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Why We Should Be Using Our Stories and the Hero's Journey to Help Recruit a More Diverse Population for Engineering

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Why we should be using Our Stories and the Hero's Journey to help Recruit and Retain a more Diverse Population in Engineering

Abstract

We, humans, are a story-understanding species that shares knowledge, teaches, and relates what we have learned via metaphors and narratives. Even our own identity in the world can be thought of as a narrative in our minds, and to imagine our future selves we must construct a future narrative. It is this power of story that we believe needs to be fundamentally embraced by diversity efforts in engineering and computing to make a significant change in our demographic challenges. And yet, the power of story is left, mostly, unexplored in engineering as it does not fit with our STEM-focused fields that sit strongly in the camps of quantitative evidence, testing, and design.

We will argue in this paper, that there is convincing evidence that leveraging the power of story might be the "holy grail" for changing the composition of engineers and computing specialists to a more diverse and welcoming culture.

In particular, we will look at three story-related research topics that we believe should be examined carefully and employed in our Colleges and Universities to help make this important change. First, we describe how our own narratives define who we are, and how role models provide us with ways of imagining our future narratives. These role models, therefore, if not curated properly do not allow us to imagine our own narratives fitting well in the field. Second, we look to Baxter Magolda's studies of self-knowing and self-authorship to begin to understand the deeper meaning of our stories and how we learn to exist in the world. Third, we look to the metaphor of the Hero's/Heroine's journey as related to us by Campbell as a story-driven metaphor that can help us design and relate to college learning. In our philosophical discussion of these three story-driven ideas, we will provide some practical implementations or guidance on how we might explore and intervene with these concepts. We believe that interesting interventions can be created to focus on story and test the effectiveness of these approaches in recruitment and retainment in our Universities and Colleges. The overall goal is to change or enlighten society with the real stories of engineering and computing such that we can all imagine ourselves pursuing such exciting paths.

Introduction

Assuming our goal is to broaden and diversify the population of professional engineers, those of us who are championing these efforts are designing interventions that, we believe, relate to the story, without truly understanding the power of the story. This is to be expected since most engineering educators are trained as engineers who solve problems by harnessing quantitative and scientific ideas to iteratively build better systems. Unfortunately, the human side of these systems is "softer" in terms of quantitative measures and is "complex" beyond the capabilities of our design approaches such that our interventions, though well-meaning, do not capture the importance of understanding the story and its benefit to our causes.

In this work, we make a philosophical argument that engineering and computing should seek out the power of narrative and story as the fundamental intervention path that will improve our diversity. In particular, we believe that three existing research ideas related to stories should be examined and understood to help us achieve our diversification goals. We start by providing a model of the story for the idea of the transformation and recruitment of a student to become an engineer. Next, we describe how our own personal narratives define who we are, and how role models provide us with ways of imagining our future. These role models, therefore, if not curated properly do not allow us to imagine our own narratives fitting into being engineering professionals. After that, we look to Baxter Magolda's model [1] of self-knowing and self-authorship to help us understand the deeper meaning of our stories and how we progress intellectually as individuals in society. Third, we look to the metaphor of the Hero's/Heroine's journey as related to us by Campbell [2] as a story-driven metaphor that can help us design and relate college learning. For each of these ideas, we provide some example interventions at the undergraduate level that we believe should be experimentally tested at higher education institutions. Our overall goal is to help engineers understand the power of story and how it might be the fundamental idea that we need to address in diversifying our engineering populations by leveraging these ideas to recruit and retain a more diverse population of future engineers.

Story and Narrative

Our cultures are deeply linked by story, and many of us describe humans as a story-based species as these concepts go far earlier in time than our inventions of science and mathematics. In reality, a story is the domain of the humanities, which from a higher education perspective is almost as far away from engineering as you can get.

