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The pedagogy and potential of educational comics

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The Pedagogy and Potential of Educational Comics

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Introduction – Educational Comics, Past, Present and Future

Comics can be effective and sophisticated tools for education, but they have often been associated with frivolity, irresponsibility and even illiteracy. Despite skepticism and criticism from many mainstream cultural and educational institutions for much of the 20th century, advocates for comics have recognised the pedagogical potential for this "major medium of communication and influence" (Zorbaugh 1944, 196) for more than a century. From newspaper comics in the 1920s that were used as history lessons (Kleefeld 2014), to the monthly comic book about mechanical maintenance that the United States Army has published since the 1950s (Bakwin 1953; Eisner et al. 2012; Mercer 2011, 623), to the Marxist 'graphic guides' that gained widespread popularity in the 1970s (Lekachman 1979), there is a long history of comics being used for educational purposes.

Today, a growing volume of contemporary examples is joining that history, as comics and graphic novels are becoming increasingly accepted, and even championed, as educational tools (Chowdhury 2015; Depares 2014; Fessenden 2016; Garrelts 2012; Hunter 2013; Short 2012; Sousanis 2012). In the early 2000s, comics were frequently advocated as a way of assisting struggling or sub-literate learners (Allen and Ingulsrud 2003; Bitz 2004; Hughes-Hassell and Rodge 2007; Schwarz 2002; Wilson and Casey 2007), and more recently the medium has been used at the highest levels of education (DeSantis 2012; Hawkins 2013; Lin

et al. 2014), and even as a primary form for publishing academic research in journals like *Nature* (Monastersky and Sousanis 2015) and *The Annals of Internal Medicine* (Green and Rieck 2013). Emerging fields such as Graphic Medicine and Applied Cartooning are developing this trend further by increasing the places where comics are used as targeted educational interventions (Albright 2014; Squier 2015).

Despite this historical legacy and contemporary significance, scholarship on educational comics remains sparse. Even as experimental research is validating the use of comics in education (Hosler and Boomer 2011; Katz et al. 2014; Mallia 2007; Short et al. 2013; Sim et al. 2014; Spiegel et al. 2013; Webb et al. 2012), the field lacks a body of critical theory. Although researchers have shown that comics *can* succeed as educational tools, the questions of *why* and *how* they work best have been left relatively unexamined. This article will situate educational comics within the conceptual frameworks of media studies and critical pedagogy primarily through the work of two major voices in these fields, Marshall McLuhan and Paulo Friere, respectively, to develop a *pedagogy of comics*, a theory of how they help readers to construct an understanding of the world.

My intention in returning primarily to the work of these seminal theorists is to provide a broad platform to build from. McLuhan and Freire are both pioneers of their respective fields of media studies and critical pedagogy, and both produced their most influential works during the late 1960s and early 1970s, a time of great technological advancements and political upheaval. Perhaps due to the similar changes affecting today's society, scholarly interest in both Freire and McLuhan remains strong today. Recently, scholars have given McLuhan's work a favourable reappraisal compared to the scepticism if garnered from his contemporaries (e.g. Duffy 1969; Mitchell 2014). Hiebert (2014) argues "it's hard to overstate McLuhan's prescience." Meanwhile, Freire's work has remained central to the field of critical pedagogy since radical educators embraced the English translation of *Pedagogy of the Oppressed* in 1970, and he has been the subject of more than 100 scholarly books (Darder 2014, ix). Many writers and researchers have critiqued and expanded upon on both McLuhan and Freire's theories, some of which will be discussed below.

Ultimately, this article uses the work of McLuhan and Freire to argue that comics often ask readers to interpret and draw connections in a way that can lead to deeper engagement with the material, and can be a potential site of *praxis* where readers can be active participants in the construction of meaning. The final section of this article applies this

pedagogy of comics to several recent educational graphic novels to demonstrate how this framework can be used.

Hot Lectures and Cool Comics

Given the growing mainstream acceptance of educational comics in the early 21st century, it's striking to note that the pervasive view of educators during the 20th century was that the comic book form was not just uneducational, but *anti-educational*. In 1940, Sterling North claimed that comics "make the child impatient with better, though quieter, stories" (North 1940, 56). Frederick Wertham reiterated this line of thinking: "The most important harm done by comic books is in the field of reading. They interfere with elementary mechanisms of learning to read and with the acquisition of the essential perceptual techniques" (Wertham 1954, 396)." Comics were accused of spoiling children's brains by being too appealing and too "easy to read." These criticisms were not just based on the content of the comics, but on their formal properties, so it is useful to consider how comics mediate information differently compared to forms more commonly used for education, such as lectures, seminars and textbooks.

The Canadian media theorist Marshall McLuhan provides a useful lens for examining the properties of comics as a medium. McLuhan is remembered for popularizing the exhortation "the medium is the message" (McLuhan 1964, 7), a phrase that encapsulated his central argument: the way that information is communicated has at least as much communicative value as the 'content' of that information. McLuhan was interested in how societies change in concert with the technologies that they use to mediate communication (Bobbitt 2011). As a way of understanding the differences between forms of media, McLuhan conceived of a theoretical spectrum where forms of media could be organised according to their affordances and effects (McLuhan 1964, 22-24). At one end, McLuhan placed what he called "hot" media forms, which engage in one sense directly in high-definition, while the other end of the spectrum contained "cool" media forms that are of a lower definition and require more participation from audiences.

