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Interactive Technologies that Engage Children with Disabilities in Visual Art – A Review

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Abstract:
This paper reviews interactive technologies that encourage children with developmental disabilities to creatively engage in art. Digital art provides an opportunity for therapy, rehabilitation, leisure and the development of problem solving, motor, communication skills and creativity in a safe environment that is easy to monitor and mess free.

Tablet and console art programs were analysed based on features, simplicity and intuitiveness gathered from peer reviewed papers and online user reviews. Simple and intuitive iPad art apps exist but there are few other suitable apps. Console art programs are scarce and controllers are difficult to manipulate. Kinect-based programs can encourage movement without demanding fine motor control, through live video user tracking. Some open source Kinect programs create artistic effects in response to movement or voice. However, most have few functions and no validation studies. The Kinect Virtual Art Program was successfully piloted with children with cerebral palsy but it is not yet available commercially.

In conclusion, utilising interactive technology to encourage creativity amongst children with disabilities is relatively new, with few programs available and minimal research conducted into its leisure, developmental and therapeutic benefits.

Keywords: *Virtual art, interactive technology, impairments, children, cerebral palsy*

1. INTRODUCTION

Modern technologies including iPads, Android tablets, smart phones and gaming consoles have been increasingly used to engage and teach children with disabilities. Technology can provide the structure and graphical environment that enables many children with disabilities to communicate. These mainstream products are also easy to use, affordable and socially accepted, which overcomes barriers that many assistive technologies face [1]. With so many apps available, it can be a difficult task searching for an appropriate app to meet a child's needs. This paper reviews digital art applications and their appropriateness for students with a range of developmental disabilities.

A virtual art program provides an opportunity for therapy, rehabilitation, leisure and development of problem solving, motor, communication skills and creativity in a safe environment that is easy to monitor [2]. To enable children with developmental disabilities to access the art program, it must be intuitive and cognitively simple as well as easy to manipulate for children who lack fine motor control or do not have the muscle strength or control to manipulate a paintbrush, pencil or other art media. An appealing, interactive and fun art program requires a combination of interesting and engaging visual effects and a variety of functions that can be performed as well as an ability to store the art created.

Because children with disabilities have such a broad range of impairments and interests, a range of methods and media are required to suit different individuals. Digital art programs are simple to set up and pack up as well as being mess free, cheap and requiring little supervision. The iPad has a simple and visually robust user interface. It is easily customised and now has many apps available to support a variety of special needs [3]. Gaming consoles are typically less intuitive and require grip strength and fine motor control to use their controllers. However, the Kinect has removed the need for a controller, using cameras to track the user's body. This technology enables children with motor

impairments to engage with it easily. The Kinect can be used with the Xbox console or connected directly to a computer. Art programs can create visual effects based on a range of inputs. While iPad focuses on touch input, Kinect can encourage movement which builds muscle tone, range of motion and increases fitness. Kinect can also provide visual output to voice input.

2. METHODS

ProQuest Central, Expanded Academic ASAP and PubMed databases were systematically searched using combinations of the following search terms: Kinect, iPad, console, interactive technology, art, creativity, paint, disability, cerebral palsy and therapy. A general Google search for reviews on art apps for children with disabilities and a search of the iPad app store were also used to gather information.

The resulting art programs were analysed according to:

- Platform used to interface with the program,
- Customisability or adaptability to an individual,
- Simplicity and intuitiveness of the interface,
- Degree of fine motor control required,
- Encouragement of exploration and creativity,
- Data collection for analysing a user's change over time,
- Price

3. RESULTS

Results identified many tablet art apps but most were too complex for children with developmental disabilities. The main apps that met the criteria were designed for the iPad. Console art programs are scarce and controllers are often difficult to manipulate. The Kinect has enabled the design of art programs that track the user's body without requiring a controller. These encourage movement without demanding fine motor control. Open source programs have been designed for the Kinect that create artistic effects in response to the user's movement or voice. These have few functions and have generally not been trialed with children who have disabilities. The exceptions are *Somantics* and *ReacTickles* by Wendy Keay-Bright, which have been designed and tested with children on the autism spectrum [4][5]. The other art application that has been successfully piloted with children that have impairments is the Kinect Virtual Art Program, designed for the PC.

3.1. Interactive art technology designed for children with disabilities

The original *ReacTickles* applications provided cause and effect responses to mouse, keyboard, microphone and interactive whiteboard inputs. *ReacTickles Magic* has since advanced this idea to create an open source suite of simple applications designed for children with communication difficulties that use a web camera or Kinect and provide varied visual responses to both movements and sounds. *Somantics* is a similar suite of applications that use touch and gesture input. The applications provide varied visual responses such as painting effects, kaleidoscope and sparkles. Only one effect occurs at a time and the effects fade and change continuously, not allowing for saving and focused on the moment rather than the artistic output. *Somantics* and *ReacTickles Magic* are both available for the iPad. They are also available for the PC and Mac using a Kinect sensor or a webcam [4][5][6].

