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EDTC 625: Curriculum Proposal

Student Technology Club: Design Challenge: *DIY Assistive Game Controllers*

Video gaming is a social activity that can empower participants. The AbleGamers Foundation is a non-profit organization that “aims to improve the overall quality of life for those with disabilities through the power of video games” (“The AbleGamers Foundation,” 2014). This charity publishes Game Accessibility Guidelines, called Includification. This project is presented to students as a design challenge. To be authentic, the culminating examples will be on display at a Maker Space. The purpose is to raise awareness, and possible funding, for The Able Games Foundation.

A proof-of-concept:

After careful review of [The AbleGamer Foundation’s Game Accessibility Guidelines](#) and suggested assistive activities on the [MaKey MaKey Assistive Project page](#), two proofs of concepts – one for each recommended project (here called a “Design Challenge.”) AbleGamers recommended keyboard remapping, in which the computer’s keys can be rerouted to best work with a person’s needs. The first is uses a directional head movement interface. Moving one’s head can take the place of the arrow keys. The second proof was far more restrictive: tongue interface. A “single-button” physics game was chosen, which levels up in difficulty.

The ideation phase included a brainstorming session. Paper towel rolls, hats, shirt collars, and other apparatus were considered. The most flexible tool for the head movement interface was a circle made from pipe cleaners. Wearing the contraption proved uncomfortable and awkward. The researcher’s wife suggested using a travel pillow. This accomplished two things: an object to prop up the pipe cleaner ring and something to provide added comfort. The paper towel roll was used for the tongue interface because it reached from the table to the user’s mouth. For both, aluminum foil was chosen as the conductive material, affixed in four directions (corresponding with the directions of the arrow keys).

For a demonstration, please visit: <https://vimeo.com/102276050>



### The “powerful ideas”:

Switch interfaces are commonly used in assistive technology. More often than not, the teacher or paraprofessional is responsible for adapting a device to fit a person’s need. A switch is defined as “hardware devices that send signals to the computer to emulate various computer inputs such as a mouse click or Enter command” (Dell, Newton, & Petroff, 2012, p. 193). Switch interfaces can be “a mouse, joystick, or other item through which a switch may be connected” (Dell, Newton, & Petroff, 2012, p. 193). In this case, the MaKey MaKey kit serves as that switch interface. It is built on an Arduino board and it includes a USB cable, alligator clips, and additional wires. Almost anything that carries an electrical current – graphite, fruit, modeling clay – becomes part of the circuit. When the USB is plugged in, the computer’s keyboard interface becomes shared with MaKey MaKey.

The project is presented to students as a design challenge. It is similar to those found on the OpenIDEO website. IDEO is the company that designed, among many things, the first computer mouse. It has a social awareness design challenge campaign, open for all: <https://openideo.com>. This curriculum project authentically puts the student in the role of designer.

Design thinking is considered to be a desirable 21<sup>st</sup> Century, or “soft,” skill. The process described in Bers’s book is sometimes simplified as: ideate, prototype, test, iterate. Constructionism is an iterative process (Bers, 2008). Students will work through the six steps, “identify problem and constraints, brainstorm solutions, construct prototype, test and evaluate, redesign, and communicate solution” (Bers, 2008, p. 18). Designers also have postmortems (literally, “after death”) to reflect on successes and shortcomings. This, too, is a powerful takeaway for students.

Educational psychology professor Val Shute conducted research about design thinking as a skill-set. Shute has also co-published articles on persistence, which is learning from failure. Design thinking involves “an in-depth cognitive processes – which may help our students build their critical thinking skills (e.g., reasoning and analysis) – it also involves personality and dispositional traits such as persistence and creativity” (Razzouk & Shute, 2012, p. 345). The testing and iterating process can be challenging to student. They watch their prototype used through someone else’s eyes; something obvious to the designer may not be obvious to the user. Working in teams can create a learning environment in which solutions emerge (Bers, 2008, p. 19).

Students will work in teams to meet the five design challenges. First they are to view a YouTube video about AbleGamer’s mission: <http://youtu.be/BM8iNa87-Po>. Each group must use the MaKey MaKey as a switching interface. They will review the Game Accessibility Guidelines PDF, as well as the Mobility Chart on MaKey MaKey’s Assistive Technology for Art project. Instructions are included on how to use its kit as an assistive technology interface.