For example, McLuhan considered cinema to be "hot," as the cinema-going experience is one where the viewer is relatively passive, sitting in a darkened theatre, absorbing a projected image that is vibrant, intense and high-resolution. By contrast, he

considered television to be “cool” both because the images were of a lower resolution, and also because the viewer had more control: they might be compelled to change the channel, or move around the house, or choose to just listen to the program while doing chores, for example.

Another example that McLuhan gave is forms of dance (McLuhan 1964, 27). He contrasted the “hot” waltz, which prescribes dance moves and body positions in a precise way that allows for many dancers to be moving in sync with each other without disruption, and its opposite, the “cool” twist, which reduced to its most basic form is really only the barest suggestion of movement, allowing for a wide variety of individual interpretations, and expressions of personal style among dancers. The fullest expression of the waltz involves many bodies moving in time, like clockwork machinery, while the excitement of the twist comes from seeing a personality emerge out of each dancer.

McLuhan’s work has been criticised as placing too much emphasis on formal properties at the expense of content and context, and therefore falling into mechanical determinism (Williams 1974). However, more recently scholars have defended McLuhan’s approach as being historically focused and dialectical (Grosswiler 1996; Guins 2014; Kroker 2015). Bobbitt reminds us that McLuhan used “hot and cool media not in terms of static definitions but as dynamic concepts that are designed to get at the *experience* and *effects* of how we use media” – a medium that is experienced as “hot” in one culture or time period may feel “cool” in another (Bobbitt 2011). For example, when McLuhan classified television as cool, he was writing in the days when television screens were small, and colour TV was only beginning to be popularized in North America. Today’s wide-screen, high definition, flat panel “home theatre”, ad-free, subscription-based streaming subscription television viewing allows for a much “hotter” viewing experience was possible in the 1960s. McLuhan did not mean for these terms to be deterministic or absolute categories, but as a way of talking about the way different media interact with and are experienced in particular cultures.

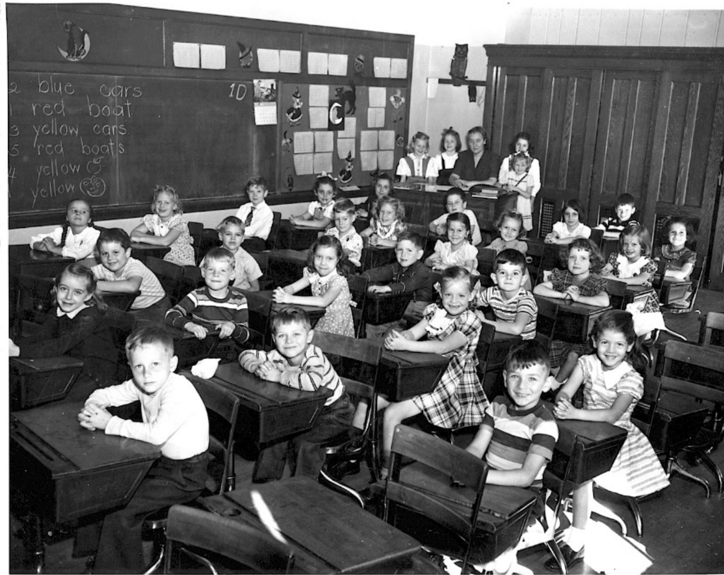
Under McLuhan’s taxonomy, other “hot” media forms include lectures alongside radio and print and lectures, while other “cool” media forms include telephone conversations, comic books, and seminars (McLuhan 1964, 22-23). McLuhan’s theories about the “coolness” of comics have generally been overlooked in studies of educational comics, but they align well with more contemporary theories about comics developed by scholars including McCloud (1993, 2006) and Groensteen (2007). Briefly, the low-resolution style of

drawing used in many cartoons requires readers to use their imaginations and memories to fill in the gaps, while the combination of words and images "make comics a potentially poly-semic text, encouraging multiple interpretations, even ones completely oppositional to any specific artistic intent" (McAllister et al. 2001, 4). Whether one agrees with McLuhan's taxonomy or not, it is clear that the form used to express a message plays a substantial role in how that message can be understood and interacted with. As McLuhan intended for his "hot" and "cold" distinctions to be both culturally and historically dependent, it is also important to examine the broader cultural context in which these forms of communication were formed.

Comics and Educational Authority

At the height of comic books' popularity in the 1940s and '50s, teachers complained of being "plagued" by "heathen" students who would "surreptitiously carry copies of comic books between the covers of legitimate textbooks" (Dias 1946, 143), as a tactic to avoid doing any actual learning. Photos of children reading comics from this time commonly show the readers spread out on the floor in youthful disarray, and stand in stark contrast to typical photos of classrooms from the same period, where students sit in identical desks arranged in neat rows.

