Friends with Different Abilities:
An educational computer game

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Abstract: This paper describes a project about how someone might learn about disabilities, simply by playing a computer game. An educational computer game was developed where a player is given a quest to go to classrooms of a school for orientation. There are seven disabilities represented (ADHD, Asperger's, autism, dyscalculia, dysgraphia, dyslexia, and wheelchair bound) in seven of the twelve classrooms in the game. The game was developed in GameMaker Lite 8.1, and images for the backgrounds and objects in the game are from pictures taken at a high school. The game has 54 sprites, 57 objects with behaviors, and 12 rooms in it. In November of 2016, 69 subjects took a pre-test, played the game, and took a post-test. The data showed that people learned from the game, averaging a pre-test score of 8.32 (59%) and post-test score of 12.19 (87%) out of 14 questions.

Background & Motivation

Games have been around for thousands of years while gamification is finally an emerging field (NMC and Educause, 2013). Teachers have been using games in classrooms for generations and, recently, the idea of bringing what works well about gaming into learning has been acknowledged as valuable (Kapp, 2012). Many benefits of computer games have been shown (Ferdig, 2009) with over 89 empirical studies completed on the effectiveness of educational computer games (Ke, 2009). Holz (2012) found studies that show games can improve perception, decision making, dexterity, and even creativity. Other results showed that practiced gamers can pay attention to six things at once without getting confused, as opposed to four that most people can track. Gamers can act on choices six times a second which is four times faster than most people. Computer games can be good for us.

Educational computer games have been available since the early personal computers. Some popular ones on PCs have been the Reader Rabbit and Math Blaster series of games. Over 1500 educational computer games have been cataloged at www.EducationalComputerGaming.com (www.wingz2fly.com/wp/search). Although only a few mobile apps have been added to that database to date, no games have been found that teach about disabilities. The Friends with Different Abilities computer game has been developed to present basic information about some disabilities and things that might be able to help someone with the disability. The game is intended to help people learn and, hopefully, have a small sense of how it is for people with certain disabilities.

Finally, we know a number of people either with disabilities or who have family members with disabilities, and they have been bullied. In fact, about 13% of public school students in the United States has some sort of disability. We hope that if more people know some things about disabilities and how it might be for someone with disabilities, the less likely the person with disabilities will be bullied, and may even be appreciated.

Design and Development of the Game

After reading about disabilities and speaking with a special education coordinator, we decided to have the game focus on learning disabilities. The player is a new student at a high school going to orientation and is welcomed in the office with a course schedule. The player becomes a mustang in the game, the mascot of the school, and must go to each of the classrooms that match the schedule. The player moves the mustang with the arrow keys around a hallway room. In each room, the player reads a little and performs a task such as clicking on options, moving the mustang toward an object, or dragging an object in the room. A learning disability is connected with different class subjects such as dyslexia (reading issues) with English. The table below shows the disability name,

common characteristic, and something that might help for that disability. Each of the facts is shown during the game play. The goal for the player is to visit each classroom, complete an activity in the room, and head to the bus at the end. At the bus, the player moves the mustang to the bus while an animation of other mustangs moving around plays.

Disability (classroom)	Characteristic	What can help
ADHD (Science)	Has difficulty focusing and is easily distracted	Chunk information and take lots of breaks
Aspergers (Computer)	Has trouble in social situations but may do well with computers	Keep things routine and visual
Autism (Library)	May act out of turn or not respond to a question	Have rituals and a space to calm down
Dyscalculia (Math)	Has difficulty memorizing and understanding math facts	Use a calculator and graph paper
Dysgraphia (Social studies)	Has trouble writing including spelling, grammar, and usage issues	Write in smaller chunks and use a word processor
Dyslexia (English)	Mixes up letters and has difficulty reading	Have auditory support such as reading out load
Physical Disabilities (Gym/PE)	Physical disabilities may be caused such things as spinal cord injuries, scoliosis, or cerebral palsy	Ask if you can help and how you can help

