

Visual Verbal Integrated (VIVID) Comics - A pedagogy for teaching transferable and humanistic skills in Engineering

Kai Zhuang^{1,2}, Dimpho Radebe³, Mojgan Jadidi ¹, and Evan Hu²

1: Lassonde School of Engineering, York University, Canada

2: Brave49, Canada

3: University of Toronto, Canada

0: Abstract

Transferable, humanistic, and future-ready skills, such as emotional intelligence and ethical leadership, are essential for students' success, thriving, and contribution, particularly in technical fields such as engineering. However, many engineering students, being technically-focused, find these topics difficult to engage with and may lose interest and motivation along the way.

We have been developing and piloting a novel pedagogy, called Visual Verbal Integrated (VIVID) Storytelling, that makes use of educational comics for teaching humanistic subject matters to engineering students. Over the past two years, we have applied this pedagogy to the teaching of visual thinking, storytelling, ethics, teamwork, motivation, and other humanistic topics in various curricular and co-curricular settings in two universities, including two courses taken by all engineering students, a peer mentorship program attended by all first-year engineering students, two bridge-programs for students entering university, a workshop for graduate researchers, and a STEAM program for female high school students.

Our initial experience applying this pedagogy shows that by combining the engagingness of visual storytelling with the searchability and indexability of text narratives, VIVID Storytelling is an effective medium for teaching humanistic subjective matters to engineering students in an accessible, approachable, and inclusive manner while fostering creative and associative thinking as well as relatability of the subject matters.

1: Introduction

The development of humanistic skills, attributes, and learnings that are transferable across career paths are essential for students' capacity to succeed, to be well, and to contribute positively and meaningfully. Skills such as creative thinking, emotional intelligence, motivation, and adaptability are becoming widely recognized as crucial skills for the next generation (Lappalainen, 2015; Rottmann et al., 2015; World Economic Forum, 2020). On the other hand, the lack of resilience, a growth mindset, and self-awareness are recognized as contributing factors for the rising mental health crisis in higher education (Hunsu et al., 2021; Jensen, 2021). However, many engineering students find these topics difficult to engage with and often lose interest and motivation along the way (Badenhorst et al., 2020), and the development of these essential skills and attributes in engineering education has been challenging (Riley, 2008).

Based on our 20 plus years of combined experience teaching humanistic skills to engineering students, we have noticed that there are at least three major challenges in teaching and learning of these subject matters in engineering:

1. **Motivation.** Despite the growing recognition of their importance, the majority of students and faculties in engineering see transferable and humanistic learning as supplementary to technical learning (Rottmann et al., 2015). Influenced by this perspective, students are often unwilling to invest time and effort in these subject areas, especially when faced with a notoriously grueling engineering curriculum.
2. **Approachability.** As a result of their engineering training, engineering students tend to excel in linear, reductionist, and technical thinking and are fluent in the language of mathematics and science (Riley, 2008). On the other hand, they often lack capacity development in emotional, divergent, and associative thinking and are foreign to the language of the humanities. As a result, engineering students may find subject matter involving humanistic and transferable learning daunting and unapproachable from the onset.
3. **Lack of Instructional Expertise.** Most engineering educators are technical experts without the necessary training and experience to instruct humanistic subject matter effectively (Brownell & Tanner, 2012). On the other hand, experts in humanistic subject matter often lack the cultural and disciplinary familiarity with engineering to develop learning experiences that are effective and appropriate for engineering students. Engineering polymaths with humanistic training and expertise do exist, although they are quite rare in academia and their humanistic expertise may be marginalized by the techno-centric culture of engineering education.

In this paper, we will present a novel pedagogy and pedagogical practice inspired by visual arts and practices that integrate visual and verbal elements called Visual Verbal Integrated (VIVID) Storytelling, which produces learning artifacts called Visual Verbal Integrated (VIVID) Comics. We will present four examples where we have used VIVID Storytelling and Comics to teach humanistic subject matter to engineering students in three different learning modalities: workshops or short programs, self-directed reading, and educational videos. We found that this comic-based pedagogy is able to address the aforementioned challenges by: 1) being engaging while requiring relatively low time and effort investment on the part of the student, 2) presenting concepts and learning material in an approachable way while

promoting the development of students' emotional, divergent, and associative thinking capacities, and 3) leveraging and magnifying the unique expertise of engineering polymaths who both understand the culture and idiosyncrasies of engineering education and have the capacity to instruct humanistic subjects through intentionally designed narratives.