Reading comic books on the floor. Photo from 1951, published in *Friends* Magazine, August 1959 (Mavlen 2011)



First grade class, Highland Elementary School, Midland Park (1961)

In these images, we can see bodily reactions to the “hot” and “cool” effects McLuhan delineated. The image of the classroom, although obviously staged for a photographer, is a depiction of what we might consider the “ideal” classroom: rows of students neatly arranged with hands on their desks and smiling faces focused at the front of the classroom, where there might be a teacher about to deliver a lecture. McLuhan considered lectures to be “hot”, as they engage one primary sense, hearing, in a direct and focused way. The students fold their hands and focus their eyes on the teacher to be more fully immersed in the lessons of her words.

The classroom might be arranged in a different way, and bodies positioned differently, to engage with the other pedagogical form McLuhan classifies: the “cool” seminar. In the case of seminar-style teaching, desks are often rearranged and turned inward to allow students to talk and engage with each other, to watch and listen to many different sources, and to participate themselves.

The physical arrangement of precise order in the lecture-style classroom is mirrored in the layout of “hot” typeset text and textbooks, where each letter and sentence has a designated place, facilitating reading in a single direction and a particular order, as the eye moves in an orderly way across the page. Lectures are often transmediated to textbooks, an adaptation that is facilitated in part by the mutual “hotness” of both forms. In each case, the focus on the words, either spoken or printed, is prioritised above all else.

Unlike the word-based linguistic structures of lectures and textbooks, comics are generally not read in an entirely linear way. In *Literacy in the New Media Age*, Gunther Kress, following in McLuhan's footsteps, examines the affordances of different kinds of media. He notes that "Reading paths in writing (as in speech) are set with very little or no leeway; in the image they are open" (Kress 2003, 4). In comics, this effect is multiplied by the presence of multiple images. Although panels may at times resemble still frames from the "hot" medium of film, unlike in film, readers do not process these panels in an entirely linear way. Readers can look at multiple panels at once, or move back and forth between them at will, and eyetracking studies of comics have shown that while there is some consistency in what readers focus on when shown individual panels (Jain et al. 2012), when given a comics page to look at, readers find their own individual paths through the panels and word balloons on the page rather than following a fixed path as is common when reading conventional text (Claytor 2015; Ny et al. 2012; Omori et al. 2004).

As French film director Alain Resnais explained, "sometimes one must pick up a [comic book] page and turn it around to study some of the details. You can't do this with a film. In a good comic strip, in fact, the reader is asked for a greater measure of intellectual participation" (Resnais and Pascal 1971). This engagement is exemplified in the photo of the boy sitting on the ground surrounded by comics – it's easy to imagine he has turned the pages around, flipped them over, and generally immersed himself in the pile of comic books on the floor. The less structured reading style afforded by "cool" comics in comparison to the more structured reading style afforded by "hot" textbooks can be usefully paralleled with the less structured teaching style of "cool" seminars in comparison with the more structured style of "hot" lectures.

These photos are also a picture of the relationships between children and adult authority figures. The world of reading comics has traditionally been seen as one that adults and parents are excluded from. Parents may encourage, tolerate, or even vehemently oppose the reading of comics by their children, but the act of reading comics has traditionally been seen as entering a world in which the authority of adults is disregarded. The boy in the photo looking up to see an adult is caught between worlds. Education, conversely, is a world where teachers, parents and adult figures are assumed to have absolute authority. The well-behaved students in the classroom photo are looking up expectantly, as if at an adult figure who will soon impart knowledge to them.

This institutional and regimented conception of authority and education is part of how schools perform the roles of what Foucault would call "normalizing institutions," where hierarchies of authority are reinforced through the organization of the classroom (as seen in the photo above), the privileging of facts over concepts, and teaching that is oriented more toward "standardized tests than for intellectual nourishment" (Cheshier 1999, p. 12).

As Roger Deacon argued, even an "apparently 'simple' transfer of knowledge from one person to another… cannot be disentangled from those authoritative processes which seek to instil discipline into the deepest recesses of the school system, into the moral fibres of its inmates" (2005, 89). The regimented, hierarchical and compartmentalised systems of education were generally communicated through what McLuhan would classify as "hot" media forms, "from the gymnastics of handwriting to regimens of personal cleanliness" (Deacon 2006, 182).

Deacon (2005, 2006) theorised that these authoritative power structures in education were considered "moral orthopaedics," systems for fashioning children's bodies and minds to conform to adult expectations for upstanding citizens. By contrast, comics were thought to bring about moral decay in children, and crusaders in the 1950s compared their damages to those of drugs, alcohol and pornography (Criswell 1955). This sentiment is central to how comic books were understood during most of the 20th century, as a place free from the authority of adults and educators. By contrast, the presence of adult authority is integral to our cultural understanding of education, and educational texts. However, since the 1960s, theories of authority in education have changed substantially, particularly through the field of 'Critical Pedagogy'.

Critical pedagogy: the banking model vs dialogue and praxis

Critical pedagogy has called into question the effectiveness of authoritative styles of teaching, such as lecturing and regimented forms of discipline, as a growing body of evidence suggests that active and collaborative learning techniques result in better outcomes (Alt 2014; Bligh 1998; Calder et al. 2007; Clynes 2009; Doyle 2011). Much of the bedrock of this field was developed by Paulo Freire, a Marxist who concerned himself with breaking down the unequal power structures that he critiqued in *The Pedagogy of the Oppressed* (1972). Freire's work can be characterized as part of the 1960s Latin American movement called *conscientização* in Portuguese, which is described in the English translation of *Pedagogy of the Oppressed* as "learning to perceive social, political and economic

contradictions, and to take action against the oppressive elements of reality" (17). These contradictions can be understood through the lens of Freire's theory of the "banking model of education."

