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MAKER: A Game to Make Engineering

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Nicholas Jubelt is a Junior in electrical engineering technology at Purdue University. Outside of class, he mostly helps gather and analyze data with graduate students in engineering education. He works to make engineering a more diverse field. Nicholas is passionate about his work, and really enjoys working with pre-college students who may be interested in studying engineering. To gather interest in engineering, he works with modern technology, such as 3D printers, laser cutters, vinyl cutters and more. He envisions a world where engineering does not have one predominant face, but rather the faces of millions around the world.

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Using Maker Spaces to Build a "Human Engineer"

Abstract

Making brings with it myriads of possibilities of learning and expression. The hands-on nature of working in Maker Spaces makes it a worthy candidate for implementing pedagogies centered on learning by doing. Further still, with Making not being confined to any particular field, it leaves open all possibilities for Makers to express themselves however they like. With this as inspiration, we believe that making is a great way to broaden participation by broadening the contexts of engineering. Makers can engage in activities directed by their personal interests, and at the same time experience and learn from the core tenants of engineering.

In this paper, we discuss a game developed in a Maker Space designed to embody the ideas of broadening contexts and participation in engineering. The goals of this game is to showcase the humanistic side of engineering by facilitating a thought experiment how human motivation and interest can be used to solve our society's problems. Staying true to the aforementioned aspects of making (i.e. learning and expression) players of the game would get to learn about different aspects of engineering, and at the same time be able to color their end products with their personal expressions.

All players will work with a game kit which allows them to create a story of how an engineer would use an engineering habit of mind, personal interest and engineering discipline to solve an International or National. Game pieces made in our fabrication lab will represent with each element and will be figured together by participants to represent their "human engineer." As players complete their products, they will write a brief story of their engineer and will be

encouraged to tweet/Facebook with a particular hash tag to initiate and fuel conversation about making and the humanistic aspects of engineering.

Introduction

Story telling can serve as a creative way to model understanding of a concept or idea [1,2]. For this project, the concept we seek to demonstrate is the broad context[3] of participation in engineering as well as the humanistic features of engineering endeavors[4,5]. To empower participants to learn about this concept, our research team has developed a game that allows participants to build their own model of an engineer complete with engineering habit of mind, personal interest and motivation. This paper seeks to explain how this game was developed and intended to be played.

Development of the Game

Pieces of the engineering body were sketched on a 2D sketching software, and printed using a laser printer and cardboard. The head, for example had the basic shape of a circle and was iterated to form an oval, a quarter circle and a semi-circle. Arms were developed from the basic shape of a rectangle, triangles for the torso (body) pieces and hexagonal piece for the legs. Each piece was intended to reflect a gender neutral engineer that could fit within other pieces in a number of ways.

Build a Human Engineer: Rules of the Game

The rules of the game are simple: participants must utilize different components of an engineer to tell a story about a unique engineer would solve a problem. The “uniqueness” of the engineer is generated by participant’s selection of components to choose from to build their engineer. Each participant will select pieces that (very loosely) the head, arms, body and legs of an

engineer. Each body part is inscribed with a respective theme that helps to build a richer story of the perspective of each unique engineer. After building their model of an engineer, each participant will write a brief story about the work of that engineer and these stories will be maintained by our lab as examples of the humanistic features of engineering participation. Examples of these pieces can be seen in Figure 1.