2: VIVID Storytelling: A New Pedagogy for Engineering Education

2.1: The Story of VIVID Storytelling

In some ways, the development of VIVID Storytelling, like many pedagogical innovations we have been involved with over the past two years (Jadidi et al., 2021), was an unexpected outcome of the COVID pandemic. In spring 2020, when universities in Canada dove into the mostly uncharted territory of large-scale remote learning, we were faced with three connected challenges: to keep technically-focused engineering students engaged in humanistic learning that is crucial for their future success in a remote environment, to think about accessibility and inclusivity differently in light of remote learning, and to keep the students as well as ourselves emotionally engaged in learning through unprecedented difficulties. Searching for effective responses to these challenges, the first author - who had learned to draw a year prior out of personal interest - began to incorporate drawings in communications with both students and faculty members. As the effectiveness of this pedagogical and communication approach became apparent, the first author began to experiment with applying VIVID Storytelling in a variety of post-secondary educational settings for both undergraduate and graduate audiences, in collaboration with fellow engineering educators - co-authors of this article, leading to the continuing development and optimization of the approach.

2.2: VIVID Storytelling and its Inspirations

VIVID Storytelling draws inspiration from the art of comics and the practices of sketchnoting and VIVID Thinking. By combining visual and verbal elements in communication, these practices simultaneously engage the abstractive left-brain and the holistic right-brain of the audience, making it particularly effective for communicating complex and nuanced ideas and for promoting creative and associative thinking. At the same time, these practices have their own advantages and disadvantages when applied to the educational context. To understand VIVID Comics, we have to first understand the related yet distinct art and practices of comics, sketchnoting, and VIVID Thinking.

The comic is a communication medium and artform that combines graphical storytelling and verbal narrating with the goal of telling an engaging and captivating story. Comics have a long history of being used as a pedagogical and communication tool, particularly for younger as well as mass audiences. A noted advantage of comics as an educational tool is that it inherits the engagingness of visual art with the indexability of written words - a student is kept engaged by the visual storytelling during the first readthrough, and later, the comic serves as an indexable study resource the same way a textbook does. Contrast this with educational videos, which can be engaging, but students would have a hard time looking for specific information from watched videos due to the lack of indexability. A recent example of educational comics is *Sapiens: A Graphic History: The Birth of Humankind* (Harari, 2020), which is an educational comic adapted from Yuval Harari's all-encompassing text on human

history *Sapiens: A Brief History of Humankind* (Harari, 2016). In this case, Harari worked with professional illustrators and comic artists to adapt his original book, highlighting one of the major drawbacks of comics as a pedagogy for post-secondary education: being experts in their fields, educators rarely have the skill and time to design and illustrate comics themselves; as a result, educational comics are the product of collaboration between educators and comic artists, which is a costly and time-consuming process.

Sketchnoting (Paepcke-Hjeltness et al., 2017) is a note-taking practice that has risen in popularity in recent years. Sketchnoting incorporates drawings into the notes with the goal of highlighting key ideas and concepts and improving memory recall. Unlike comics, sketchnoting does not require the sketch-noter to be a great artist - simple drawings based on rudimentary lines and shapes is sufficient for the purpose of this practice. Notably, sketchnoting is also a great tool for facilitating conversations, where the facilitator takes visual notes of the conversation in real-time, and the visual notes serve as catalysts for further and deeper discussion. A recent example of sketchnoting as an educational practice is *The Visual MBA: Two Years of Business School Packed into One Priceless Book of Pure Awesomeness* (Barron, 2019), where the author converted the sketchnotes they took during their MBA studies into a book to share knowledge with readers. Recently, the skill of sketchnoting has been explicitly taught to engineering students to foster engagement and ideation (Paepcke-Hjeltness & Mina, 2021). However, being a note-taking practice aimed at improving memory recall, sketchnotes do not incorporate narrative storytelling, making it difficult to follow for those who did not participate in the event where the notes were taken in the first place.

