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Engineering a Humanities Education: Learning like an Engineer in a Theatre Elective

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Introduction

Representing Science on Stage, an elective course for engineers at the University of Toronto, provides students in this faculty with an opportunity to create and engage in theatre. Over one semester, students read, analyze and perform scenes from three plays about science, as well as creating their own original work. Their engagement with course content is supported through activity-based seminars and studio classes focusing on the development of practical performance skills.

This course is one of multiple courses created at the University of Toronto to fulfill the complimentary studies requirements of Canada's CEAB criteria, while responding to the unique challenges of delivering Humanities instruction to engineers. These in-house Humanities electives work to accommodate engineering timetables, address differences in typical course instruction and delivery that may challenge our students, and relieve the self-consciousness of engineering students in an unfamiliar discipline. A more complete discussion of these motivating factors and the University of Toronto's response can be found in Chong, Tihanyi and Wilkinson[1].

While Representing Science on Stage demands that students step out of their comfort zone to take risks in an unfamiliar discipline, it does so in an environment that is familiar: an engineering classroom populated by their peers and taught by lecturers from within the faculty. The administration and content of the course straddles the Humanities and engineering, and as such provides a unique space in which to study the intersection of science and the arts and the perceived positive impact of a liberal arts education for engineers, including increased cultural awareness, greater flexibility in inter and cross-disciplinary collaboration, improved communication skills, and comfort with learning outside the discipline [1-6]. To extend this further, the comparatively homogenous engineering population of Representing Science on Stage and the immersion of its students in a liberal arts classroom that by necessity demands their active participation, affords insights not only into what engineering students gain from Humanities immersion, but also what their engineering approaches may bring to this field.

Background

Last year, these approaches were studied more formally through a paper delivered in a science and theatre panel at a theatre studies conference, a setting that provided insights from scholars on the other side of the science/theatre divide. This study used Kolb's learning styles inventory as its theoretical framework to analyze specific behaviours and strategies found in the Representing Science on Stage classroom. Kolb classifies learners along two basic dimensions of abstract-concrete and active-reflective learning to generate four general profiles: the converger, diverger, assilimator and accommodator. Kolb's assertion that convergers are most suited for a profession like engineering and that divergers are most attracted to careers in the arts is a significant one[7]. His description of the Converger reads in part:

Convergers' dominant learning abilities are Abstract Conceptualization and Active Experimentation. Their greatest strength lies in the practical application of ideas…These persons organize knowledge in such a way that, through hypothetical deductive-reasoning, they can focus it on specific problems. [7]

This description provides an obvious contrast to that of Divergers, which reads:

Divergers have the opposite learning strengths from those of the Convergers. They are best at Concrete Experience and Reflective Observation. Their greatest strength lies in imaginative ability. They excel in the ability to view concrete situations from many perspectives…..people of this type perform better in situations that call for generation of ideas, such as 'brainstorming' sessions. Divergers are interested in people and tend to be imaginative and emotional. [7]

While these definitions were originally published in 1981, a range of studies over the last thirty years have reiterated Kolb's theory [8 9].

Taking this distinction as its starting point the study identified student approaches that appeared commensurate with these types, while also discussing atypical strategies that were not as easily classified, arguing that some of these methods worked to enable the type of convergence, or belief in a single discoverable answer, that is associated with this type of learner. The paper observed that students initially approach play reading and character analysis with a belief in one single correct interpretation (of both character and story). In the process of working towards this elusive right answer, students frequently utilize visual problem solving strategies, most notably graphing, to gain a clearer understanding of character and story arch. They also frequently look to models or examples to aid their understanding and enactment of character. Their approaches could be interpreted as dampening the type of exploratory creative divergence encouraged and nurtured within a theatre classroom, but they also present alternative models for approaching play analysis and development. It argued that these new strategies, while borne out of an education that values convergence, can actually facilitate a meaningful immersion with theatrical subjects, as students find methods or models to more confidently engage with their new discipline.

The study's observations were based on a range of materials, notably student blog posts (a required component of the course), rehearsal diaries recording process on scene development, and in-class observation, and as such extrapolated trends from sometimes disparate types of reflection and communication. Although this method yielded interesting data, without a common prompt that encouraged responses around one activity or issue, this data could appear to be cherry-picked or manipulated. In an attempt to address this issue a new assignment was added to the class that would require student reflection on a more limited range of materials in response to clear and direct prompts. This process analysis assignment introduced a consistent measure for tracking strategies, as students were asked, in response to a single scene performance, to explicitly identify and analyze strategies that they had adapted into their new field.