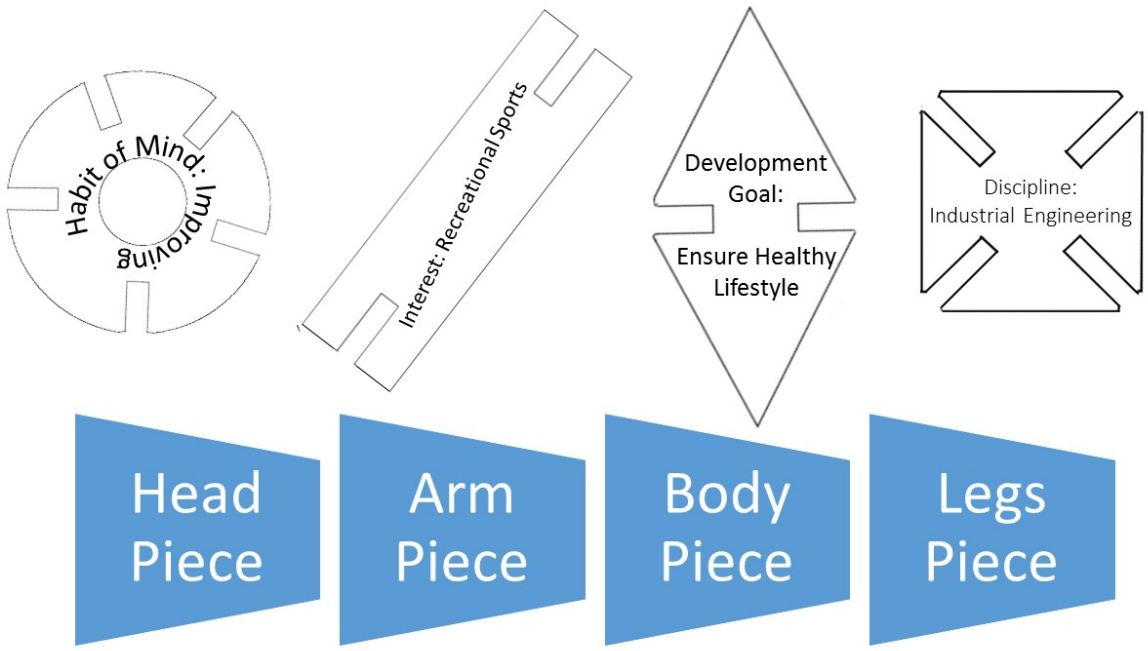

Figure 1. Example Game Pieces

Theme of Body Parts

Each body part represents a component of what makes every human engineer unique. To symbolize the thinking techniques utilized by engineers, each head piece is inscribed with one of the Engineering Habits of Mind[6]. To symbolize the interest that may motivate an engineer to approach a problem, each arm piece is inscribed with a hobby or interest that may serve to motivate how the engineer approaches the problem they have selected. To symbolize the work

that needs to be done, each body piece is inscribed with a problem that comes either from the Grand Challenges for Engineering[7] laid out by the National Academy of Engineering or the Millennium Development Goals[8] laid out by the United Nations. Lastly, to symbolize the tools engineers can use, each leg piece is inscribed with a context or discipline than an engineer can use to approach each problem. A breakdown of the categories inscribed on each piece is reflected in Figure 2.

Storytelling

Once participants have built their engineer, they will be supplied with a card to tell the story of the engineer they created. Participants can create their story from a template depicted in Figure 3 or may be more creative and use the themes of each body part to tell their own stories. In this story telling, participants will demonstrate their understanding of the broad context of what engineering participation can look like.

Participants will also be encouraged to join larger discussions of their story and engineer via social media.