Visual Verbal Integrated (VIVID) Thinking (Roam, 2011) is an approach to communication and visual thinking developed by business visualization expert Dan Roam. Built on the theory that for most people, verbal communication is linear and reductionist whereas visual communication is holistic and synthesizing, VIVID Thinking describes a number of communication rules that integrate visual and verbal elements to improve communication and catalyze ideation. In many ways, VIVID Thinking is very similar to sketchnoting, and like sketchnoting, VIVID Thinking does not emphasize narrative storytelling the same way as comics do. On the other hand, the rule-based communication approach of VIVID Thinking makes it a highly teachable and replicable practice. VIVID Thinking, to our knowledge, has not been applied to the educational context except as an ideation tool.

We call our pedagogical and communication approach VIVID Storytelling and the learning artifacts produced through this approach VIVID Comics because we have built it by combining the visual-verbal integrated communication rules of VIVID Thinking with the emphasis on storytelling from comic art. We have also incorporated elements from sketchnoting, such as the use of simple visuals, the highlighting of key concepts, and the practice of visual facilitation into VIVID Storytelling practice. It should be noted that while comics and sketchnoting have been applied to the educational context in the past, the art and the practice were not explicitly designed for educational purposes. In our case, we have explicitly and intentionally developed VIVID Storytelling as a pedagogical practice - as such, we were able to combine the advantages of comics, sketchnoting, and VIVID Thinking while eliminating their shortcomings in the educational context (Table 1).

Table 1. Comparing different visual-verbal communication practices for educational purpose

Method	Advantage	Disadvantage
Comics	<ul style="list-style-type: none"> • Engaging storytelling • Easy to follow without prior knowledge or context 	<ul style="list-style-type: none"> • Costly to produce • Requires significant artistic skill
Sketchnoting	<ul style="list-style-type: none"> • Facilitation friendly • Requires little artistic skill 	<ul style="list-style-type: none"> • Lacks emphasis on storytelling • Can be hard to follow without prior knowledge or context
VIVID Thinking	<ul style="list-style-type: none"> • Easy to teach and replicate 	<ul style="list-style-type: none"> • Lacks emphasis on storytelling
VIVID Storytelling	<ul style="list-style-type: none"> • Engaging storytelling • Easy to follow without prior knowledge or context • Facilitation friendly • Requires little artistic skill • Easy to teach and replicate 	<ul style="list-style-type: none"> • None

2.3: VIVID Storytelling in Engineering Education

Combining the advantages of comics, sketchnoting, and VIVID Thinking, VIVID Storytelling produces VIVID Comics that are engaging, indexable, and particularly effective at communicating complex and nuanced ideas and for catalyzing creative and associative thinking, making it an ideal medium for teaching and learning.

Comics can be used in the educational and development setting in three formats:

1. As a visual aid in workshops and presentations, either instead of, or in conjunction with, presentation slides.
2. As self-directed learning material, in particular, as visual workbooks.
3. As the basis for educational videos.

The nature of the VIVID Comics makes it very easy to adapt between these formats. This allows for a variety of alternative offerings to be developed based on the same source material, significantly reducing the cost of development and deployment as well as lowering the barrier to learning and access.

In the following section, we will present four selected examples where we have used VIVID Storytelling and Comics in four distinct learning modalities - workshop, short program, self-directed reading, and educational videos - in engineering education. Through these examples, we hope to demonstrate that VIVID Comics can address the challenges we presented in the beginning by: 1) being engaging while requiring relatively low time and effort investment on the part of the student, 2) presenting concepts and learning material in an approachable way while promoting the development of students' emotional, divergent, and associative thinking capacities, and 3) leveraging and magnifying the unique expertise of engineering polymaths who both understand the culture and idiosyncrasies of engineering

education and have the capacity to instruct humanistic subjects through intentionally designed narratives.