This study then aims to review responses to the process analysis assignment not only to revisit and further examine some of the strategies uncovered in the earlier study, but also to consider

how students were thinking and talking about these strategies. Could they recognize and articulate the methods and approaches they brought to their own creative process? Were they consciously adapting and applying engineering approaches to their work? Did they see this adaptation as organic? Simple? Challenging? Could they recognize the confluence of different learning approaches in this field?

Process Analysis Assignment

The process analysis assignment is best understood in the context of the larger course design. In Representing Science on Stage, students perform three different scenes in groups of between four and six. The first of these performances is an original creation of the group, while the latter two performances are based on plays studied in the course. The first scene performance was a suitable focus for this assignment given its timing at the beginning of the year, and the fact that it was the students' only original scene work. We believed that at this stage of the course our students would be more likely to borrow approaches and strategies from their engineering training without any bias about their appropriateness for this type of classroom. In addition, the role of student creation from idea generation to plot development to design and performance promised a wealth of material to reflect upon.

The process analysis assignment was distributed early in the semester, as students began work on this scene. As they prepared for their performance they were asked to record their development process, including the generation and application of specific strategies, and then to evaluate their effectiveness, with an emphasis on our four assessment criteria for the first scene performance: clarity of story, clarity of environment, clarity of character and use of multiple languages of performance.

In responding to the assignment students could draw on their independent work or a number of more structured class activities used to scaffold the first scene performance. This scaffolding began with the first studio class activity, when students were asked to brainstorm and record ideas around science and theatre on a large sheet of chart paper. They could record anything on the paper using visuals or diagrams, words, sentences or phrases. Students jotted down examples of science fiction movies, technologies that they saw as straddling these two spheres of science and theatre, and celebrities or characters, for example Bill Nye the Science Guy, that they saw as personifying this intersection. In addition, they recorded some items that did not as obviously overlap, by, for example, sketching a picture of Albert Einstein, a Shakespearean stage, or the comedy and tragedy masks. After this initial brainstorming session students had the opportunity to circulate around the classroom adding items or ideas to the other groups' papers. They were asked to take their chart paper home at the end of the class and to return with it for the next class, but did not learn until then that the elements of this brainstorming session would be used to inspire their first scene.

After this structured start, students had three more studio classes in which to prepare their scene for performance. Each of these studio classes began with a warm-up activity designed to support a particular area of creation. Our warm-up in the second studio focused on clarity of story, and was organized around a children's game in which players are asked to develop a story one line at a time. Each player in the circle provides a new sentence/story idea that builds on the plot development of the previous player. We started this game off by providing the class with a

character, a place and an object to focus the storytelling, but nevertheless, each round resulted in a fairly meandering often illogical story. Our third studio warm-up focused on the development of space and environment, when we assigned each group a place, such as a busy diner, a forest, a library or a beach, and asked them to create these scenes using only movement and sound. Our last warm-up before the final scene performance helped to develop character and was linked to homework from the previous week, when we asked students to write a profile of one of their characters. After a general physical warm-up we asked students to embody their character, paying special attention to their personality and motivation as articulated in the profile. Students were asked to move around the room as their character, and when ready to add a line from their script to this movement. After a few minutes we asked students to stop in front of a random partner to deliver their character line and movement. Their partner then had to share everything they could deduce about this character from their movement, phrase, and vocal and physical delivery, including factors such as age, gender, motivation and emotional state. These activities together worked to strengthen the factors that we would be assessing during the actual scene performance: clarity of story, clarity of space, and clarity of character.

Scope

The addition of the process analysis assignment ensured that all students were considering the creative process in response to the assignment prompts, and consequently promised a greater yield of student reflections on their approach to the new discipline. Unfortunately even with this new assignment, a number of factors that had not been properly accounted for limited the variety of student responses. Students undertake their first scene performance in groups of between four and six, meaning that the class of twenty-seven students divided into five groups in total. While commentary on individual rehearsal strategies might differ, accounts of team-based strategies were consistent between team members. Surprisingly, and as will be discussed in greater detail in the discussion section, most students opted to write very little about their individual work, and consequently these team-based reflections form the majority of content. While this trend speaks well for group cohesion, it limits the diversity of approaches recorded in the analyses and available for this discussion. Furthermore, these team-based activities covered a limited area of the creative process, focusing primarily on large scale decisions such as story development and scenography, as opposed to individual process decisions such as the physical or vocal particularities of character. As a result, most process analyses were comprised almost exclusively of discussions around plot and story development.

