

PECSOnline: A Bespoke Classroom Based Picture Exchange Communication System (PECS) for Children with Autism

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Abstract. We present PECSONline, a Picture Exchange Communication System (PECS) tailored to meet the specific needs of classroom environments rather than an individual. To ensure the tool would meet the practical requirements of the classroom, we employed a participatory design approach, which involved input from educators of children with autism. Our focus was on developing an application that would be personalised and cater to multiple users, a feature that has not yet been tested in a classroom setting. We conducted a pilot test of our application, and the response from teachers of children with autism was overwhelmingly positive.

Keywords: Autism · PECS · Mobile App · Classroom

1 Introduction and Motivation

Autism spectrum disorder (ASD) is a type of neurodevelopmental condition that affects various abilities, such as social interactions, verbal communication, and physical capabilities. Based on research spanning the last half-century, the World Health Organization predicts a global increase in the occurrence of Autism Spectrum Disorder (ASD), estimating that approximately one in every 160 children will be affected by this condition. Children with autism usually have a varied amount of difficulty socialising with each other [4, 5] and often communication differs from the norm [2]. To mitigate this communication, the Picture Exchange Communication System (PECS)[9] has been developed; a system that enables a gradual approach to developing language skills, and it is used internationally as the main communication way between a child with autism and others. PECS has successfully been implemented worldwide with thousands of learners of all ages who have various cognitive, physical and communication challenges [3]. PECS uses symbols of items with the respective name of the items on them. It consists of six phases and begins by teaching an individual to give a single picture of a desired item or action to a “communicative partner” who immediately honours the

exchange as a request. The system goes on to teach discrimination of pictures and how to put them together in sentences. In the more advanced phases, individuals are taught to use modifiers, answer questions and comments. PECS allow people with autism to become communicative and comprehend items, descriptions and verbs with prompts to tell them, so that it will allow both communicators to understand each other, even if one communicator does not do so verbally. Santos et al. provide compelling evidence supporting the notion that PECS serves as more than just an augmentative or alternative communication tool for children; it also fosters substantial enhancements in their comprehension of contextual information [8]. Within the demographics of people with Autism, routine and familiarity is paramount [10]. There exist applications that can apply PECS to children. Our motivation lies in the fact that most current PECS systems are predominantly generic and lack customisation to address individual user requirements, such as the incorporation of personalised images. Similarly, while certain PECS systems offer limited personalised settings, they are tailored to one child, and they provide a one to one relationship between the two people engaged in a communication. In other words, they are typically designed for individual children, establishing a one-to-one correspondence between the two individuals communicating. In our PECS system, however, we present the capability of allowing more than one child and more than one adult (teacher or parent) to use the same application. Simply put, many teachers can use the application with many (different) students each. In this scenario, most of current PECS applications or alternatives become impractical since it is not feasible for each child to consistently carry an individual phone or tablet tailored to their specific environment. In this work, we present a bespoke PECS system specifically designed for the classroom setting. We offer comprehensive customisation and personalising features to facilitate interaction among multiple teachers, multiple parents, and multiple students at different PECS levels. The system was developed through a participatory design approach involving teachers from a specialized primary school in the UK, ensuring their active involvement and input throughout the design process. First, we describe the architecture and interface of the system, followed by a pilot study conducted in an actual special school environment. The feedback and usage reports received from teachers were predominantly positive, indicating initial success. Future research will explore the broader effects of implementing this approach with children diagnosed with autism.

2 The PECSONline System

To ensure optimal classroom use, we utilised participatory design to gather requirements and develop our application with teachers working with children on the autism spectrum. These requirements were:

1. The application should be OS agnostic, and the delivery of the PECS application is primarily given through iPads and Android Tablets.
2. Accounts for teachers and parents should be available.
3. Both teachers and parents should be able to add multiple children to their (admin) accounts

4. We should comply with each of the PECS levels (phases) 3 to 6.
5. Include user security to prevent unauthorised changes by children, such as adult pass codes.
6. First This Approach [6] should also be included.
7. User Interface needs to be simple, minimalist and child friendly.