3: Examples and Pilots

VIVID Storytelling is a pedagogy, but it is also an art and a practice. The best way to describe VIVID Storytelling and demonstrate its effectiveness and usefulness is by showing the VIVID Comics produced through this approach. As such, in this section, we will describe four examples where we have applied this pedagogy to teach engineering students humanistic subject matter as well as connecting technical subject matter to humanistic subject matter. We have included the five sets of VIVID Comics developed and used for these four examples in the supplementary materials.

3.1: Workshop: Visual Thinking

One of the first sets of VIVID Comics (Figure 1, Supplementary Materials 1) we had developed was to teach visual thinking using the VIVID Thinking methodology. This set of VIVID Comics was developed as a visual aid for workshops and seminars that ran 1 to 3 hours long. As facilitators, we would share our screens via Zoom and scroll and draw directly on the comics to facilitate the conversation and learning. The workshop was delivered in a variety of settings to a variety of audiences, most notably to a group of fifteen female high school students as a part of an outreach program aimed at inspiring them to take up engineering studies, and to a group of seven engineering graduate students interested in expanding their research skill toolbox.

3.2: Short Program: Motivation and Teamwork

In the summer of 2021, we facilitated two “bridge” programs at Lakehead University and Lassonde School of Engineering. A “bridge” program is a program designed to prepare students entering university for the upcoming learning journey. Being engineering polymaths, we combined our experience and learning teaching leadership skills in industry and academia and developed a set of VIVID Comics around teamwork and motivation. Later, in fall 2022, the first author designed a mentorship program for all first-year engineering students where this comic set was further developed and used to introduce the concepts of psychological safety and self-determination theory (key elements of teamwork and motivation) to first year engineering students. Here, we present the two comic sets (Figure 2, Supplementary Material 2a and 2b) used for the first-year mentorship program at the Lassonde School of Engineering.

3.3: Self-Directed Learning Material: Towards a New Engineering Education

Throughout the pandemic, we were involved in a number of engineering education change initiatives as educators, educational developers, and educational entrepreneurs. In these roles, we were often asked to share our thoughts and perspectives on engineering education with students, faculty members, and other stakeholders. To facilitate this process, we developed a VIVID Comics set as self-directed learning material (Supplementary Material 3). Compared to the previous two sets, this set is intentionally more verbose in its use of text. The increase in verbosity ensures that the reader is able to follow the story with ease, as if there was someone narrating the story. This demonstrates a different use of the comics. To convert the comic set back to a visual aid for workshops and courses, all one has to do is reduce the verbosity (i.e., use keywords instead of full sentences).

3.4: Educational Video: Introduction to Computational Thinking

In the previous examples, VIVID Storytelling was used to teach and discuss humanistic subject matter with engineering audiences. However, VIVID Storytelling can also be used to connect engineering subject matter to humanistic ones, or to introduce engineering subject matter to students while keeping them connected to the bigger picture of people, society, and the environment. In this last example, we present a set of VIVID Comics designed to introduce the concept of “computational thinking” to first year students, and to tell the story of how “computational thinking” can be used to solve societally relevant problems beyond coding (Supplementary Material 4a). This particular comic set was used as the basis of an educational video (Supplementary Material 4b), showcasing yet another use of educational comics. Notably, after the comic set was developed, the recording of the 5-minute long video only took about 15 minutes to record, including preparations and two recording takes. In this example, a student is able to watch the video first, and then refer back to the comics as an indexable reference material.

Figure 1. Sample Page: Excerpt from *Visual Thinking*. Please see Supplementary Materials 1 for the full comic deck.