Given this limited range of response, this study has tightened its focus to look more closely at just this stage in the creative process, by examining how students worked together to devise and refine their central story. This paper will describe the five different approaches to story development utilized by the teams to consider how these engineering students responded to the creative process, before discussing the various factors that may have led to these approaches.

Brainstorming Strategies

Rather than trying to analyze common approaches across teams, this description treats each team separately and describes their unique process. Interestingly, despite common scaffolding exercises there was little duplication between team approaches.

Team 1

This team, composed of a number of highly motivated students, used strategies drawn from inside and outside of this classroom to produce a handful of different possible story scenarios. Most of the group began plotting the scene before the assignment had been formally introduced in the second studio class. Their enthusiasm actually impeded their process as their plans were entrenched by the time they learnt that their poster was to be their primary creative source. As a result, one team member who developed an entire storyline over the weekend was forced to let go of his project when teammates argued that it did not align with the content of their poster. Despite the eventual rejection of his story, his systematic approach to story development is intriguing. He describes his creative process as follows:

> I did a lot of research that weekend to come up with an idea which would appeal to the audience. My research included looking at various techniques related to delivery of ideas along with detailed research into appealing to the audience's ethos, pathos and logos. From my research I found out that the best way to reach an audience is to appeal to their emotions. Hence, I decided that the next step would be to list down different emotions which we experience to see how I could appeal to that emotion and to see which ideas could relate to them. At this point however, I noticed that I had a lot of ideas around "sadness" and "joy". This made me realise that maybe they are the two strongest emotions which appeal to the audience. Furthermore, I thought that it would be logical to show something sad and then something jolly (somehow overcoming the sadness), so the two emotions would complement each other very nicely. Once I decided to appeal to these two emotions, I wrote down a quick list of possible ideas which could appeal to these emotions.[10]

After his initial work the student decided that his team should produce a scene in which a young, developmentally challenged boy is bullied until he meets an advocate who stands up for him. The student believed that a story like this would at first unsettle the audience (sadness) before reminding them of the good in humanity (joy). His approach is interesting for a number of reasons. His decision to research the most effective way to elicit an audience response seems to reflect the convergent notion of a 'right' way to produce theatre. At the same time, his research into theories of the theatre reveals a source—likely Aristotle's *Poetics*—that provides him with a formula. While the basis of his approach, grounded on the possibility of a formula for good theatre, seems unusual in a drama classroom, it is firmly rooted in a history of theorizing about theatre.

Following their rejection of this student's script, group members introduced a completely new system to generate a plot that was favoured by the entire team. Another group member provided the following description:

> In the first studio class, our instructors asked each team to prepare a poster for future story development. The poster should reflect the relationship between theatre and science. Our team used texts and illustrations to reflect our thoughts about the specified relationship. Following this, our team used these ideas to determine a topic for our short scene performance. Using a structured brainstorming method, where each of the members has to think alone on the topic for five to ten minutes, each member noted down ideas on a story

topic. By selectively voting on only two topics, the winning topic chosen was 'Time Travelling into a Prehistoric Period'.[11]

This later technique brings together the brainstorming exercise from our first studio and a common idea generation technique used in design classrooms across the faculty: affinity diagramming. In this approach team members use sticky notes to generate and record ideas independently; then, with the rest of the group they arrange these silently on a large piece of chart paper, their desks, or a space on the wall. This technique encourages the generation of ideas within a group while mitigating the self-consciousness that might arise in public discussion, when approaches can be immediately rejected or discarded. As a popular approach across various courses in the faculty, it is unsurprising that students adapted it for use within our classroom.

Significantly, a third team member confirms the success of this approach in freeing the team from fear of judgement and encouraging a greater range of response. While speaking to the effectiveness of this approach, his observation also suggests the strong presence of the student whose initial idea was rejected, as he frequently dominated group discussions and rehearsal periods. The teams' familiarity with a range of brainstorming techniques from design courses in the faculty provided them with a useful problem solving strategy for dealing with this challenging group member.

Team 2

This team had an interesting approach to story development, which took advantage of the enthusiasm of one of the group members, while integrating collaborative brainstorming to improve upon his basic story. Like some of the students in Team 1, this team member individually devised and recorded a complete scene directly after the first studio class. Despite his lack of consultation the team was generally happy with his concept, which revolved around a WWII scientist whose rebellious son consumes an experimental drug transforming him into a weapon of war. But while the team was in favour of this framework, they were concerned about its structure; the group was challenged to establish the father-son relationship given the time constraints of the piece. This group was grappling with the challenge of establishing character and relationship, and, rather than undertaking formal research decided to draw on their basic understanding of plot structure.