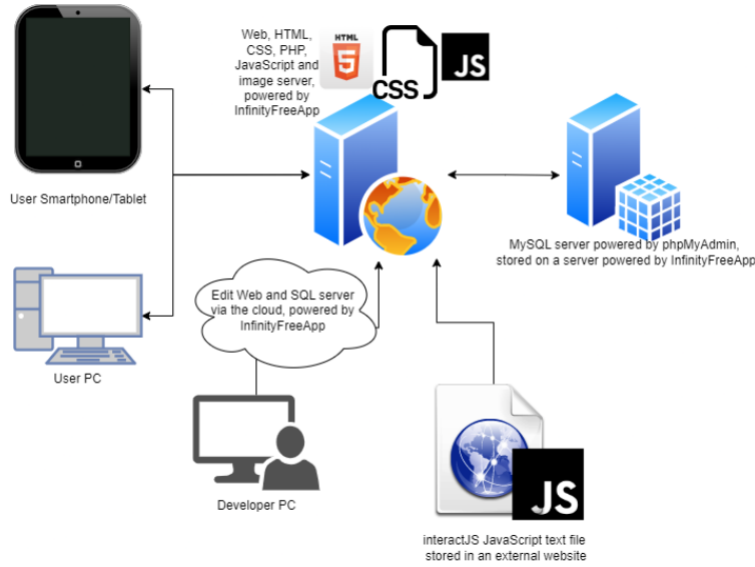


Fig. 1. Technology Architecture of PECSONline

Our PECSONline application is available at pecs-online.infinityfreeapp.com and can be accessed free of charge by anyone who wishes to try an early pre-bespoke prototype of it. Figure 1 shows the technology architecture of PECSONline. The content of the application is displayed in a web browser through HTML, which can be appropriately styled using CSS. The web pages are built using PHP to enable the use of dynamic variables while JavaScript allows users to modify the status of the web page, such as relocating cards. The implemented technology for the mobile drag and drop feature is interact.js, which was successfully incorporated into both First This Then That (FTTT) and Advanced PECS Book pages. This technology enables symbols to be dragged on both PCs and mobile devices, making it the backbone of the mobile drag and drop feature.

Through our participatory design exercises, we have effectively implemented all of the necessary requirements. The left image of Figure 2 depicts the various functionality options for PECS, specifically levels 3-6. Additionally, the right image in the same figure illustrates the personalized feature which enables images of the children’s personal belongings to be incorporated into the system for

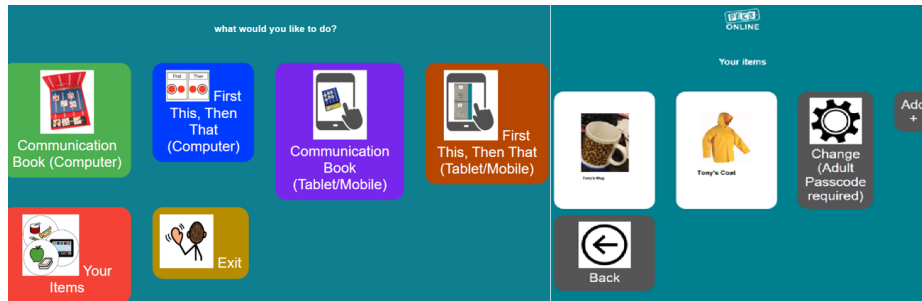


Fig. 2. PECSONline Interface. Left: options of functionality. Right: personalisation feature.

utilisation. Figure 3 shows two distinct features of the system. The left image demonstrates the "first this then that" function, enabling children to create more intricate linear requests and enhance their communication skills. The right image, on the other hand, highlights the classroom capability feature, which facilitates the addition of multiple users, such as teachers, parents, and other students as a sub-tree, allowing for concurrent usage of the system.

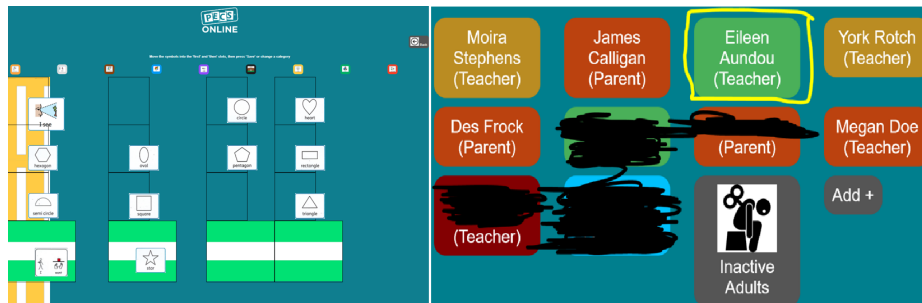


Fig. 3. PECSONline Interface. Left: Example of "this then that" functionality. Right: classroom (multiple user) feature.

