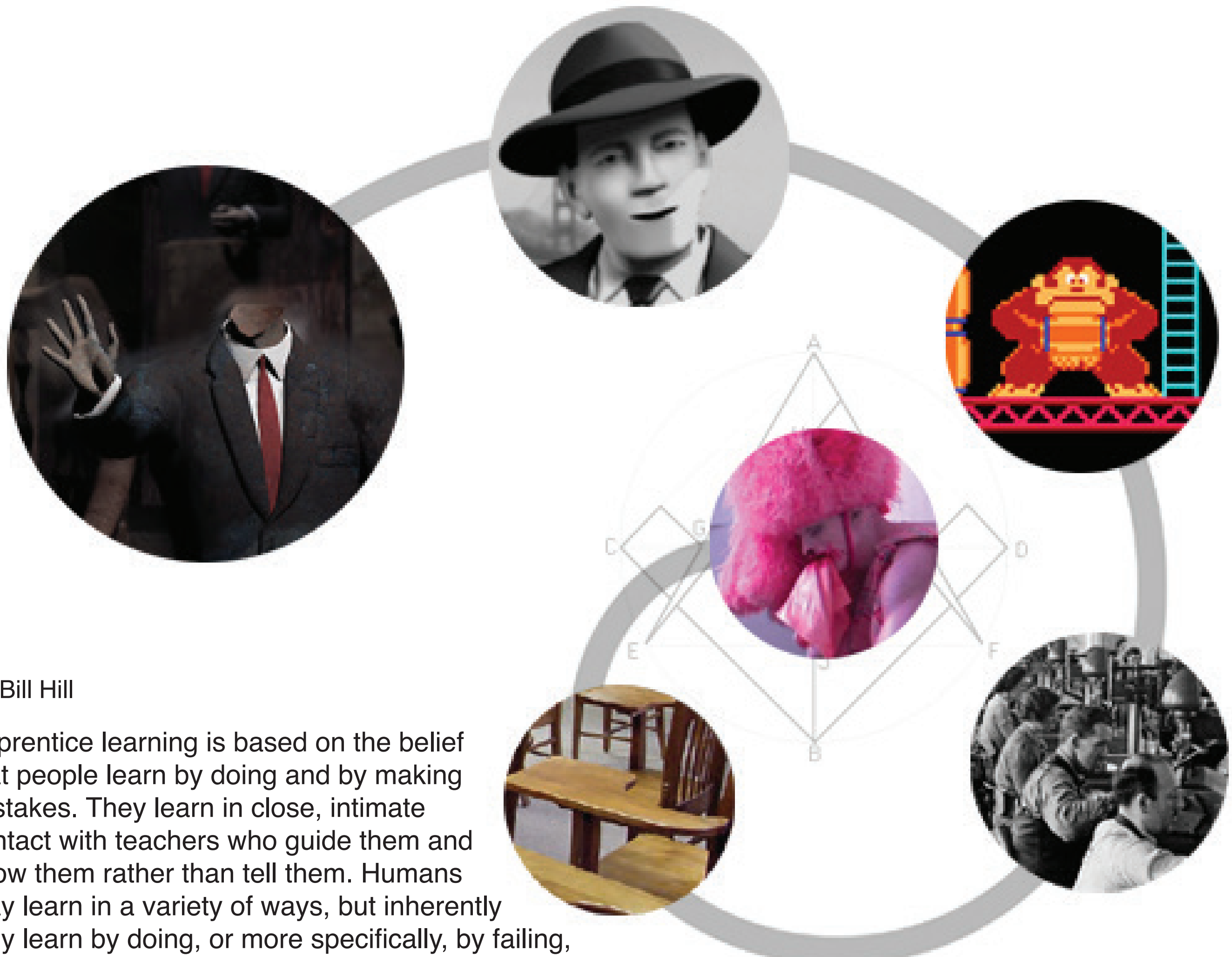
ENTERED APPRENTICE:
A CASE FOR FAILURE IN LEARNING