Freire used the banking model to critique the idea that teaching is a one-way transmission of information from teacher to student. He described it thusly:

> *"(a) the teacher teaches and the students are taught;*
>
> *(b) the teacher knows everything and the students know nothing;*
>
> *(c) the teacher thinks and the students are thought about;*
>
> *(d) the teacher talks and the students listen—meekly;*
>
> *(e) the teacher disciplines and the students are disciplined;*
>
> *(f) the teacher chooses and enforces his choice, and the students comply;*
>
> *(g) the teacher acts and the students have the illusion of acting through the action of the teacher;*
>
> *(h) the teacher chooses the program content, and the students (who were not consulted) adapt to it;*
>
> *(i) the teacher confuses the authority of knowledge with his or her own professional authority, which she and he sets in opposition to the freedom of the students;*
>
> *(j) the teacher is the Subject of the learning process, while the pupils are mere objects."*

(Freire 1972, p. 73)

Pedagogy of the Oppressed has been extremely influential, and to many educationalists "it is not only a classic but continues to be relevant in the twenty-first century" (Macedo 2013, 8), continuing to inspire new approaches to research and pedagogy (e.g. Benade 2015; Castro 2016; Martinez-Maldonado et al. 2014; Narita and Green 2015; Rodrick 2013; Wilkins 2013). However, is not without its detractors. Sol Stern, described by the *New York Times* as a "cantankerous provocateur against liberal education policies" (Medina 2008), has lamented Freire's influence on American teachers, and criticized his work for being overly vague and focusing on political ideology, noting that it fails to address practical problems that educators face, such as "testing, standards, curriculum, the role of parents, how to organize schools, what subjects should be taught in various grades, how best to train teachers, the most effective way of teaching disadvantaged students" (Stern 2009). However, as Stanley Aronowitz argues, it is a misreading of Freire's work to view it as "a kind of manual for teachers" (Aronowitz 1985, 8). Instead, it should be understood as a critique of the power structures of Western educational systems which normalized the idea that teaching and learning work via a one-way transmission of knowledge from teacher to student (Kuhn 2015). Reprinted below is a cartoon by Arnold Roth (2009) that accompanied Stern's article,

representing a frightful vision of what critics of Freire's work fear could happen if the banking model were to be overturned.