3 User Feedback

To obtain valuable feedback on the system's usability from those who would be utilising it regularly, we engaged the assistance of eight teachers who work closely with autistic children. In order to avoid bias in the results, these teachers involved in the user feedback were not the teachers involved the development of PECSONline. The evaluation process was divided into two stages. The first stage involved the teachers using the system and performing some predefined tasks to ensure they use most of the features within the system. They were then asked to complete a questionnaire designed to evaluate the usability and overall effectiveness of the system in the second stage. The questionnaire included 60 items. The questions were developed based on Jakob Nielsen's 10 Usability Heuristics for User Design [1], the System Usability Scale (SUS) [7], as well as the

specific requirement objectives for the system. The participants were not asked to perform a heuristic evaluation of the PECSOnline system, but rather given the time to use the system and then answer our questionnaire. Testing was approved by the Cardiff University Computer Science and Informatics Ethics committee.

3.1 Result Details

The questionnaire comprised several sections, with the first section consisting of 10 questions related to the usability matrix. Additionally, each question provided a comments box to allow participants to provide additional feedback, if desired. We received a total of 7 responses for the questionnaire. We present the average rating for the questions as well figures of the final four questions given to the participants in the questionnaire.

All of the participants voted “good” and “very good” for 90% of the usability matrix, and all of them appreciated the interface. They agreed that the system is “[e]asy to navigate” and has consistent design throughout the different sections of the app. They commented that “the interface is highly usable in a variety of settings”. Regarding the communication book categories, some believed that it is “[t]he most impressive addition to this App” while agreeing that adding more categories, sections, extra visual cards would be good enhancements. Similarly, the drag and drop and the First This Then That features received modest ratings with most of the users asking for more symbols in the system at its later stages. They found the First This Then That feature a “good feature” and a “vital tool” in the system. Adult and child registration elements received unanimous positive reviews with no comments for improvements. Bespoke symbol addition and modification as well as their activated status were smooth processes as well. Most of the testers agreed that they were quick and easy with comments of “[n]othing [m]ore is needed. [I]t is simple and easy to do”. The comparison between the physical version of the PECS communication book and PECS-Online showed high confidence because none of the participants voted negatively to the relevant question. They claimed that “categories and symbols are added [to] this system will eliminate the need to create physical cards which can be costly in time and money” and “it covers all areas of PECS and will be easy to use and a lot faster to make the PECS symbols”. Some of the participants suggested some enhancements to the mobile app to make it look more similar to the standard physical book, “the ability to select a visual then switch categories to select another without losing your original visual from a sentence from a sentence strip of now and next board needs a bit of more work”. Finally, thoughts on user and symbol customisation, navigation, friend recommendations, and app usage were all positive. Some teachers suggested adding an avatar to the name, adding undo option, and enhancing drag and drop items while all of them agreeing that “This App has a huge potential.” As an indicator, some of the scores provided on a 5 point Likert scale for some features were: (a) 4.43/5.0 average rating for interface interaction (b) 3.71/5.0 average rating for the communication book categories (c) 4.29/5.0 average rating for symbol selection (d) 3.14/5.0 for thoughts on “First This Then That”. (e) 4.57/5.0 for adding bespoke symbols (f) 4.29/5.0 for

changing bespoke symbols (g) 4.43/5.0 for thoughts on changing all symbols' activated status (h) 4.14/5.0 for thoughts on navigation (i) 4.57/5.0 on whether the participants enjoyed using PECS-Online. Overall, the feedback received from the teachers indicated that the PECSOnline system was well-received and effective in meeting the needs of both teachers and their students. The system was found to be intuitive and easy to use, and the addition of personalized and multiple user account features were particularly appreciated. The feedback gathered from the teachers during the testing process played a vital role in the development and refinement of PECSOnline, ensuring that it meets the needs of its intended users. This feedback helped us to identify potential areas for improvement in the system, and to make necessary adjustments to enhance the user experience. Currently, we are conducting a longitudinal study to explore the effects of PECSOnline on communication, socialisation, and emotional development in a classroom environment.

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