Table 1. Disability Facts

For the game play, the student starts outside of the school, clicks to go to the office and get a schedule, moves around with the arrow keys through a hallway rooms that leads to the other rooms:

English (A100)   Computer (A200)   PE (Gym)
Math (B400)   Social Studies (C100)   Language Lab (C200)
Science (C400)   Library   Bus

All the backgrounds and most of the images in the game are from pictures taken by the authors at John Jay High School. GameMaker Lite 8.1 was selected for its ease of use and the ability to create a useful game in a relatively short amount of time, and the games run on Windows platforms (Yoyo Games, 2013). In GameMaker, images are attached to objects in order for them to show in a room. After images were pulled into the GameMaker tool for sprites and backgrounds, objects were made. Objects have behaviors associated with them by selecting events such as mouse clicks and arrow key presses. The events then have actions attached to them such as to show or move or destroy something. Finally, backgrounds and objects are placed into rooms.

Friends with Different Abilities has 12 rooms, 11 background images, 57 objects (many with events and actions), and 54 sprites. The game development took about 100 person hours to design, create and test. The image below shows the GameMaker interface with a list of many of the objects on the left, the science room, and the mustang player piece.
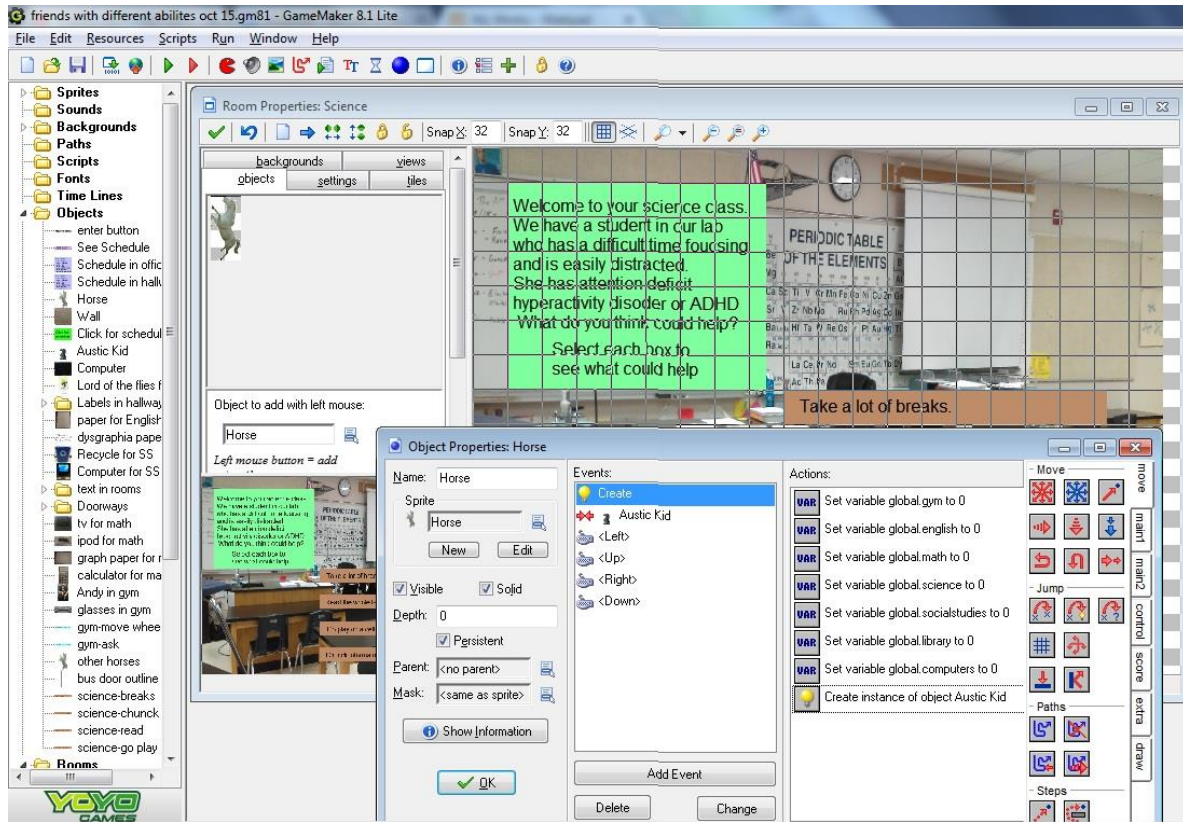
Figure 1. GameMaker with a room and object of FwDA