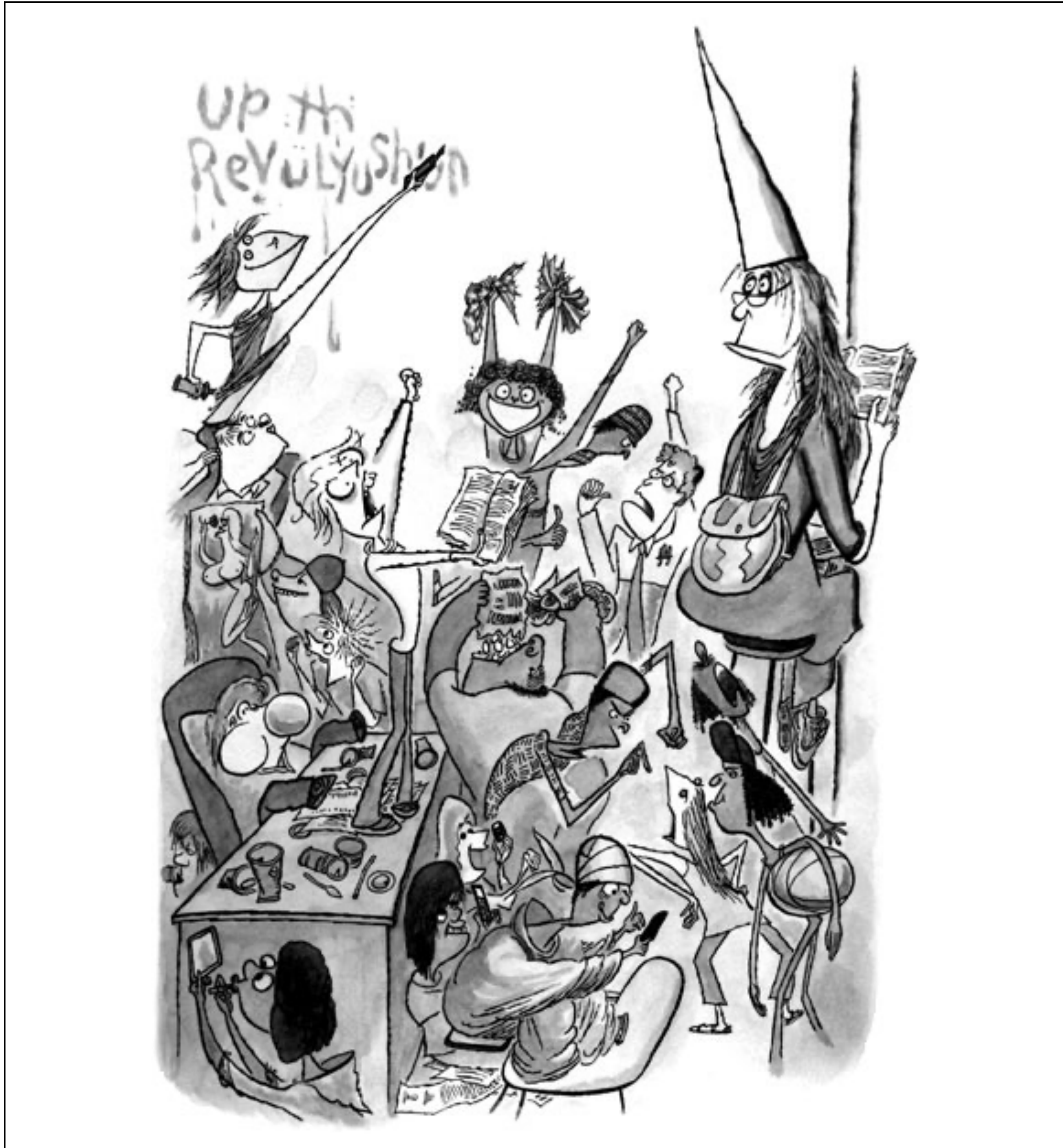


Figure 3: Arnold Roth's cartoon inverts the lecturer-dominated classroom and replaces the pointer with a child's cartoonishly long arm.

What is missing from this cartoon is any sort of dialogue. Instead of presenting the dialogic pedagogy that Freire advocated, this cartoon simply shows a funhouse mirror-image of the iconography of the banking model. The exaggerated arm of the student in the upper left resembles the traditional lecturer's pointer, parodying its traditional authority. In another reversal of the traditional power structure, it is the teacher (wearing a dunce's cap) who is placed in a position of subjugation, forced to sit and listen (meekly) to the ranting nonsense of the students. Roth's cartoon is meant to critique Freire's work, but it can actually be read

as a critique of the educational power structures that Freire sought to overturn. The traditional, oppressive, power structure of the classroom is still extant in Roth's cartoon – is has simply switched polarities, so that students are now the oppressors and the teacher is the oppressed. This replicates the one-way flow of power that Freire critiqued. What Freire advocated for was not this carnivalesque inversion of the classroom, but instead an entire reimagination of the way power works within education, where instead of taking on the roles of oppressor and oppressed, teachers and students could act together as co-investigators.

A better cartoon image of Freirian pedagogy is this depiction of a preschool classroom from the comic strip Cul De Sac by Richard Thompson.

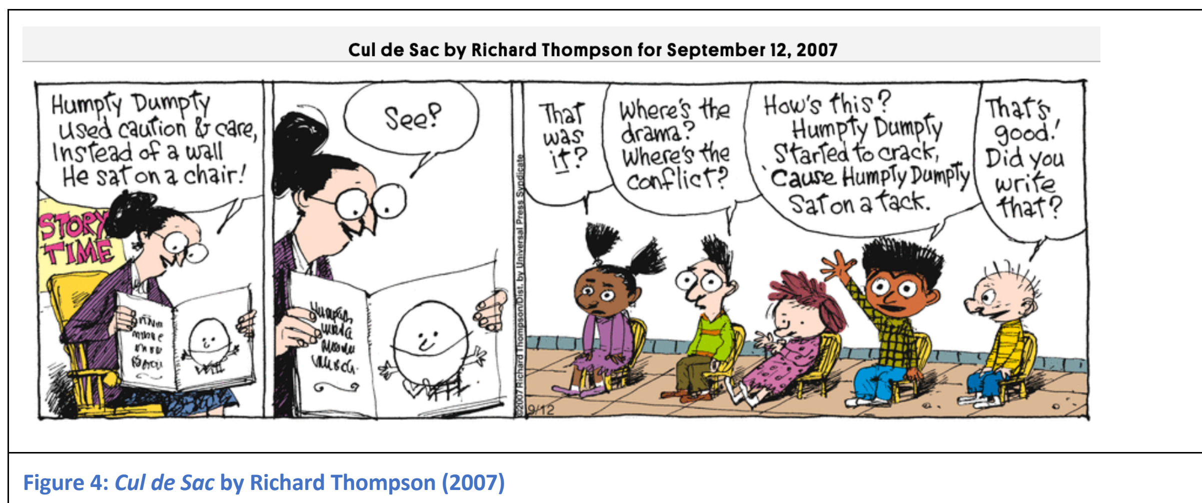


Figure 4: *Cul de Sac* by Richard Thompson (2007)

In this comic, the beleaguered teacher Miss Bliss is telling a sanitised version of Humpty Dumpty teach her young students a moral lesson about safety (sit on a chair, not a wall!), perhaps expecting them to internalise this message as she sees it, as the banking model would expect. Her students, however, take this lesson in divergent ways. They critique the story ("Where's the drama?"), propose and discuss new versions, or are otherwise immersed in their own worlds. They are constructing their own meanings from Miss Bliss' lesson, potentially learning quite a bit more than she was prepared for. The comic implies that this learning will most likely go unattended to, as in Cul De Sac's strips Miss Bliss typically disciplines students and gives up on lessons when the students don't behave as she expects.