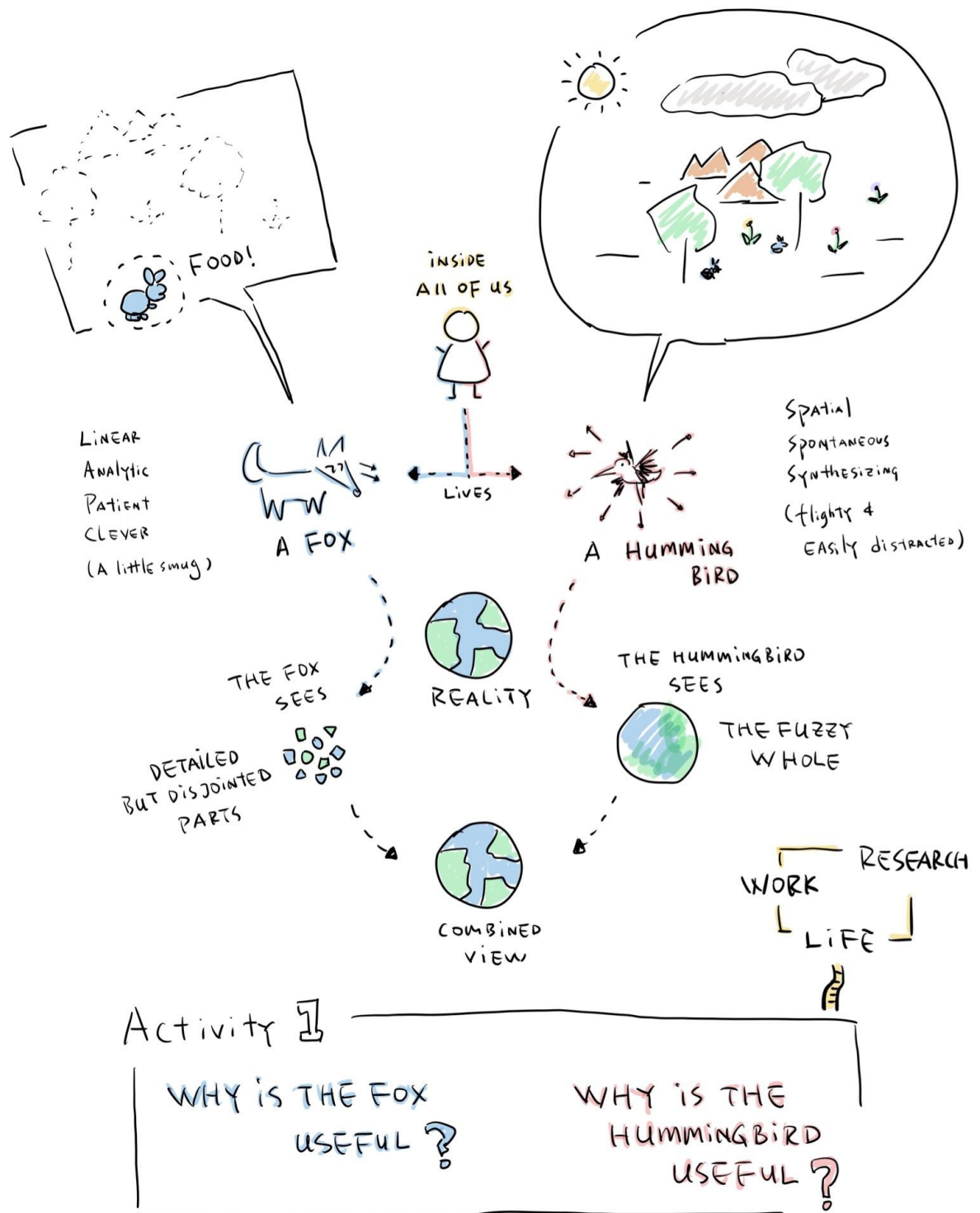
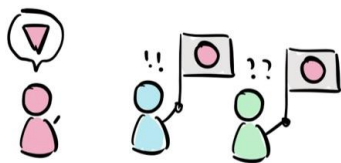


Figure 2. Sample Page: Excerpt from *Foundations of Teamwork*. Please see Supplementary Materials 2a for the full comic deck.