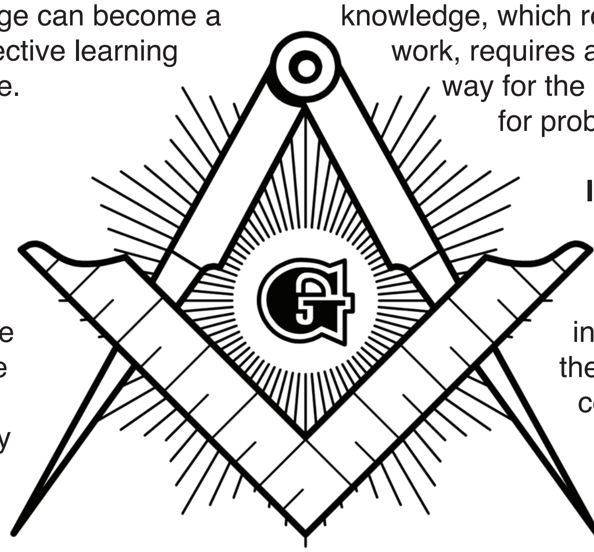


By Bill Hill

Apprentice learning is based on the belief that people learn by doing and by making mistakes. They learn in close, intimate contact with teachers who guide them and show them rather than tell them. Humans may learn in a variety of ways, but inherently they learn by doing, or more specifically, by failing, by trial and error, by making mistakes and correcting them. This is most apparent by watching a young child play a video game. Without fear, without direction, they jump in, not concerned with how often they fail, but focused only on reaching the goal of victory. They never complain of the need to repeat over and over the tasks necessary to gain their skills. They never allow bystanders and onlookers to deter their commitment. They focus on the game. They learn.

Truly engaged learning extends beyond the classroom and must encompass interaction in alternative environments; it is nonlinear and is most widely absorbed when connected to a narrative. Regardless of subject, embracing and integrating seemingly "unrelated" disciplines can build a sense of community to foster horizontal interaction. This deconstruction of traditional top down learning imbues a necessary self-direction. Chiefly, Students acquire deep learning when they are put in the position of the apprentice and they learn by doing under the guidance of a master.

The organization of Free Masonry, with structured roots that span over 350 years and who are believed to have evolved from Megalithic tribes, 5000 BCE, use the teachings from the construction of King Solomon's temple as far back as 945 BCE and not as a mystical cult, but as a body of like-minded, responsible men, who in their own way, wish to progress as individuals and share a journey of personal development towards enlightenment. It is the continual quest for knowledge and the infrastructure of this group, which is of significance. This research seeks to use the underpinnings of Free Masonry, specifically its method of symbolically applying the principles of architecture and operative masonry to the science and art of character building, to construct a series of levels that will compel learning through failure. Although the initial application has been in, three-dimensional computer animation, the need to synthesize raw data and construct compelling narratives will transcend disciplines. In many ways, information technology and the automation, which accompanies it has diminished the amount of failure in our traditional learning model. Specifically, three-dimensional animation, specifically, has grown increasingly reliant on tutorial models, which achieves isolated outcomes without implanting abstract knowledge. The decoding of Masonic language can become a model cipher for constructing effective learning in the forthcoming conceptual age.



A Paradox

As a teacher of evolving and emerging technologies, I have been continually presented with a paradox that continues to shape my interests in education. It is the mixture of necessary right-brain and left-brain cognition necessary to produce students capable of applying the content of my instruction beyond the classroom. As I began teaching this technology I would spend a large amount of time in the beginning building a technical foundation. The instruction was very thorough and I made sure they learned how to use nearly every feature within the software program. After the directed instruction, nearly everyone would be successful on the challenging test over features of the program. What continued to frustrate me, however, was that a few weeks later, as students would be asked to apply their tools more abstractly, they would be incapable of tapping into the content they previously regurgitated.

It puzzled me why these students didn’t remember how to use the software. These were bright students who had had no problems during class and who had done well on the test. Very little time had passed since we had last used the particular tools. There was no reason that they should not know how to use it. I knew I had taught the material well, but there was obviously something I didn’t understand about learning.