We use Searle-White and Crozier's [3] work where they attempt to help teachers improve their teaching, and they provide a simple definition of narrative:

> A narrative is simply a description of a situation, a change that happens to that situation, and the result of that change.

where stories via storytelling are:

> Storytelling, defined broadly, is simply embodied narrative —– a process in which a narrative is conveyed, in real-time, through voice, gesture, and physical presence.

Education and stories are intertwined, and in the literature, there exist many examples of how

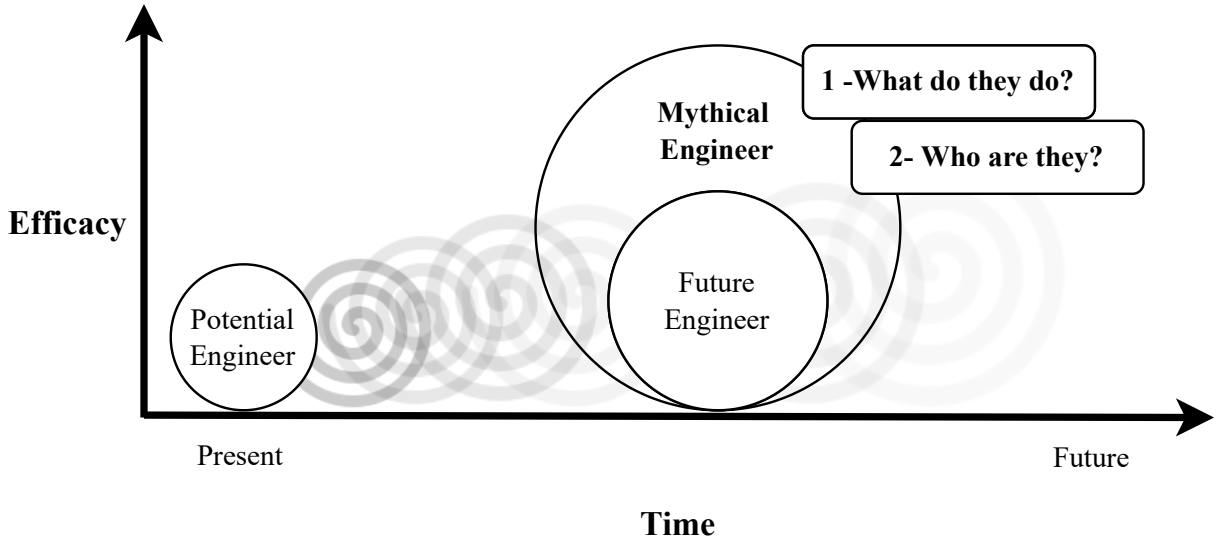

Figure 1: Shows our narrative model with a "potential engineer" and where they might want to proceed to.

stories are used by teachers [4]. We would like to propose a larger narrative-based model of a person who might want to become an engineer as shown in Figure 1. This model shows the time along the x-axis from the present going to the future as a simple time-based narrative. The y-axis shows "Efficacy" which attempts to capture the capabilities of a person at a given time whether that be knowledge, skills, experience, and all the aspects that encompass an individual's capabilities as it broadly applies to engineering. In this model, we show a "Potential Engineer" as a starting circle (to the left) that over time might progress into a "Future Engineer". The "Future Engineer" is not a specific endpoint, but we might define it as someone who has completed an undergraduate engineering degree. In this transformational process, we show spirals that represent the progress of an individual and their overall growth in efficacy that comes with experiences in the classroom and labs and outside the classroom in the form of internships, projects, and life. The larger circle that encompasses the "Future Engineer" is the "Mythical Engineer", where this represents what a "Potential Engineer" believes the goal is of becoming. The "Mythical Engineer" is made up of our own series of stories whether they be from our personal experiences with engineers, family and friend relationships of engineers, and/or depictions of engineers in popular and our personal cultures. We will argue that the "Potential Engineer" will not take on this transformation if they cannot imagine how their personal narrative fits with aspects of who is the "Mythical Engineer" and what the "Mythical Engineer" does in the world.