One teammate differentiated between the successful and unsuccessful solutions that the team used to check the structural integrity of the existing story and to generate solutions in response, writing:

> The next step to developing the story for SSP1 was to define the story. We had discussed many possible ideas of possible settings, plot points, and characters however it was unclear as to how the story would actually progress.
>
> - Ineffective Tool: Free Brainstorming. This tool proved to be ineffective because people were not always brainstorming for the purpose of defining the story. Often people would try to talk about lighting, staging, or little details of the story. Although

these were good ideas, they distracted from what was really important: defining a beginning, middle and end of the story.

- Tool Used: Plot Diagram: I drew a plot diagram to keep everyone on track. By drawing out the plot diagram, everyone was able to see the elements of the story that were not defined. Important points like the point of conflict and point of climax were discussed.[12]

Her simple plot diagram sketches out the story arch, identifying moments of exposition, rising action and a climax before the denouement of the 'secret revealed'.
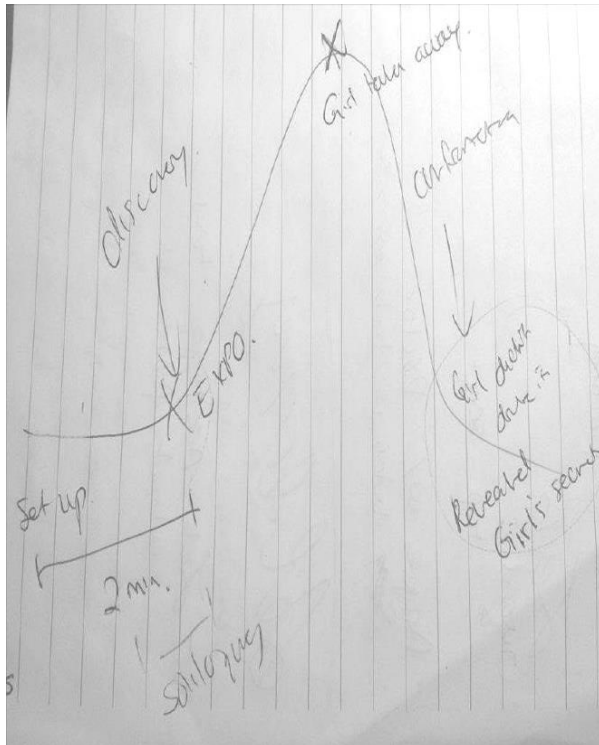

Figure 1. Plot Diagram[12]

Significantly, the climax of the story at this point is identified as 'girl taken away' (the child was originally supposed to be female). The diagram worked to visually elucidate a problem with this configuration as half of the scene would be spent on story resolution, and the team felt they lacked sufficient time to establish the emotional depth needed to make this fallout resonant. In this way the diagram effectively utilized a technical approach to visualizing and understanding story development. This visualization technique, a strategy borrowed from STEM education, allowed this like-minded group of engineers to converge on common ground.

Team 3

This team adapted our second studio activity to collectively create their story. After selecting characters, a setting, and an event from their poster (science students and teacher, science centre and chemical explosion respectively) they rotated through the group, with each group member contributing one sentence of the story at a time, to build a single narrative. While this technique

helped the group to develop an interesting and entertaining scene, they were divided in their feelings about its success. One group member for example, reflected upon this process with considerable ambivalence, writing:

> After defining the characters and the audience, we improvised the story again and built the foundation of our performance. I found the story telling exercise very effective for performances like this one. Although one person could write a story and the rest could perform it, we created a story collectively, which satisfied all of us. We balanced each other with our inputs and had to decide what message we want to deliver as a group. However, I would definitely not choose the same method of story creation if I want to deliver a strong opinion since collective story creation distorts opinions of the individuals unless they all share the same opinion. For instance, I would have loved to portray a critique of companies and their health and safety obsessions especially for office workers.[13]

Interestingly, this student seems to think that this highly collaborative approach worked to weaken or obfuscate a central message. And yet, despite a lack of 'strong' message, his group created a scene with an identifiable storyline, clear characters and a compelling plot.