Game Play

The player starts outside of the new school and must click near the door to enter into the office. After getting a schedule, the player visits each room by moving the player piece with the arrow keys in the hallways. Each room has an activity to click on some things, move the piece around, and/or drag something around. Below are pictures of the game play including outside the school, the office, hallways, one classroom, and the bus. The game flow is shown after some of the individual room pictures.
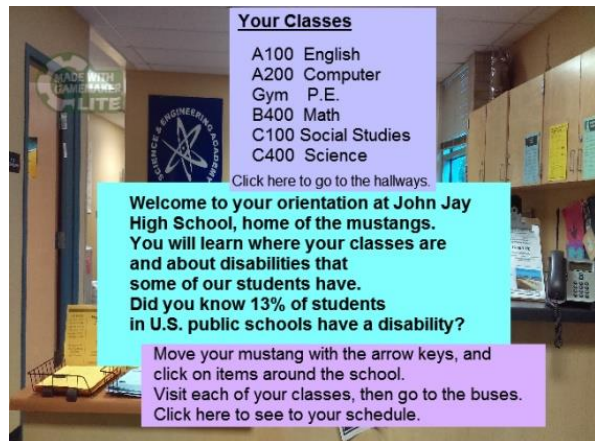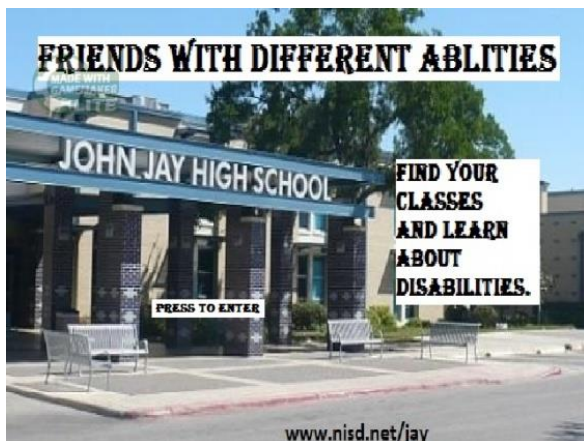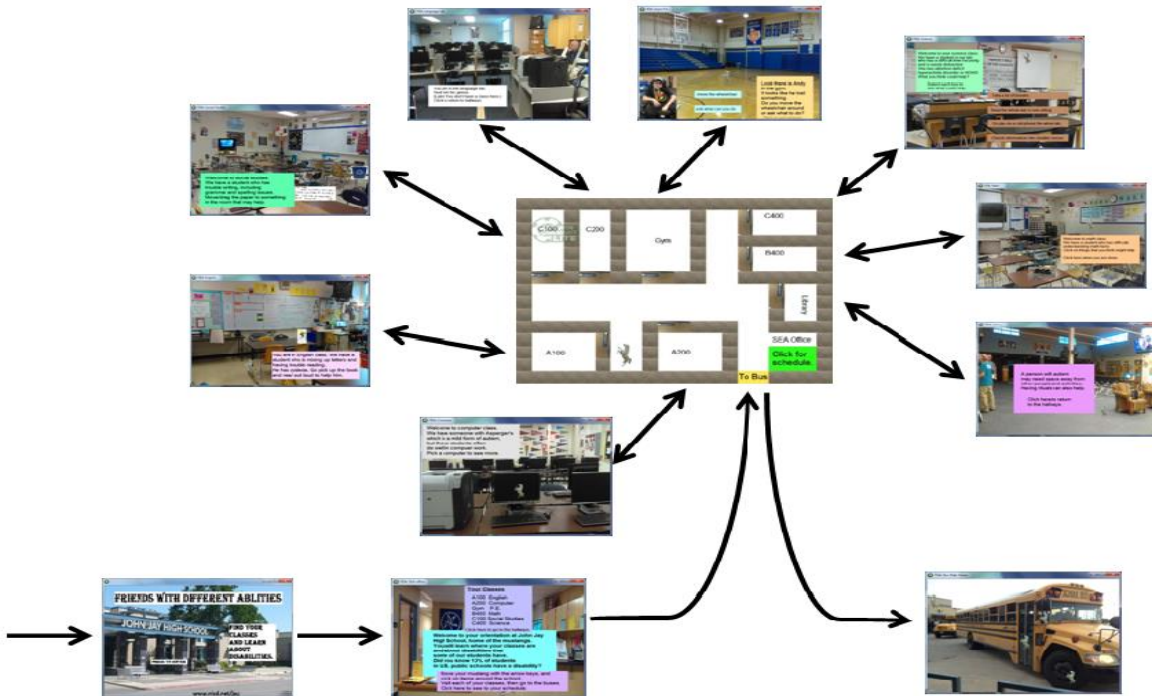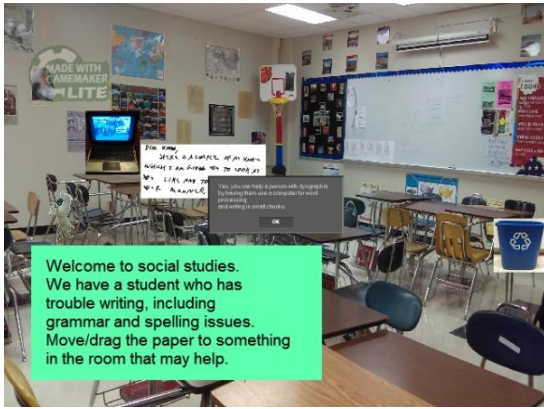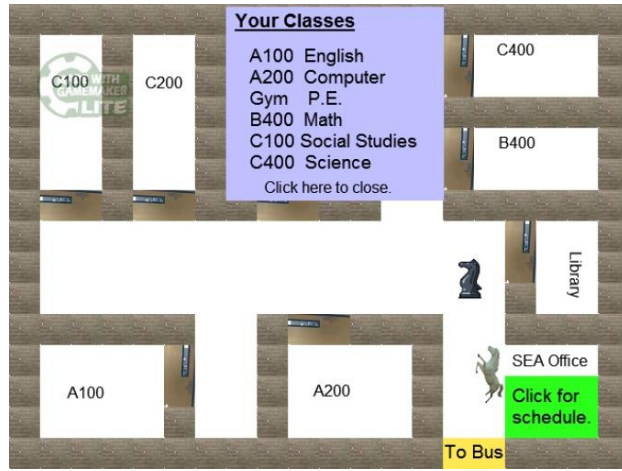
Figure 2. FwDA Rooms and Game Flow