One aspect that is not captured in this model is the idea of a community of "Potential Engineers" and how the transformation is done by many. We might argue that the third dimension of this narrative model is an axis that intertwines engineers and humans of all sorts as we all progress in our own stories.

Using this model, we can relate how interventions to help diversify the engineering population relate to the narrative. For example, Girls Who Code (`https://girlswhocode.com/`)

2016 report shows that there is a high-school dropoff in female interest in computing due to no friends doing similar pursuits, and the report also shows how early exposure to games impacts participation [5]. We argue that both of these intervention points fit our narrative model in that lack of friends fits our third axis of community, and lack of exposure relates to our model of not understanding what the "Mythical Engineer" is. Additionally, the report shows the importance of role models, which shape our notions of the "Mythical Engineering" and we will look at this in more depth in the next section.

We, also, note that the narrative model of engineering recruitment and retention is an important idea, but it still does not capture all aspects of our diversity challenge. For example, recent research by Nishi [6] suggests that our different lived histories and associated privileges result in significantly different behaviors in an early algebra class, which is linked to STEM performance based on the success of completing the early class. Specifically, when resources are not equally accessible for courses like algebra, then it appears that a student's race can result in non-equal sharing, which then leads to disadvantages in STEM for minorities. There are elements of story in these ideas, but in this work, our proposed interventions do not dive into all of the deep and complex challenges we face.

The use of stories is not completely ignored by engineering educators, and we note Eskandri *et. al.* efforts in using story and the narrative to help in the entrepreneurial design process [7]. Within her research, a more recent publication by Karanian *et. al.* [8] attempts to study what gendered perceptions exist for engineering students when they look at a prescribed prompt story in an attempt to discover their underlying motives of the subjects.

Role Models and their Stories make an Attainable "Mythical Engineer"

In our narrative model of becoming an engineer, one of the key pieces to a "Potential Engineer" embarking on the transformational story is the question of whether I can imagine myself as a "Future Engineer". This is in part linked to the "Mythical Engineer" and being able to understand who they are. This might include similar interests and values, but from a diversity perspective, it is much more important to be able to identify demographic representation within the profession such as race and/or gender. This is, especially, challenging if one's local community does not have many engineers within it.

This leads to the importance of role models as a means to change the story of the "Mythical Engineer" such that the "Potential Engineer" can imagine themselves as the "Future Engineer". The two aspects of role models that have been discussed in the literature is the potential for a role model to help recruitment and the role model's impact on a student's engagement in the profession.

The recruitment phase is how we bring in new "Potential Engineers". Milgram looked at how the importance of role models plays in recruiting women to STEM-based fields [9]. Sandlin and Peña [10] examined the importance of authentic stories in our social media advertising to future students and how these authentic stories are key in persuading prospective students to select a particular college. In all the research, Thompson [11] provides a futuristic view of recruiting based on race and imagines a scenario where we recruit black students like we recruit black athletes. In all of this work, the focal point is that role models and their respective stories are used

as a means to recruit, and based on our narrative model, this links the "Potential Engineer" to be able to imagine themselves as the "Mythical Engineer" based on role-model evidence.

The importance of role models from a retention perspective is further linking the stories of our role models to our own narrative of what we as "Future Engineers" will be. In this way, Buzzanee *et. al.* [12] describes how mentoring in academia for engineering women of color is tightly linked via stories. Shin *et. al.* [13] describes the importance of role models to STEM student engagement, and Aish *et. al.* [14] looks into the importance of relatable role models for underrepresented minorities.

It is clear from this research, that our own stories of the "Mythical Engineer" can be altered by the presence of role models that we can identify with. However, this comes with a logistical concern since, what we will call, pioneers in the space of engineering higher education and professionals, means that there is a huge and disproportionate expectation on pioneers to be role models to the next generation in an effort to solve the problem. Research (for example Hanasono *et. al.* [15]) has documented the significantly higher service load for minorities and females, partially, due to the expectations and needs in diversification efforts. Our sample intervention (presented next) in this space attempts to alleviate some of this burden.