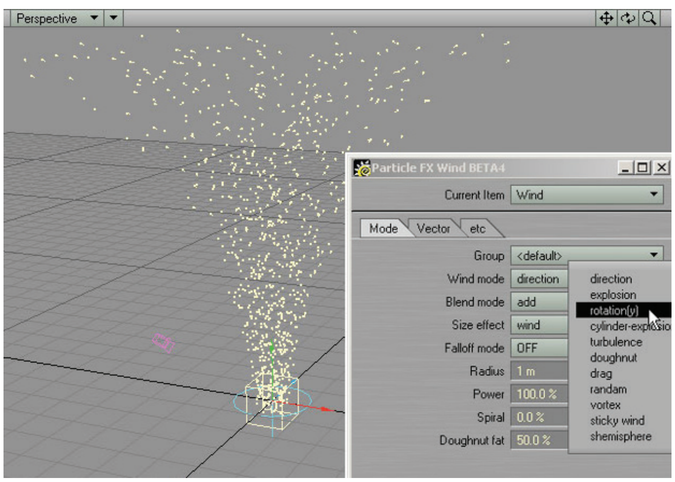
The information was being transferred. Students received the information and indexed it in their brains as evidenced by their success on the tests that required them to recall specific details. But this new knowledge was not retained and, more importantly, was not applied to more learning or to solve problems. It has become apparent that a single mode of transportation of information is not effective to generate the breath and depth of understanding for true learning. The mind can store small chunks of relatively unrelated information. Cognitive scientists refer to this as taxon memory, where the mind can handle chunks of up to about seven units, but its capacity is finite. The type of knowledge, which remains necessary in my coursework, requires a more abstract interwoven pathway for the student to access it and apply it for problem solving.

Industry Standards

It became apparent early on, research into modes of learning would be necessary, but as the students could not look at the content of the courses in isolation, I began to investigate the different methods of delivering education. Computer animation is an ever-changing field, requiring constant retooling and sharpening of skills and knowledge. One of my first questions became; how are professionals in the industry staying current? There are a variety of answers to this question running the gamut from formal instruction in a “classroom” environment to reading a variety of books published electronically or in physical form. Nothing too shocking. So, I began focusing on my students; who they are and how they came to know three-dimensional animation was their career aspiration. Most students come into an undergraduate program in animation with very limited formal education in the discipline. Most high schools, at present, do not include it in their curriculum. But students arrive with a rather significant amount of knowledge of the discipline. Where did they acquire this? It appears much of their education came from television programs and reading. But the delivery of the information wasn’t issue; it was the context in which the information was being transferred. The majority of technical skill had come from tutorials that isolate the information from any context. It is basically a paint by numbers approach to learning where one goes through the steps and reaches the sought outcome, but clear understanding of how and why these steps are taken are many times unclear, if even addressed.

Tutorial Deconstructed

Students are coming into undergraduate courses with previous learning experiences derived largely from tutorials that were sought out because the student had a specific interest in being able to accomplish a particular task. Generally speaking, the tutorial is used to accomplish, not to learn. It is a highly effective form of delivery for the purpose of implementation, but it does not successfully embed knowledge that can be abstractly accessed and used for problem solving or to promote further connections to generate new knowledge. Aside from isolating information, the tutorial usually only commands direct action and does not ask for any reflective response; it does not attach personal connections to the actions; it does not encourage experimentation; but, most importantly, it does accomplish something. It guarantees success. It is this lack of failure that is the greatest hurdle to meaningful learning.



Students for the most part had previous exposure to animation, but not in traditional classroom environment. There was a consensus that tutorials were a good method of learning how to make an animation. But was this truly an effective method of deep learning, which would enable abstract application of concepts in new ways? I assigned each of the students to find an online tutorial for a specific technique they wanted to learn. Without exception every one was a special effects tutorial using particle emitters and hypervoxels. Students where assigned to the same tutorial to create a tornado. This would consist of their creating a particle emitter, which would generate a certain number of particles per second, controlling the lifetime of those particles, and forcing their movement within a virtual space. Once they had achieved the appropriate movement of these invisible points, they would convert them to volumetric pixels, which would have both mass and surface attributes.