By contrast, Friere advocated a form of education in which teachers and students become joint investigators in dialogue with each other. In this dialogue, both teacher and student are positioned as learners, where "both participants bring knowledge to the relationship and one of the objects of the pedagogic process is to explore what each knows and what they can

teach other” (Aronowitz 1985, 8). While many educators include dialogue as part of the pedagogical process, Kelvin Stewart Beckett notes that for “Freire education *is* dialogue” (2012, 50).

According to Freire, the content of this dialogue of should be the re-presentation to students of things they are curious about, as determined and organized by their own view of the world. Thus, “the task of the dialogical teacher … is to ‘re-present’ that universe to the people from whom he first received it—and ‘re-present’ it not as a lecture, but as a problem” (1972, 109). Freire argued that learning emerges only through students’ action and reflection, or invention and reinvention, a process that he called praxis. The focus is on students creating and acting upon their own ideas rather than being fed the thoughts of others. It’s notable that the panels and word balloons of comics, such as Thompson’s above, are better able to depict dialogue, with all of its inflections, pauses, overlaps and circuitous routes, than the authoritative, monodirectional writing that characterises most textbooks. Furthermore, cartoon drawings can be a mode of subjective ‘re-presentation’ that can potentially encourage greater interpretation than more ‘objectively’ representational images like photographs.

Writing as a form of lecture

Academic writing is expected to register in a voice that would not be out of place in a university lecture theatre, and it can also be considered a remediation of the lecture-based, banking model of education that Friere so staunchly criticized. In fact, the parallels between the banking model of education and academic writing may account for fact that “by all reports, the lecture is alive, well, in fact thriving” (Calder et al. 2007, 4) nearly thirty years after education’s critical turn in the mid-1980s (Gottesman 2010). Academics are expected to teach and to publish research; while there are many ways to approach teaching, there is really only one accepted model for academic publication, a model that leans toward lecture-like writing. It is understandable that academics who must use this mode of communication in the writing part of their profession will be inclined to adopt it in their teaching practice as well.

The lecturer’s voice remains central to textbooks, which Hickman and Porfilio argue are positioned by elite cultural authorities and textbook manufacturers who encourage teachers to view textbooks “as rarefied forms of knowledge that not only should never be questioned, but also must be at the centre of their instruction, where students continually regurgitate this information to pass a battery of high-stakes examinations and come to believe

social and economic inequalities are individual rather than social and economic phenomena" (2012, xxi).

This is not to say that readers' minds are at the mercy of their textbooks, since readers can and do construct a wide variety of interpretations, or readings, of a text. As Stuart Hall has suggested, these may be dominant readings that reflect the intended message, negotiated readings that dispute certain aspects, or oppositional readings which reject the dominant message entirely (Hall 1980). Michael Apple notes that readers "do not passively receive texts, but actively read them based on their own class race, gender and religious experiences—although we must always remember that there are institutional constraints on oppositional readings" (2000, 191).

Whether dominant, negotiated or oppositional readings, whatever meaning a reader takes from a text is invariably informed by the reader's conception of how the text positions the relationship between the author and the reader. In most textbooks, this relationship by default is positioned as one resembling that of a knowledgeable lecturer speaking to ignorant students, which is reinforced by the mutual 'hotness' of both lectures and printed text.

Comics and Constructivism

By contrast, seminars, identified by McLuhan as "cool" and involving more participation, are a mode of learning that are frequently advocated in constructivist pedagogies, which emphasize student-led and student-centred learning. Constructivism in general suggests that learning is more successful when students play a greater role in constructing meaning in the classroom, so this type of pedagogy would seem to work best when mediated through what McLuhan called 'cool' forms of communication, such as seminars and comics, rather than 'hot' forms like lectures and printed text. However, while a wide variety of techniques have been suggested to reconfigure classrooms to better support learner-centred learning (Baird and Munir 2015; Bostock 1998; Cotterill 2015; Strachan and Liyanage 2015), it is less clear how textbooks and academic writing can be reformulated in a similar way. One possible route is through the use of comics as a medium for teaching and learning. The parallels between lecturing and textbooks, suggest that there are parallels between 'cool' seminars and comics as a form of education. Compared to lectures and writing, where the lecturer or author determines the precise order in which words are arranged, in comics the reader may be given more control over the pace and direction that that information unfolds.

This is not to say that all educational comics engage readers in the same way or can be considered comparable sites for praxis. Rather, an understanding of the pedagogy of media forms can be a useful tool for evaluating the educational structures employed by different comics. For example, a common practice in the growing genre of ‘graphic nonfiction’ over the past decade is the collaboration between an expert writer in the field, and a cartoonist who is tasked with adapting their work into comics. Typically, the writer appears as a central character in the book, given a visual presence as a host or narrator. While this can be an be an organisational strategy that is simple and easy to understand, it also has the effect of replicating some of the pedagogy of lectures

This can be seen in the book *Open Borders: The Science and Ethics of Immigration* (2019) (Figure 5) by behavioural economist Bryan Caplan and Zach Weinersmith, the cartoonist of the popular webcomic Saturday Morning Breakfast Cereal. The book is structured largely as a lecture delivered to the reader, with Caplan’s word balloons dominating most pages. Weinersmith’s cartooning provides a blend of earnestness and irreverence which help to make Caplan’s argument accessible and comprehensible. However, the reliance on a lecturing guide character means that the book is still mostly a polemic.