INTERVENTION - Curating our Stories

The first intervention that we suggest engineering institutions test is to start curating engineers' stories in undergraduate education. What we suggest here is to have undergraduate students curate their own stories as they progress through engineering education and then archive these stories so that the next generation can view the variety of stories that have been pursued and, eventually, practiced as professional engineers.

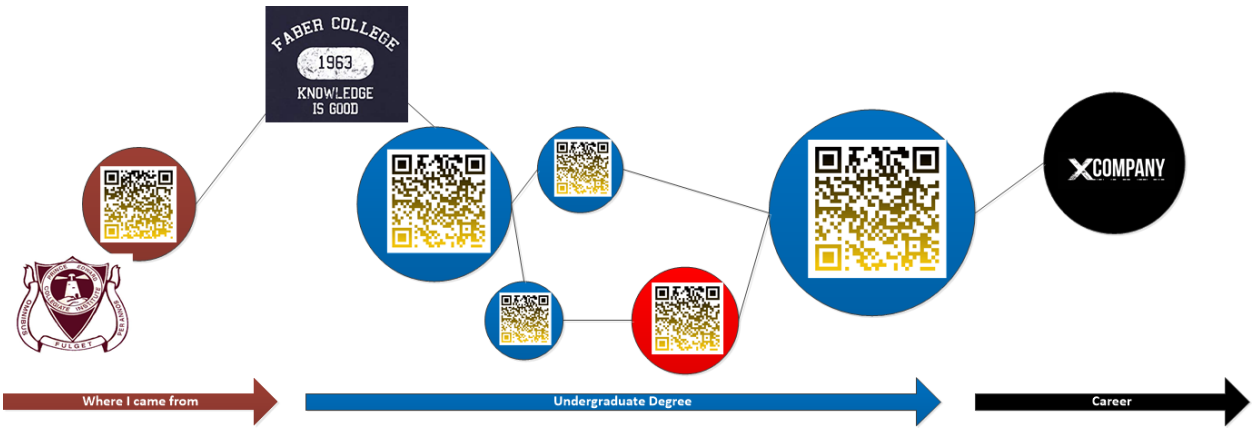

Figure 2: A sample curated story of an undergraduate engineer progressing from High School through to a company.

Figure 2 shows a digital version of an imaginary student's progress from high school through an undergraduate degree to a career. We imagine that the curation of the story can be accomplished with digital tools including QR codes that link to a digital portfolio of multimedia items such that others could then access a previous student's story. This would allow engineering schools to

create a museum of sorts with all their alumnus' stories available to be viewed, and instead of asking pioneers to spend significant time mentoring students, we could potentially allow students themselves to explore stories and help them shift their own view of what the "Mythical Engineer" is for them.

To start out this process, we would need to create these tools to help curate our stories. Then with the tools in place, we could ask faculty and recent alumni to create a seed set of stories to start off an archive. Next, we would integrate story curation into our curriculum as activities/assignments that students would perform during their undergraduate education. Finally, we suggest that an activity like this should be evaluated as a research question(s) to find out if the intervention can replace (maybe only partially replace) students' perception of the "Mythical Engineer".

Understanding how education will help us write ourselves into our futures

Our second piece of how story and narrative are fundamental to diversifying engineering is more related to what is the fundamental transformation that begins in undergraduate education, and more broadly, in higher education. Here, we look at the body of work by Baxter Magolda and her ideas on intellectual development. As she has a broad base of research articles and books, we start by recommending some of her books including her more recent 2017 book on authoring our life [16] and her early book on intellectual development with an understanding of gender [1]. Those of you familiar with Perry's intellectual development model [17] might find Baxter Magolda's work a broader model based on the more diverse population it focuses on.