KEY 
LEARNING #1

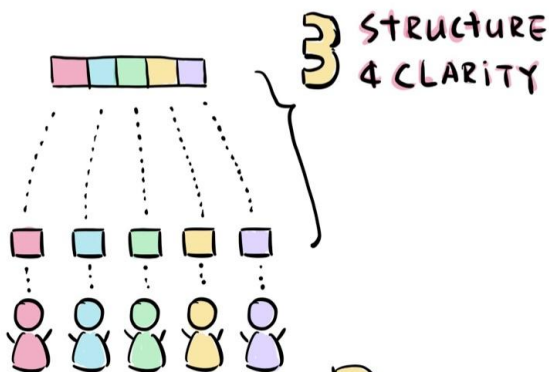
FIVE TRAITS OF EFFECTIVE TEAMWORK

(NUMBERING → ORDER OF IMPORTANCE)



1 PSYCHOLOGICAL SAFETY  MOST IMPORTANT!
DO I FEEL SAFE TO TAKE INTERPERSONAL RISKS?

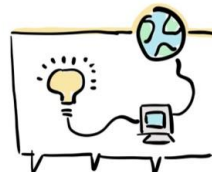
OF ROLES. PROCESSES. EXPECTATIONS.



3 STRUCTURE
& CLARITY

2 DEPENDABILITY
COMPLETE QUALITY WORK
ON TIME

5 MAKING A DIFFERENCE
IMPACT



4 MEANING
SENSE OF PURPOSE


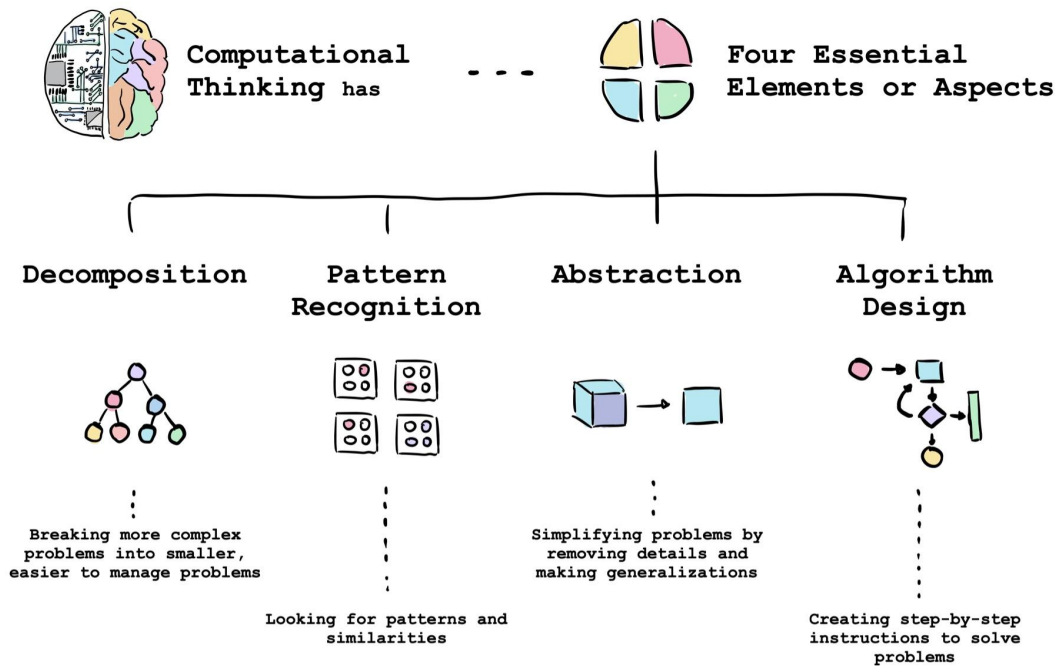


Figure 3. Sample Page: Excerpt from *What is Computational Thinking?*. Please see Supplementary Materials 4 for the full comic deck.