The strong political and social engagement of some of these students was evident from the nature of their participation in other classroom activities, and in this case their engagement may have impacted their reading of the situation. Perhaps if these students had started by clarifying their understanding of purpose or high-level objective they could have found a balance between message strength and clarity of story. The response of this particular student and his peers may suggest an increased interest in the efficacy of theatre and art over its entertainment value, which may reflect the solution-focused approach of Kolb's convergers: as a group they could agree upon the practical value of using their scene as a vehicle to relay a meaningful message, even if they were incapable of selecting and realizing this central message.

Team 4

While some groups found unstructured brainstorming difficult, especially given the necessity of advancing quickly from team introductions to brainstorming and development, Team 4 found that they were able to fully immerse themselves in this technique with few worries about the rejection of individual ideas or approaches. One group member describes the unstructured process as follows:

> In the first few rehearsals we had a very open ended strategy for our practise. We would heavily rely on *collaborative discussions and feedbacks* from every team member… I think our initial collaborative method and improvisational technique helped us move forward relatively quickly. We got to see what characters and roles every team member was comfortable with, what settings would be feasible within the classroom and how we could progress the story. The collaborative brainstorming technique also got a lot of risky but interesting ideas on the table.[14]

While this student's description is somewhat vague, what he is trying to explain here is the group's rapid transition from group discussion to trying out ideas on their feet. Rather than

spending time thinking about how they could most successfully organize their time, the group immediately began acting out the scene before it was finalized. Some of the teammates reported significant and at times frustrating conflict between team members, and disappointment when an idea was unsuccessful. The group's approach required a willingness to abandon ideas quickly and move on immediately, or to adapt ideas in response to the changing directions of the group. This approach was particularly difficult for a group of engineers who are accustomed to selecting and designing one idea in response to clear requirements. Interestingly, this approach might be compared to a rapid prototyping session, and when the group recovered from their initial discomfort they benefitted from this highly collaborative and experimental method of scene development.

Team 5

This group experienced the most difficulty at this stage of the scene development process, as they dealt with confusion and conflict around how best to tackle the challenge of story development. Difficulty with this task is reflected in the multiple and often contradictory techniques described by different team members. One team member writes about individual brainstorming in the following way:

> In order to come up with a plot for our performance, our team decided to brainstorm individually and then bring the ideas to the team. This decision was made in order to provide diversity of ideas and "free us from the distortions of group dynamics" [http://www.ted.com/talks/susan_cain_the_power_of_introverts]. [15]

The group's assumption that the team is made up of introverts whose participation needs to be fostered and even structured, certainly distinguishes this team from an equivalent group in a 'typical' theatre classroom, who might assume the opposite. At the same time, this approach seems to anticipate challenging group dynamics and problematizes the unfettered participation of all team members.

Despite the promise of this approach it was quickly replaced by a brainstorming session described as follows:

> One of the most important elements of stage performance is the story and how clear it's represented by actors on the stage. During the second week of the class where we first gathered as a group, our first assignment was creating a poster of a play that each group came up during the class. I came up with the idea that the poster we required to make could actually be a skeleton of the plot of our short stage performance and I suggested my team to come up with "words" so that they represent the musts of our performance. This methodology gave us great flexibility on composing the story. The main idea behind was in general all stories are composed of multiple sub-events and actions thus combination of all these sub elements creates the actual flow of the story. Therefore we established our first milestone in creating sub-events of our story by using the words we created during the preparation of the poster.[16]

This approach seems to contradict the top-down or objectives to requirements approach favoured by the majority of other groups, and it is eventually abandoned again in favour of a third technique. One group member describes this convergence around a central story construct:

> During the first rehearsal our team used informal group brainstorming to generate potential topics for our short scene performance. After some discussion of the ideas different members presented, we decided on an engineering fairy tale. From here we started to develop the general structure of our scene. In an attempt to follow typical fairy tale quest structures we chose to have two obstacles before the climax (a third obstacle with much higher stakes). Once we had this general skeleton of our performance, we started brainstorming specific events and scenes. This is when we developed the first scene of our performance. We wanted to open with a narrator in order to keep with the fairy tale motif and use a fairy godfather character to present the quest to the two students. At this point, we discussed creating a storyboard next class and developing a script from that.[17]

While this group eventually settled on one central story, the engineering fairy tale, they were forced to make up for significant process delays as they attempted to integrate these different techniques. Their final story reflected the difficulty they had in deciding on one approach, as a central fairy tale construct was adapted (somewhat confusingly) to accommodate the input of other group members through a number of completely illogical plot devices. The experience of this group (though perhaps disheartening) may be the most logical place to conclude this discussion, as it speaks to the challenge that these students sometimes experience as they navigate this new discipline. This group tried a number of techniques to manage play development, and ultimately found that this unfocused approach was unsuccessful. It could be argued that their integration of multiple techniques runs contrary to the type of unified approach that would typically define their engineering problem solving. In attempting to explore multiple approaches to play development they may have moved too far from their comfort zone, and overlooked the potential of their own structured techniques in contributing to the creative process.