In Baxter Magolda's 2008 paper [18], she identifies three elements of self-authorship via her longitudinal studies, where self-authorship, is the idea that in college we transform intellectually to understand how we and our associated field(s) to merge and allow us to determine how we write ourselves and our ideas into the world. In this work, the three elements are:

1. Trusting the Internal Voice - where an individual learns that their reactions to the world are in their control.
2. Building an Internal Foundation - where an individual develops a philosophy of how they will react to changes in the world.
3. Securing Internal Commitments - where an individual now lives by their philosophy.

These three elements are transitioned by each of us in the respective order (though there is no guarantee of the transformation occurring), and from Baxter Magolda's work, this transformation is, typically, started in college, but is not necessarily completed after graduation.

The idea of this aspect of intellectual transformation parallels our progression from "Potential Engineer" to "Future Engineer", but allows for the transformation to have more defined steps that a student or teacher might be able to illuminate to the learner.

INTERVENTION - curation with self-examination of intellectual development

The intervention for the idea of intervening with self-authorship is a little less well-formed than the curation of our stories. We imagine that similar to Baxter Magolda's longitudinal

methodology we could get written stories from students and analyze them in our curation intervention, but we note that this is a major research endeavor that Baxter Magolda did over an entire career.

We recommend reading Hodge *et. al.* [19] paper (where Baxter Magolda is a co-author). This work provides some ideas on how a liberal arts college can cultivate self-authorship through a program they developed called "Engaged Learning University". As we are focusing more on engineering and the diversity challenges within this space, we might suggest looking into "Engaged Learning Engineering" as a smaller-scale intervention of their ideas.

From a research perspective, a Baxter Magolda-like study focusing on engineers including an additional focus on gender and minority impacts would be greatly enlightening for all of us.

Using Story in our Classes and Curriculum - the Heroine's Journey

The last piece of our philosophical argument on why engineering educators should embrace narrative and story is based on the Hero's/Heroine's Journey as first described by Campbell [2]. In his work and many others, the journey is used to break down literature and popular culture stories via his twelve-step model of the journey. In this space, however, the Hero's/Heroine's Journey is used as a metaphor for understanding how we the Heroes/Heroines can approach challenges and transformation in our own lives and goals. This metaphor, as it applies to education, is best captured in O'Shea and Stone's work [20] which relates women coming back into education via their stories. A quote from their work captures this best,

> Making the nature of this journey explicit to first-year students may assist them to continue traveling rather than abandoning this journey ([20], page 89).

The idea of linking the Heroine's/Hero's journey to education is not new, and many ideas in this space have been investigated. Brown and Moffet's book [21] looked at how educators can transform and improve learning via the hero's journey. Follo [22] looks at the journey and how it can be applied as an intervention to recruit females in male-dominated professions (forestry in Norway). Goldstein [23] uses the journey as a means to help educate teachers, and even in course design, Farmer [24] looks at how small modules in a course can be designed around the 12 steps of the Heroine's/Hero's journey.

Obviously, the Heroine's/Hero's journey is an idea that aligns well with the process of transformation. Additionally, the nature of the model fits well with our ideas of the story in this paper. In Figure 1, our model captures the nature of the Hero's/Heroine's journey as the growing spirals that link between the "Potential Engineer" and the "Future Engineer" and beyond. We believe that making students aware of this metaphor and designing it both in our curriculum and individual courses will have benefits. In some way, the metaphor is a model to help students achieve grit which is a skill, popularized by Duckworth *et. al.* [25], that many of us suggest our students need to become successful engineers.