In the end, students had successfully achieved their desired outcome of creating a virtual tornado. They had succeeded in a rather easy fashion with little frustration and effort. Every student expressed satisfaction in the learning experience and believed they had learned something of value. When students were asked to apply these newly acquired skills towards a similar technique to depict a waterfall, without instruction they were universally unable to transform the process to the other application. They recognized the tutorial had given them the numeric value to enter into the field with explaining how those values could be applied differently, but more importantly they acknowledged their focus was only on the outcome and not on the process; therefore they ignored what they were exactly doing. Furthermore, a level of immediate gratification was achieved, undermining their psychological ability to develop the necessary foundation to serve them in the future.

Students were then asked to construct an effective tutorial, which would achieve the level of deep learning we were seeking. The following criteria were collectively adopted in their strategies to form their tutorials:

- The use of images and text to illustrate the process.
- Short concise steps.
- Encourage experimentation.
- Open up to personal applications, i.e. show alternative to the steps for other purposes.
- Explain process with analogies to physical world and use cultural knowledge.
- Reinforce benefits.
- Repetition.
- Failure.

Students were reluctant to agree on the need for failure in the learning process, probably because they are programmed to resist failure. Even though from an early age we are told to learn from our mistakes and our earliest lessons are taught only through trial and error, the grading system of organized education discourages failure. Students learn early not to challenge systems, not to experiment, not to take risks, not to process but rather to store and respond. Fundamentally, this is how most structured education is delivered, first by establishing a foundation of solid "Fact Building" and then moving into the more complex creative problem solving applications where those facts will have value. There is a disconnect between the features and their benefits.

In the early months of 1811, workers, upset by wage reductions and the use of unapprenticed workmen, began to break into factories at night to destory the new machines.

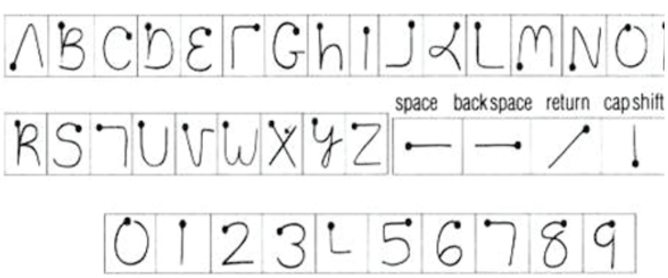
Inverted Foundation

Foundation development is essential for true comprehension of a given discipline, but is it a prerequisite for learning? Ever since the Bauhaus in the early 1920's, there has been a universal approach to visual arts instruction beginning with a foundations program covering the nuts and bolts upon which students would build. The basic concept makes sense. You need to know about the tools before you can use them effectively. If you were building a house you wouldn't start with the windows. You would lay out the foundation and start building up walls and then the roof in a linear fashion.

The same approach has been applied to the learning model in codified education. Computer animation would appear to be perfectly tailored to this hierarchy of learning. There is a large amount of raw information needed before knowledge can be acquired, for example, the operation and understanding of digital technology, both hardware and software. Within the software packages there is an extensive array of tools that rely on vast concepts; understanding of the physics of light and motion; knowledge of the persistence of vision and narrative construction; of sculpting and acting, and on and on. In the traditional model of education all of the areas would require linear blocks of instruction, which must be mastered prior to bringing them together for conceptual applications. But these areas are not independent, and our world is not linear. As Daniel Pink states on the first page of his book A Whole New Mind, "we are moving from an economy and a society built on the logical, linear, computer like capabilities of the Information Age to an economy and a society built on the inventive, empathic, big-picture capabilities of what's rising in its place, the Conceptual Age." In addition, in the electronic age where we find ourselves, the ability to recall information indexed in an individual brain at a moments notice is not as valuable as it once was. Technology has become an efficient augmentation of raw information. What is more important is the ability to contextualize the information and the development of creative applications of such information. Daniel Pink refers to this as symphony. "Symphony is largely about relationships. People who hope to thrive in the Conceptual Age must understand the connection between diverse, and seemingly separate, disciplines. They must know how to link apparently unconnected elements to create something new. And they must become adept at analogy – at seeing one thing in terms of another."