Kinect Virtual Art Program (KVAP) is designed for the PC, using Microsoft Kinect software. It tracks movements, allowing users to create artworks simply by moving their limbs. The program is simple to use and allows artwork to be saved. It can also track movements for analysis of speed and range-of-motion. A pilot study using *KVAP* successfully engaged children with severe cerebral palsy in art but the product is not yet commercially available [2].
Art of Glow by Natenai Ariyatrakool is a simple iPad app that aims to provide sensory stimulus and encourage relaxation. This is particularly useful for those on the autism spectrum. Tapping an area of the screen causes the area to glow with preset shapes and colours [7].

3.2. Mainstream art technologies that may suit children with disabilities

There are popular children's colouring apps for the iPad including *My Coloring Book Free* by Jeff Pedersen, as well as *Kids Coloring Book* and *Paint Sparkles Draw* by Kids Games Club by TabTale. While these programs do require fine motor control, they aim to be intuitive for young children. They are designed to develop hand-eye coordination and enable artwork to be saved. *Draw with Stars* is another iPad app that allows simple finger painting across the screen. The difference here is that there is a blank background and the paint is a trail of moving stars that disappear if touched again and have corresponding sound effects [8]. *Drawing Carl* is a more complex iPad app, with many functions and creative opportunities but it is less intuitive and requires more motor control than other iPad drawing apps reviewed. *Kids Paint Free* is a simpler virtual finger painting app that is available for Android as well as iPad.

iLoveFireworks by Fireworks Games is a simple to use iPad app that creates a visual and auditory response to touch, releasing fireworks effects. There is limited scope for creativity but the cause-and-effect response is intuitive. *Kinect Party* and *Double Fine Happy Action Theater* by Double Fine Productions are also not designed specifically for visual art but they are simple to use, intuitive and encourage creativity and exploration through interactive scenes [9].

Visikord by Davor Magdic is computer-based, using the Kinect to track movements and create visual effects. The system is aimed at nightclubs, creating a virtual mirror with splashy graphics that respond to dancing. While *Visikord* is not designed for children with disabilities, reviews show that it has been useful in encouraging movement and engagement amongst children with autism [10].

Noise Ink, designed by Trent Brooks, is available for Mac computers. It also uses Kinect to interactively track users and create graphic effects based on movement. The movements affect the flow of ink-like visuals, causing cloudy ink patterns to appear on the screen [10].

Fluid Wall by Austin Hines uses the Kinect to track users in 3D. It is a virtual wall that creates graphic effects as the user's body passes through the virtual wall [10].

3.3. Comparison of interactive art products

Table 1. Comparison of interactive art programs

Product	**Platform**	**Customisation**	**Intuitiveness**	**Motor control**	**Creativity**	**Monitoring**	**Price**
Somantics	iPad and Kinect/PC	Medium	High	Medium	Medium	None	Free
Reactickles Magic	iPad and Kinect/PC	Medium	High	Medium	Medium	None	Free
Kinect Virtual Art Program	Kinect/PC	High	Medium	Low	High	Records image and movements	Not yet commercial
Art of Glow	iPad	Medium	High	Medium	Medium	Saves image	$0.99
My Coloring Book Free	iPad	Medium	Medium	High	Medium	Saves image	Free
Kids Coloring Book/ Paint Sparkles Draw	iPad	Medium	Medium	High	Medium	Saves image	Free but costs for additional scenes
Draw with Stars	iPad	None	High	Medium	Medium	None	$0.99
Drawing Carl	iPad	Medium	Low	High	High	Saves images	$3.79
Kids Paint Free	iPad, Android	None	Medium	Medium	High	Saves images	Free
iLoveFireworks	iPad	None	High	Low	Low	None	$0.99

Kinect Party/ Double Fine Happy Action Theater	Kinect/ Xbox	Medium	High	Low	High	None	$9.99
Visikord	Kinect/PC	None	High	Low	Low	None	Free
Noise Ink	Kinect/Mac	None	High	Low	Medium	None	Free
Fluid Wall	Kinect/PC	None	High	Low	Low	None	Free

4. DISCUSSION

Very few existing art programs have been designed with the needs of children with disabilities in mind. However, some of the mainstream iPad and windows apps could be useful for this population, particularly programs that can be connected to a smart board to encourage gross motor movement.

There is little scientific research into the benefits of digital art for children with impairments but there is strong scientific evidence that art can benefit children with disabilities both developmentally and therapeutically [11]. Research also shows the benefits of interactive technology for engaging children with cerebral palsy and autism [12][13].

In conclusion, the application of interactive technology to encourage creativity amongst those with disabilities is relatively new. This interactive technology is available but has had minimal research conducted into its leisure and developmental benefits or its therapeutic value.

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