part time support of 1 staff member. Due to this arrangement, it was difficult to meet the standard required for IOA and contributed to the failure of discovering data collection errors. Another factor impeding the implementation of our study was inclement weather which closed area schools for approximately 2 weeks during the study. Despite these limitations, probe data looks promising. All participants are consistently greeting their teachers which is a pivot behavior for employment.

6 ACKNOWLEDGMENTS

REFERENCES