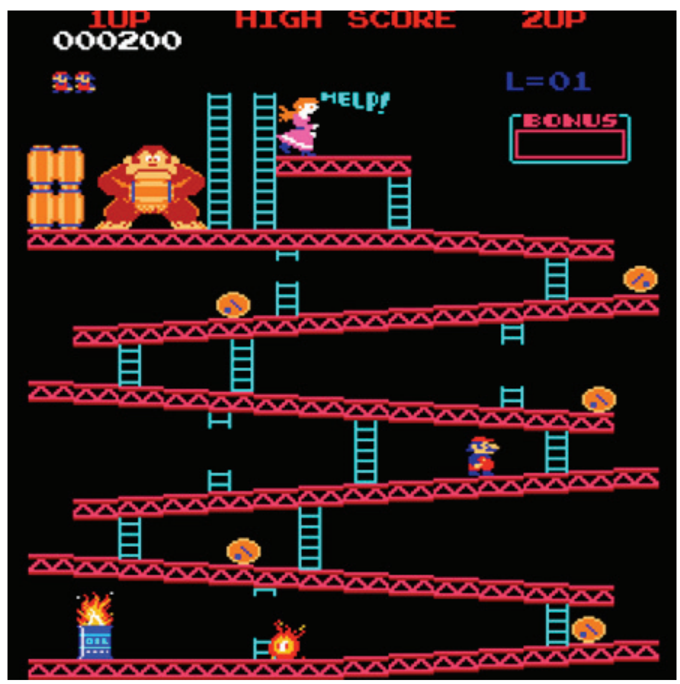
Computer animation relies on this type of synthesis. Students must pull from social knowledge that which is embedded in the telecommunications of their generation. Growing up with MTV and Playstation has produced a generation of non-linear, multi-processing minds, which work best with simultaneous signals. Instead of a traditional foundation of tools, they will require a foundation of concepts. The focus of instruction is not the how, but the why. Understanding the big picture rather than the formal elements is the foundation. It is not a question of the content, which needs to be delivered, but the order and the process of transferring. By focusing first on the conceptual and relying on the failure in the formal areas, students will be self-driven to master the craft of the discipline. Like children learning to walk, provided with an environment where everyone is walking around them, they develop their skills, not by being told the principles of kinematics and anatomy, but by trial and error. They see others around them performing the feat and they emulate them. The same is true for structured learning environments. We cannot teach someone, but we can aid their learning by providing them opportunities to fail; by reinforcing their successes and encouraging continued failure. Just like the tutorial has a level of built-in success that undermines meaningful learning, so too does the structure of tool-teaching, of building a traditional foundation to have increased knowledge built. It conceptually makes sense but the lack of failure ensures a minimal level of deep learning.

The key foundational elements in the emerging technology of computer animation are the more traditional elements of narrative development, visualization, and imagination. Technology is not just a tool. It is information, in that it shapes how we think and, in the absence of an alternate reality (i.e., nature), what we think about and know. Therefore, we must resist jumping to the technical development of tool learning, which has the capacity not only to limit the creative process, but can actually dictate the method of thinking and behavior. For example, the technology of Personal Digital Assistants (PDA's) requires a specific type of physical behavior to recognize the input. If the user does not develop the physical behavior dictated by the machine, the input will not be recognized. Therefore the user's behavior will be modified by the parameters of the technology. Much like the amputee, which remaps their muscular networks to control the prosthesis. Only here we are using a stylus and it is shaping our penmanship. As indicated in the diagram below the construction of letterform must adhere to the system or they will not be recognized.



Beginning students, especially, need to be discouraged from spending all their energies learning to behave as the technology wants them to. Rather they must literally think outside the box and see the hardware and software as a production tool, not a creative tool.