## Projects:

Each suggested project is based on remappable keyboard suggestions in the AbleGamers Game Accessibility Guidelines. The activities are based on specific disabilities:

1. Mini-Keyboard Challenge: AbleGamers with Muscular Dystrophy can find movement across a keyboard to be difficult; however, more precise movements can be made. A track ball interface is often used instead of a mouse. The ball can be rolled without moving or stretching one's arms. The challenge is to use MaKey MaKey to move game keys very close together. Create a dedicated mini-keyboard for the WASD keys, along with the arrow keys, spacebar, and enter button. The user must be able to operate the controller with one idle hand.
2. Macro-Keyboard Challenge: AbleGamers with cerebral palsy find fine motor activity to be nearly impossible. The challenge is to use MaKey MaKey to spread out the WASD keys, along with the arrow keys, spacebar, and enter button.
3. Head Mobility Challenge: Some AbleGamers can only move their heads. The challenge is to design a game controller using only head movement to take the place of arrow keys. Try it with this dancing game: <http://scratch.mit.edu/projects/10598360/>.
4. Simple Switch Challenge: Some AbleGamers have very restricted mobility. A hand chop, shoulder shrug, or even a tongue move can be used to interact with a one-button game: <http://www.casualgirlgamer.com/articles/entry/35/best-one-button-games/>. Try Flabby Physics, playable with just a spacebar: [http://www.gamesforwork.com/games/play-15772-Flabby\\_Physics-Flash\\_Game](http://www.gamesforwork.com/games/play-15772-Flabby_Physics-Flash_Game).
5. Cognitive Disability Challenge: Some members of the AbleGamer community are veterans with cognitive disabilities. In 2009, researchers at [Oxford University](#) [reported](#) that *Tetris* has a positive affect on sufferers of Post Traumatic Stress Disorder (PTSD). The Game Accessibility Guidelines recommends creating clear, concise, and intuitive directions. Create an aesthetically clear alternative to using arrow keys on a crowded computer keyboard. *Tetris* can be played for free, online: <http://www.freetetris.org/game.php>.

## 5 important organizational considerations and solutions:

1. Usertesting can be challenging to a student. Bers wrote, "if we help children learn how to react when things do not work as expected, we are also helping them to become sure of themselves" (2008, p. 39). It can be difficult for a student to not tell someone how to use his or her creation. For example, a video game playtester may go left when the designer intended the player to go right. The designer cannot tell the player which direction to move. To alleviate this, a third student participant must observe and "police" the testing process.

2. MaKey MaKey kits are better suited for small groups. A jigsaw cooperative structure would work effectively in the testing phases. Testers would move from group to group. No one should test the same design twice. This setting would be best with at least five MaKey MaKey kits for a classroom of 20 (four per group). If the teacher has only one kit, then groups should work at a station, out of view from the rest of the class. The goal is for other students to not see the prototyped design.
3. The high stakes standardized testing environment in today's schools are incongruent to the design thinking process. A culture of failure must exist in the classroom. Nonetheless, children shouldn't fear giving a "wrong" solution. Fail fast and then iterate on design. If students have "opportunities to develop their projects, they will learn from their failures" (Bers, 2008, p. 39). Learning from failure teaches grit, tenacity, and persistence. This notion is echoed in the book, *How Children Succeed: Grit, Curiosity, and the Hidden Power of Character*, by Paul Tough, reported research from Angela Duckworth: [http://www.ted.com/talks/angela\\_lee\\_duckworth\\_the\\_key\\_to\\_success\\_grit](http://www.ted.com/talks/angela_lee_duckworth_the_key_to_success_grit), and in a report from the Department of Education: <http://pgbovine.net/OET-Draft-Grit-Report-2-17-13.pdf>.
4. The MaKey MaKey kit is a tool. Take the systemic approach, as opposed to technocentric, to its integration. In this case, it is used as a switch to remap a keyboard with the goal of enabling AbleGamers to play video games. The introduced technology is not the sole focus of the activity.
5. The MaKey MaKey kit was created to inspire youth to invent. Students are often consumers of products, not creators. They see the finished video game controller in its plastic hard shell. A computer is a black box of circuits. Using the MaKey MaKey kit opens up discussions of basic electrical circuitry, how things work "under-the-hood." Here is a teachable moment to turn content consumers into content creators and makers.

## References

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