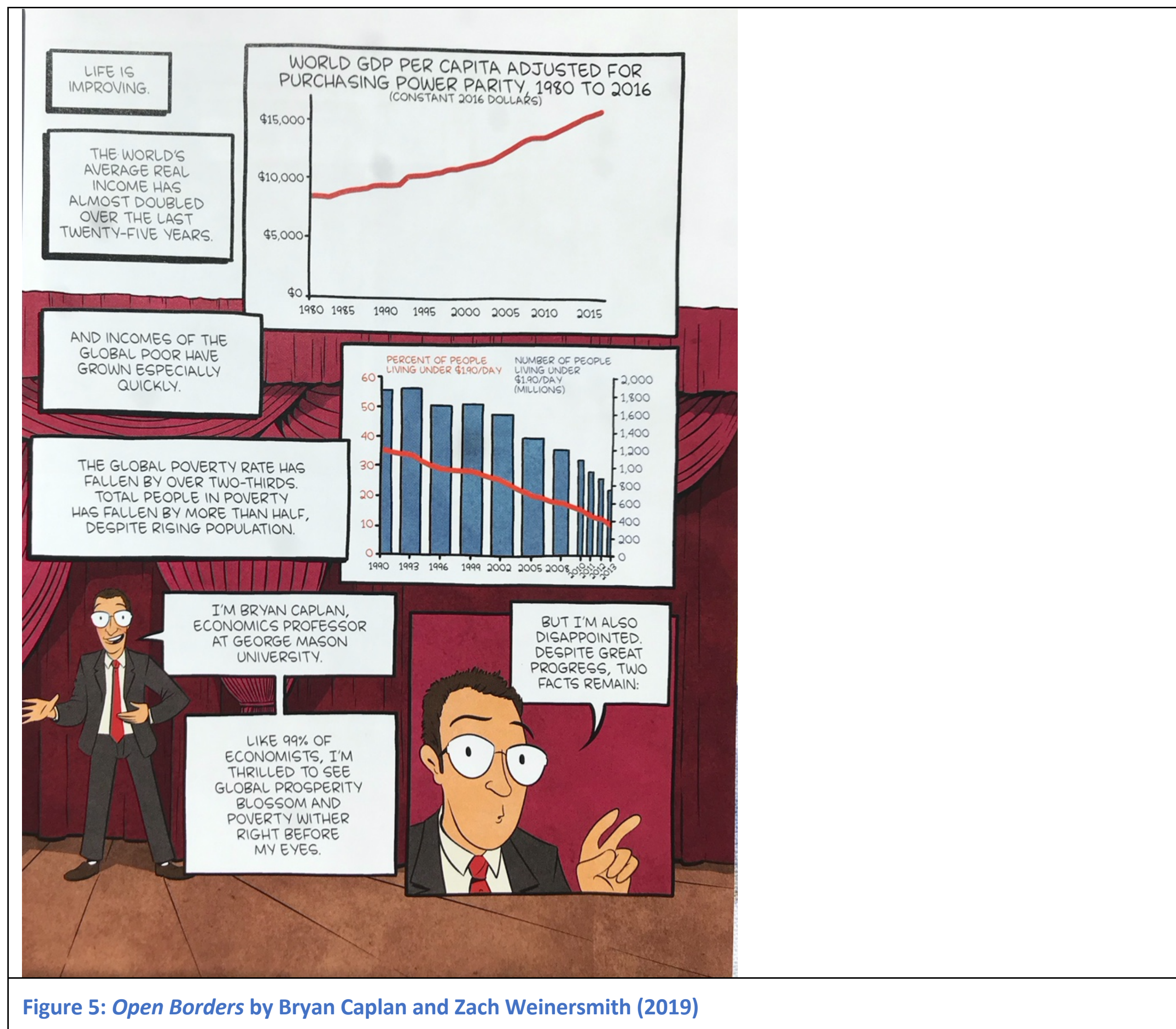


Figure 5: *Open Borders* by Bryan Caplan and Zach Weinersmith (2019)

A more dialectical approach characterises *Sapiens: A Graphic History (2020)*, an adaptation of historian Yuval Noah Harari's bestselling book by comic book writer David Vandermeulen and artist Daniel Casanave, which was first published in Hebrew in 2011, with an English version following in 2020. Although Harari is a central guiding figure throughout the book, Vandermeulen and Casanave use a variety of discursive structures. There is a loose plot where Harari travels to visit experts in other fields, who are eventually brought together to participate in an academic roundtable. In the final chapter, Harari and some of the other characters are called to participate in a fanciful courtroom trial where homo sapiens are accused of causing mass extinctions of other species beginning 3,500 years ago. Throughout the book, Vandermeulen and Casanave visualise the social and professional lives of Harari and his colleagues. The way the characters share meals, travel through airports, and stroll through the countryside emphasises the some of the book's central arguments about the way that homo sapiens cooperate, socialise and impact the natural world. This shows knowledge

as a constructed, collaborative process, and gives scenes set in lecture theatres a greater pedagogical context. Drawings of historical artifacts, or imagined prehistorical scenes are frequently presented in ways that encourage the readers to interrogate their meanings and reconstruct the past.