Analysis

Sixty-nine subjects took a pre-test, played the game, and took a post-test in November of 2016. Many of the subjects were students at John Jay High School or at St. Mary's University, and the subjects ranged in ages from 12 to 63. We did not use people who were teachers, psychology majors or ESL students as we found they either knew the subject area already or did not have enough English proficiency yet. The pre-test and post-test questions were worded differently but represented each of the 14 facts presented. The *pre-test* scores averaged 8.32 correct out of 14 for *59%*. The *post-test* scores averaged 12.19 correct out of 14 for *87% correct*. Performing a one-tail paired t-test showed a very significant result with a p value os 1.3×10^{-16}. The pre- and post-test scores are shown in table 2 for each subject. Table 3 shows the pre- and post-test scores for each question.
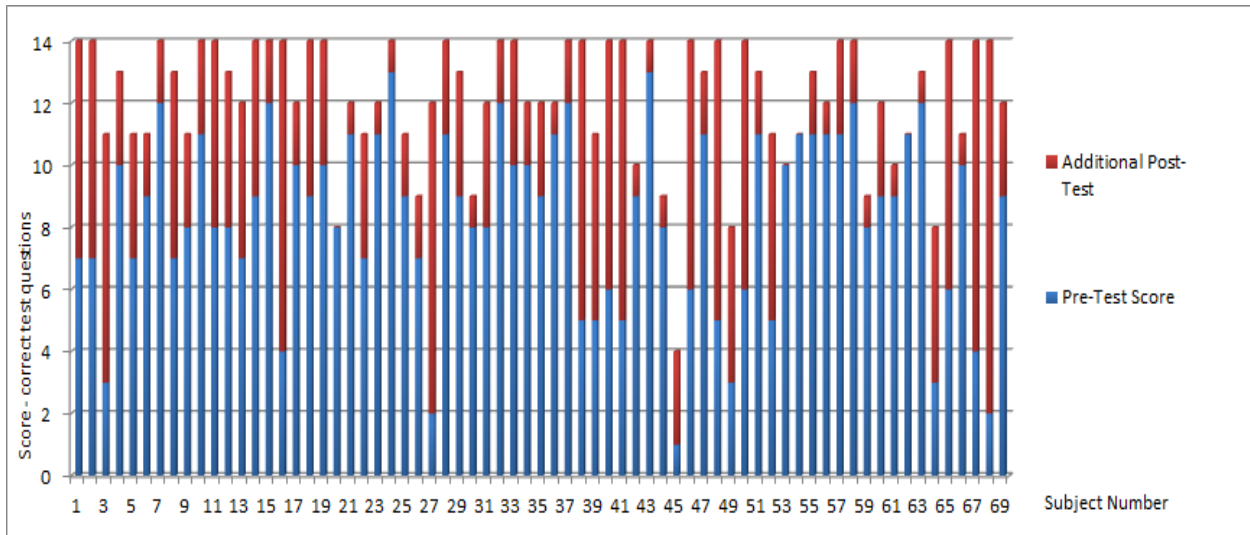

Table 2: Subject Test Scores

Disability	Class-room	Characteristic/ helped by		Pretest %	Posttest %
ADHD	Science	Hard to focus; Easily distracted	Read	**95**	97
		Chunk information, take breaks	Select 4 boxes	61	97
Asperger's	Computer	Trouble in social situations	Read	79	97
		Keep routine, visual	Select computer	62	89
Autism	Library	Act out of turn, not respond	Collide object	81	89
		Have rituals, space to calm	Read	67	93
Dyscalculia	Math	Difficulty with math facts	Read	61	89
		Use calculator, graphing paper	Select 2-4 objects	48	87
Dysgraphia	Social studies	Trouble writing, spelling, grammar, usage	Read	30	61
		Write small chunks, Word	Drag paper	18	57
Dyslexia	English	Mixes up letters, reading troubles	Read	90	91

		Use auditory support	Collide with book	79	80
Physical	Gym/PE	Wheelchair- ask if can help	Find glasses	85	97
% in schools with disabilities	Office	About 13% US public school	Read	**21**	**98**

Table3: Compare Tests Questions

The players did learn from playing the game. In the item analysis, the most improved question was about the fact that about 13% of U.S. public school students have some sort of disability. Interestingly, many (95%) already knew what ADHD was, yet most (82%) did not know about dysgraphia and that it can be helped by writing in small chunks and using a word processor.

Conclusions

We have been able to create a game that has a game goal of visiting all the classes in a schedule and getting to the bus to go home. The education goal is to learn about the disabilities. All seven disabilities have been represented in seven of the rooms with a major characteristic of the disability and at least one thing that might help someone with that disability. There were plenty of participants with enough gain between the pre- and post-test scores to show that they did learn about disabilities from playing the game. Maybe, there will even be a better appreciation that we all have varying and different abilities and less bullying.

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