If the tutorial method of learning does not promote deep learning due to its isolation of information, limitation of outcomes and lack of failure, then one possible solution is work in the opposite direction. We create an open-ended structure of exploration, which the student is personally invested and where there is sure to be a significant amount of failure. Beginning outside of the computer, my students developed a narrative based on a personal traumatic experience. For example the night one student's parents separated and had a physical encounter leaving several holes in the walls of their home. They then displaced it onto a non-human characters to structure an alter ego, allowing students creative freedom in their visualization and interpretation. Students spent weeks developing concepts and drawings of the characters, environments, and timing of the narrative. They then acted out scenes as their character, which were videotaped and then examined and critiqued. Finally they had begun the process of transforming their two-dimensional drawings into three-dimensional characters inside the computer and animating the scenes necessary to fulfill their vision. Each outcome is different, each is specifically tied to the students' experience, and the technical skills needed to be acquired in the courses are done by motivated students who are seeing the bigger picture. With the openness of this type of application of a 3D curriculum there is a great deal of uncertainty and many failures and frustrations along the way, but the investment of preproduction visualization and the attachment of the personal connection to the work enables the students to succeed with deeper understanding of the big picture. By the end of the first semester of animation, students will have produced a 15 second animation short with sound that explores a personal experience relayed in narrative format using metaphors.



The other important component of any foundation is repetition. The more often one performs a task the more likely they will retain the information gained by performing that task. Many of my students find difficulty with repetition of concepts; they easily dismiss the review unless a direct outcome is needed. So there must be a constant goal in front of them. Nowhere is this more apparent than in video games. Participants will repeat over and over each level to better their ability. Donkey Kong is specifically highlighted as a solid analogy to the apprentice-learning environment. The student is Mario trying to climb the ladders of success. All the while, he must hurdle the challenges, which his professor, Kong, is throwing at him. His goal is also out of reach; it is a never-ending cycle where the pursuit of ascending the foundation is the outcome. The player of the games learns by failing and by repetition of the same act until they acquire the necessary experience and understanding to move toward more challenges and more failures.

Fellowcraft

As with Donkey Kong, the environment plays a significant role in the development of deep learning. There must be a clear understanding that there is no end to learning, but a separation of degrees of knowledge without end. Another organization, which relies on teaching and degrees, is Free Masonry. Tracing their origin back to biblical times, Freemasons celebrate the myth of Hiram Abiff, famed builder of Solomon's Temple. Before the temple was complete, three ruffians who wanted his great knowledge taunted Abiff. The ruffian demands, "Your life, or the secrets." Hiram responds, "My life you can have, my integrity - never." When they fail to get what they want, they strike Hiram with one of the working tools and he staggers to the next gate and the next encounter. The third ruffian is also unable to extract the secrets from Hiram Abiff. He strikes Hiram on the head with a setting maul and kills him.

Like many social orders, such as the military or priesthood, the Masons have created a system of levels (Entered Apprentice, Fellowcraft, Master Mason, Mark Master). As a rite of passage, the candidate for Master Mason will be taken through a ritual of three stages, which simulates the experience Abiff went through holding onto his secrets and integrity against his three attackers. The Entered Apprentice appears at the bottom of the order starting his ascent up the structure like Mario.

Therefore Masonry teaches that redemption and salvation are both the power and the responsibility of the individual Mason. Saviors [like Hiram Abiff] can and do show the way, but men must always follow and demonstrate, each for himself, his power to save himself, to build his own spiritual fabric in his own time and way. Freemasonry teaches that each man is his own savior and must take the responsibility of acquiring the necessary knowledge. The learning is in their hands and they are empowered by the master masons that guide, share and lead by example. They learn by trial and error and by watching experts around them.

Students see their responsibility in the learning process but they can only learn when they are willing participants. This requires a connection between the instruction and the student's goals. The Master Mason or professor must understand the student's purposes and values so they may be connected with the instruction. The three ruffians did not understand the importance of the journey to Master Mason; therefore they were impatient with the instruction and could not learn. Students must maintain a level of interest in the instruction if they are going to capable of learning.