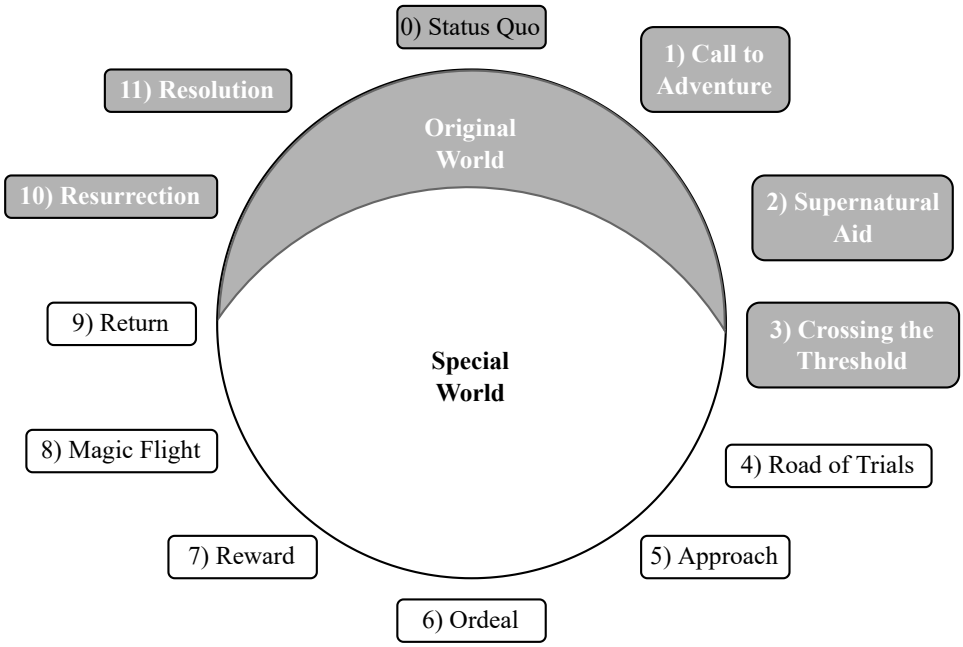

Figure 3: The 12 steps of the Heroine's/Hero's journey

INTERVENTION - apply the Heroine's Journey in our Classes and Curriculum

Figure 3 shows the 12 steps of the journey progressing from the top (analog 12 o'clock) clockwise around the journey. The "Original World" represents the space where we are comfortable, but no transformation or change happens to the individual. Only in the progress through the journey and into the "Special World" do we change who we are, noting that when we return back, we are no longer the same person. Also, in the journey, various external characters either mentors or foes will be encountered to help or hinder our progress.

This simple model can be applied recursively to our courses such that the course as a whole is a journey, and the individual ideas, skills, and modules that make up the course are themselves smaller journeys. Similarly, the entire curriculum to achieve an undergraduate major in engineering can be thought of as a Hero's/Heroine's journey.

As a first step to integrating the Heroine's/Hero's journey to engineering education, we prescribe that when designing our courses in reverse (as suggested by Wiggins *et. al.* in their book [26]) that we next consider how each learning objective is taught and assessed as it relates to the journey [24]. At the same time, in early courses, students should be made aware of the Heroine's/Hero's journey as a metaphor for the trials and tribulations that they will meet as they proceed through an undergraduate engineering degree. In this way, we might be able to differentiate classmates, friends, family, teachers, and administrators as allies in their progress through these degrees.

The research question(s) associated with this intervention lies in determining if the metaphor

helps retain students in the pursuit of engineering.

Discussion

In this work, we have presented three story-based ideas that have been applied in research into educational practices and interventions. The goal is to attempt to convince engineering educators that the power of story and its relation to ourselves might be a key ingredient that we need to further examine to help us overcome our challenges in recruiting and retaining a broader and more diverse set of engineering professionals.

Note, however, that we don't believe that in this paper we have either fully examined the possibilities of using narrative or have we provided solutions to all the challenges faced in the challenge of recruiting and retaining more broadly. For example, we have not addressed the simple question of how to motivate young students to even decide on what story they might write for themselves if they are still searching for what they are interested in.

In all of this, one of the hardest things to convince an engineer of is the importance of stories in our lives. This work is an attempt to convince all of us of the importance of stories and to focus on the narrative as the key idea in changing engineering demographics.

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