Discussion

The five processes discussed above introduce a range of different approaches to the same stage of play development. Some of these strategies, notably the use of visuals to increase understanding, the use of research in evidenced based problem solving, and the structural analysis of plot or play structure, are all closely related to methods and behaviours employed within typical engineering classrooms. While it is tempting to conclude that these strategies are seamlessly and spontaneously integrated into the other discipline, this reading is complicated by the course delivery: students take the course within an engineering building, surrounded by their peers, taught by course instructors employed by and familiar with pedagogy from the Faculty of Engineering. The students in the classroom can easily gravitate towards familiar methods to establish common ground with their peers from other engineering disciplines.

Significantly, while students were comfortable utilizing the particular languages of their discipline—problem solving, visual representation—to undertake the creative process, they were often overly concerned with the early stages of this process. This preoccupation was evident both in the content of their process analysis assignment, and the difficulty that most of the groups

experienced in moving quickly from planning to embodying performance. While this preoccupation may have limited the scope of this study, it revealed another factor for consideration: why were these students so concerned with this stage of the development process? The answer to this question might be found not so much in their engagement with the class activities, but in their ability to talk about these class activities. At this juncture of the creative process students are still developing a language of performance, or vocabulary for the discussion of theatre techniques; while they may be uncomfortable describing *how* acting or design happens they can describe the process of plot development using the same language with which they would describe brainstorming and idea generation processes in an engineering project. Their choice to write about the initial story development phase also suggests that it remained central to their thinking about the project even after its conclusion. In contrast to a theatre artist or student who might focus on the performance or embodiment of story, the engineering students were most concerned with its foundational structure, and perhaps this emphasis is unsurprising: the selection of a central theme or story-type to guide the rest of the process may be analogous to the step of defining high-level objectives before the functional requirements of an engineering solution.

Despite the limited nature of the process analyses, and the students' corresponding fixation with the early stages of development, the groups consistently produced scenes that were as strong as those one would expect from a liberal arts class tasked with this challenge for the first time. These students then tackled their assignment in a way that made sense to them, by meeting as a group to closely consider the requirements of the project through team discussion and more formal brainstorming techniques before beginning to concretize their design from its structural basis: the story or plot. In this way, their behaviour in this assignment once again speaks to the successful transferability of engineering approaches to the liberal arts classroom, and the suitability of these approaches for a group of performing engineers.

Future Directions

Work on this project is ongoing as a new cohort of students will enter this classroom in September 2015 and provide further insights into the approaches that engineering students may use within a Humanities classroom. To encourage a greater diversity of observations next year the process analysis will be shifted to later in the semester, when, presumably, students will have greater confidence in their independent contributions to the work, and comfort with the vocabulary needed to describe their performance process beyond its initial stages. Practically too, shifting the process analysis assignment will force students to look beyond story development as later scene work uses a pre-existing published script rather than their original work.

Beyond the logistics of effectively integrating the process analysis assignment, this project will also attempt to expand its analyses beyond Kolb's bifurcated learning styles. Adoption of Kolb's inventory assumes a spectrum that places engineers in opposition to their counterparts in the Humanities classroom, but without a focus group from a Humanities classroom, the study delivers a type of one-sided comparison, making assumptions about the types of behaviour that would be delivered there instead of here. One solution to this challenge would be to form this comparison group and to undertake a direct comparison based on the same lessons, scaffolding

activities, and in-class discussion prompts. This approach however, underestimates the complexities of the learning environment that fosters these behaviours.

As instructors in the Faculty of Engineering we strive to create lessons and introduce content in our theatre classroom that fosters engagement from students with an engineering background. On the one hand our 'insider knowledge' helps us to make the Humanities generally, and theatre specifically, more relevant to our engineering students, but on the other hand, it influences our expectations and our delivery. It would be impossible to offer an equivalent type of environment to a student enrolled in a Humanities program because their learning needs would be different, and our knowledge of these needs too would be limited. While this study then affords insights into the way that engineers approach creative tasks it does so in a local rather than universal context. A continued focus in this work will be to identify opportunities for transferable approaches and more global observations that could be applied to new classroom, departmental and faculty environments.

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