In nearly every subject taught, as with Free Masonry and digital environments, there are language systems and a level of indoctrination required prior to learning. Terminology and industry jargon act as a barrier to understanding. Specific tool sets inhibit the outsider from performing the necessary activity. And without the basic entry being opened up, student will not attain the experience necessary for success. We must understand there are walls, both physical and virtual that surround knowledge. This needs to become less transparent, especially in Computer Animation. The faculty and student should come to rely on this membership status in education and use the virtual environment of belonging to a group as a foundation to support failure and to enhance meaningful learning.

Disciplines

As Vicky Phillips writes in an often-republished essay, Education in the Electronic Ether; "The idea that the American mind is best taught using a factory model — where students sit in neat rows, holding up their hands for permission to speak, clock-watching their way through textbooks and lectures which are broken into discrete knowledge widgets — has never been shown to be an effective way to learn. It has been shown to be a convenient way for colleges to transcript that a standardized body of knowledge has been dutifully delivered. The American factory model. Everyone on the assembly line is delivered the same standardized units of information (lectures and textbooks); they then all must pass the same quality inspection (objective exams)."

Apprentice learning is based on the belief that people learn by doing and by making mistakes. They learn in close, intimate contact with teachers who guide them and show them rather than tell them. Due to its craft aspects, the instruction in the arts has always taken on a more mentoring relationship between students and faculty. With a low student to teacher ratio it is quite easy to implement this type of instruction. But is this method transferable to other discipline and is it scalable? In short, yes, but it will require a complete shift in the paradigm of codified education models. It does not promote chunks of finite isolated information, delivered in a short period of time and objectively measured. It would require horizontal learning where varying level of students work side by side. It would require faculty to lead by example and foster interdisciplinary team teaching philosophies, which would consistently connect with student's goals. Regardless, there needs to be a clear focus on students not subject, learning not teaching. All too often professors assume the responsibility of the tidy process of didactic, top-down instruction and the students are left to the messy process of learning. Exams, projects, grades are all a convenient way for colleges to certify that a standardized body of knowledge has been dutifully delivered, but is it serving the student? As industry demands increase, it will become increasingly more necessary to modify the traditional undergraduate curriculum into a pseudo-apprentice style of education.

CASE STUDY: Public Art

An example of just such a type of education is the TUCPA commission project, which I developed over the past year with collaboration between the Computer Animation program and our Glass Art, Management, and Engineering programs. It is a collaboration between the Private/Corporate, the Public/State, and Higher Education. It seeks to engage learning and promote service, while addressing the pedagogical concerns of this issue of Apprentice Learning. The Basic Concept of the project is a Site-specific Public Artwork in Glass and other materials, to be created by Jacksonville University students and faculty. The City of Jacksonville has allocated a site within Times-Union Center for the Performing Arts for this large scale project. The Public will be involved in deciding the actual design constructed for the space. Installation and all costs provided by a generous contribution by Brumos Motor Cars, Inc. This artwork will be given as formal Donation to City of Jacksonville via Art in Public Places Commission. Additionally, WJCT will be producing a documentary of this project for local and national distribution.

The advanced students majoring in Glass each designed a site specific piece for the venue. Working with Computer Art & Design students they created an electronic presentation including a Virtual Walk-thru of the space, a website and printed presentation. Additionally Engineering students were brought into the project to assess the load and structural integrity of the design and assist in creating scale makettes. Each team presented their design to the Art in Public Places Commission for approval prior to being placed online for community feedback. Over 1,000 submissions were cataloged, which provided feedback on the designs and expressing a preference. Once the Final design was selected a team of all of the Advanced Students worked together to fabricate the work. Throughout the process students in the management program oversee the budgeting of actual vs. projected costs.

The interdisciplinary nature of the project, which brings together a variety of talents together, allowing them to learn from one another, and the applied realness of the commission forces creative solutions, while stimulating learning beyond the classroom.

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