4: Discussion and Conclusion

4.1: Impact on Engineering Education

VIVID Storytelling was developed as a pedagogical tool and practice with a primary goal of meeting engineering students where they are. That is, VIVID Storytelling leverages what engineering students already know and are familiar with (i.e., information portrayed through visual graphics, such as diagrams and charts) in order to communicate new information. While the authors recognize that words are important as they are essential for conceptualizing and communicating information, we also recognise that words have the ability to be pedantic and inaccessible. When considering the diversity of backgrounds present in the North American engineering student body, and that English may not necessarily be every students' first language, finding ways to lower barriers to access new information can help lead to a more inclusive pedagogical practice (Lea & Street, 1998). From the perspective of self-determination theory (Ryan & Deci, 2000), the leading theory in motivation, barriers to accessibility and approachability can cause students to feel incompetent, and consequently lose motivation. By making learning more approachable and accessible, we enable students to experience competence and mastery more easily, thereby preserving and improving motivation. Additionally, by emphasizing storytelling, we make the learning more relatable to the students, further improving their motivation to learn. Thus, the approach of VIVID Storytelling takes into account the pedagogical context that engineering students are grounded in, as compared to humanities and social science students who's learning is grounded in extended vocabularies (Palfreyman & van der Walt, 2017). As such, VIVID Storytelling presents a unique entry-point for bringing humanistic subject matter into engineering curricula and co-curricula. From our experience using VIVID Storytelling with a

variety of audiences and in a variety of modalities, we believe that this is the strength of using VIVID Storytelling as a pedagogical tool.

4.2: Impact on Education Beyond Engineering

Despite the fact that VIVID Storytelling was developed primarily for engineering students and within the engineering education context, it is evident that VIVID Storytelling has the potential to be a new pedagogical tool and practice that extends beyond the boundaries of engineering education. Academic language can be unapproachable and inaccessible to many. It is for this very reason that Knowledge Translation has come to be recognised as necessary with respect to academic research (Jessani & Bennett, 2011). Some scholars have also pointed to the ways in which academic language itself can be oppressive, in that it is designed to showcase one's mastery over a particular kind of use of words to indicate a particular kind of knowledge, often valuing certain types of knowledge over others (Andreotti et al., 2015). Our education systems are also structured in such a way that we associate a grade value to the words that students can produce, and often our value as a person gets associated with the grades we receive (e.g., SATs). This relationship with words can be oppressive in nature and traumatizing for many. As such, VIVID Storytelling and Comics is one of many ways to decolonise the academic language. Because this approach is accessible, accesses both the left and right brain, and is emotional and associative in nature, it provides an easier path to embodying the skills and attributes communicated within the content (Carney & Levin, 2002). Using visual storytelling, VIVID Comics decentres literacy while prioritizing and accessing non-verbal forms of communication (Palfreyman & van der Walt, 2017). Our primary goal is for students to have deep learning experiences; not necessarily to be able to generate words, but rather to acquire skills and attributes needed to embody these practices, and embodiment has no words. In this way, VIVID Storytelling is situated within an expanding body of pedagogical practices related to recognising and valuing multiple epistemologies.

4.3: Future Plans

Despite the fact that VIVID Storytelling and Comics developed organically from our own passion and interest, this pedagogical tool and approach was appreciated by both students and faculty members. Similar resources are limited or even impossible to find or adopt. Thus, we have become motivated to invest our time and resources into developing a series of open sourced educational comics as virtual educational resources for teaching future ready thriving skills, such as emotional intelligence and ethical leadership.

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Supplementary Materials

- All supplementary materials are contained in a Google Drive:
<https://drive.google.com/drive/folders/17b5ggk4Xn03Vm3hnT52Bnx3qzSsAYJUO?usp=sharing>
- We will provide a permanent hosting solution upon acceptance of this paper.
- There are six supplementary material files, five PDF documents and one video file.
- The files are named with with prefix “SM #” where SM denotes “supplementary materials” and # denotes the order of the files.
- The files are:
 - SM 1. The Art of VIVID Thinking.pdf
 - SM 2a. Foundations of Teamwork.pdf
 - SM 2b. How To Be A More Motivated?.pdf
 - SM 3. Towards a New Engineering Education.pdf
 - SM 4a. What is Computational Thinking.pdf
 - SM 4b. Computational Thinking ComicDemo.mp4