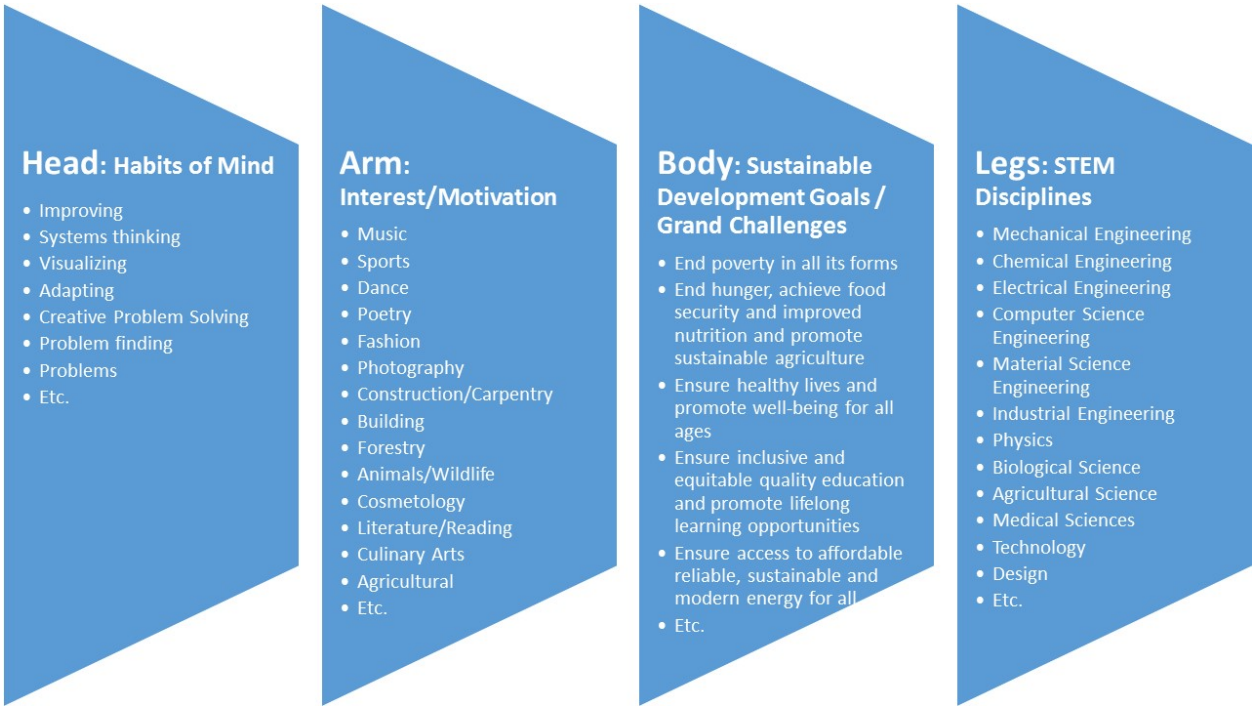

Figure 2: Components of Build and Engineer

Build An Engineer

Habit of Mind: _____
Problem / Challenge: _____
Discipline / Context: _____
Interest / Motivation: _____

My Engineer will solve _____(problem)_____ **using**
_____(habit of mind)_____ **by**
_____(application of discipline)_____ **because of their** _____(interest/concern)_____ **in/for**
_____(interest / motivation)_____.

This work will change
_____(implications)_____ **and go on to**
become _____(broader impact)_____.

Figure 3. Storytelling Prompt

Examples of Game in Play

From the four body pieces available, participants will have to pick one from each bucket. A separate base piece will be provided to that models can free stand throughout and beyond their creation. Once connected to the base, the model will depict the story the participant wants to share for the engineer.

For Example: The participant can choose the head piece inscribed with the engineering habit of mind “Improving.” They may select have an interest in recreational activities and choose to pair that with the development goal of trying to ensure healthy lifestyle from the National Challenges. They could then select the discipline of Industrial Engineering piece as the leg piece. Next, the participant will be given time to reflect on their unique engineer and build a story of how their engineer would solve this problem. Perhaps this engineer can work to create or game or a sport or a recreational exercise to ensure a healthy lifestyle by incorporating ergonomics from Industrial Engineering.

Impact & Conclusion

It is our hope that this game can serve as a learning experience for expanding the understanding of who can be and engineer and what it means to do engineering. This game can be used as a tool to educate and recruit students who may not typically be represented in the pool of prospective engineering students. Furthermore, public discussion of these stories of unique engineers can bring awareness to diversity in engineering and spark necessary conversations around the many diverse faces of engineers and their impact. Finally, this game can serve as a framework for future models of demonstrating the humanistic side of engineering and can be used to develop more games/activities to broaden participation in engineering.

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