In one section of *Sapiens* (Figure 6), two of the experts at a roundtable Harari is participating in discuss the challenge of understanding life in the stone age, and the reader is shown both fossilised artifacts, like one might find in a museum, and a scene of how those artifacts might be used. This stone fragments suggest a whole world, but much is left to conjecture, and the comic invites the reader to actively participant in interpreting the various forms of visual evidence that Harari and his colleagues present throughout the book.

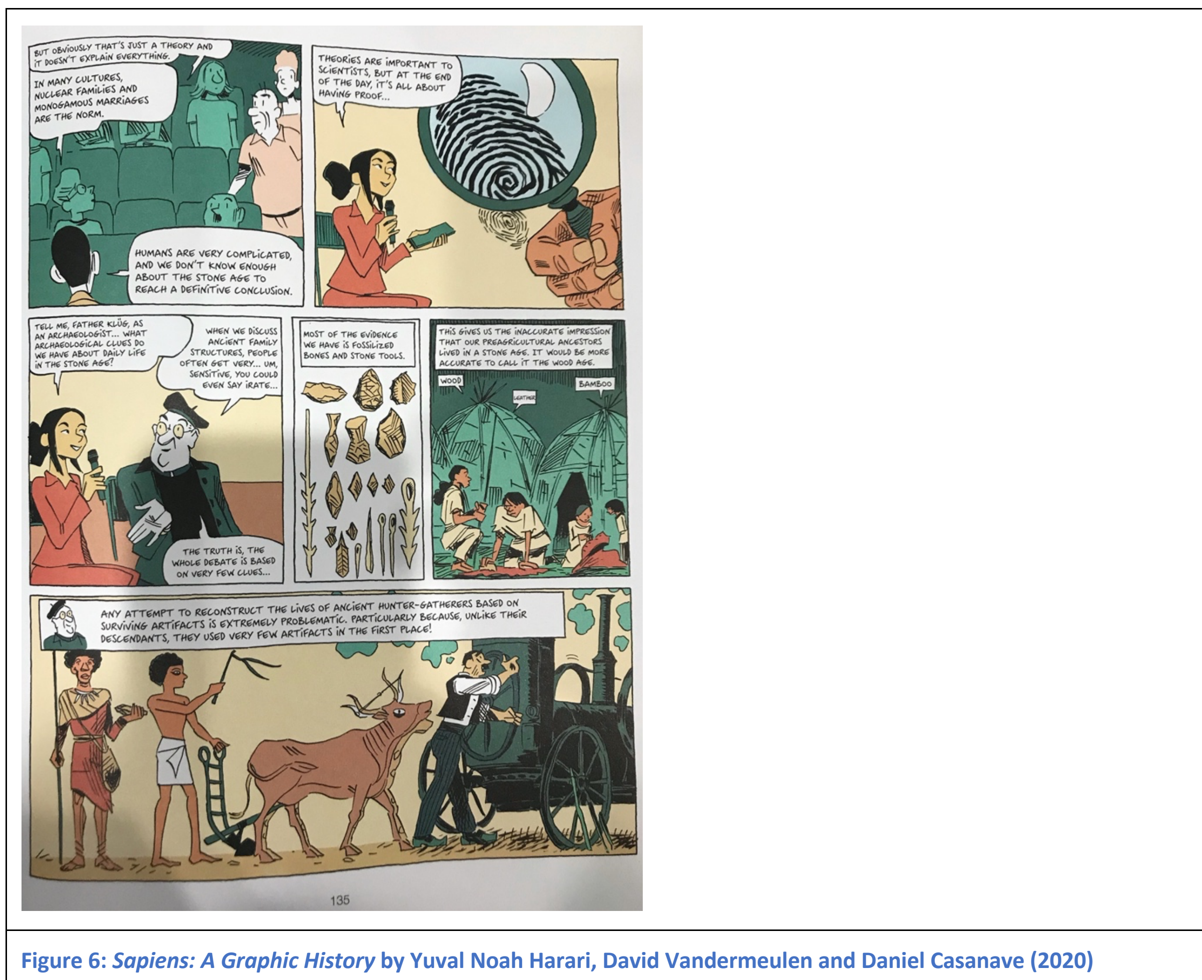


Figure 6: *Sapiens: A Graphic History* by Yuval Noah Harari, David Vandermeulen and Daniel Casanave (2020)

In educational comics, the kind of interpretation required of the reader can change frequently, sometimes even within panels. For example, some sections of *Sapiens* are presented as parodies of old comic books or advertisements, so the meanings that readers are able to construct will be built upon their own prior experiences with those genres. In this section (Figure 7), the prehistoric development of cooking with fire is presented as an

advertisement for a fad diet, re-presenting a culinary process that most readers would take for granted in a way that highlights its novel role in the development of human evolution, while also contrasting it with modern anxieties about the link between diet, good looks and productivity. There are several 'authoritative' voices in this section, from the spatula swinging caveman who declares "cooking with fire changed my life", to Ann Gibbons, author of *The First Man*, presented here as a quasi-dietician. By presenting this information in the form of a sensationalist advertisement, Vandermeulen and Casanave challenge the reader to critically interpret these claims, rather than take them at face value.

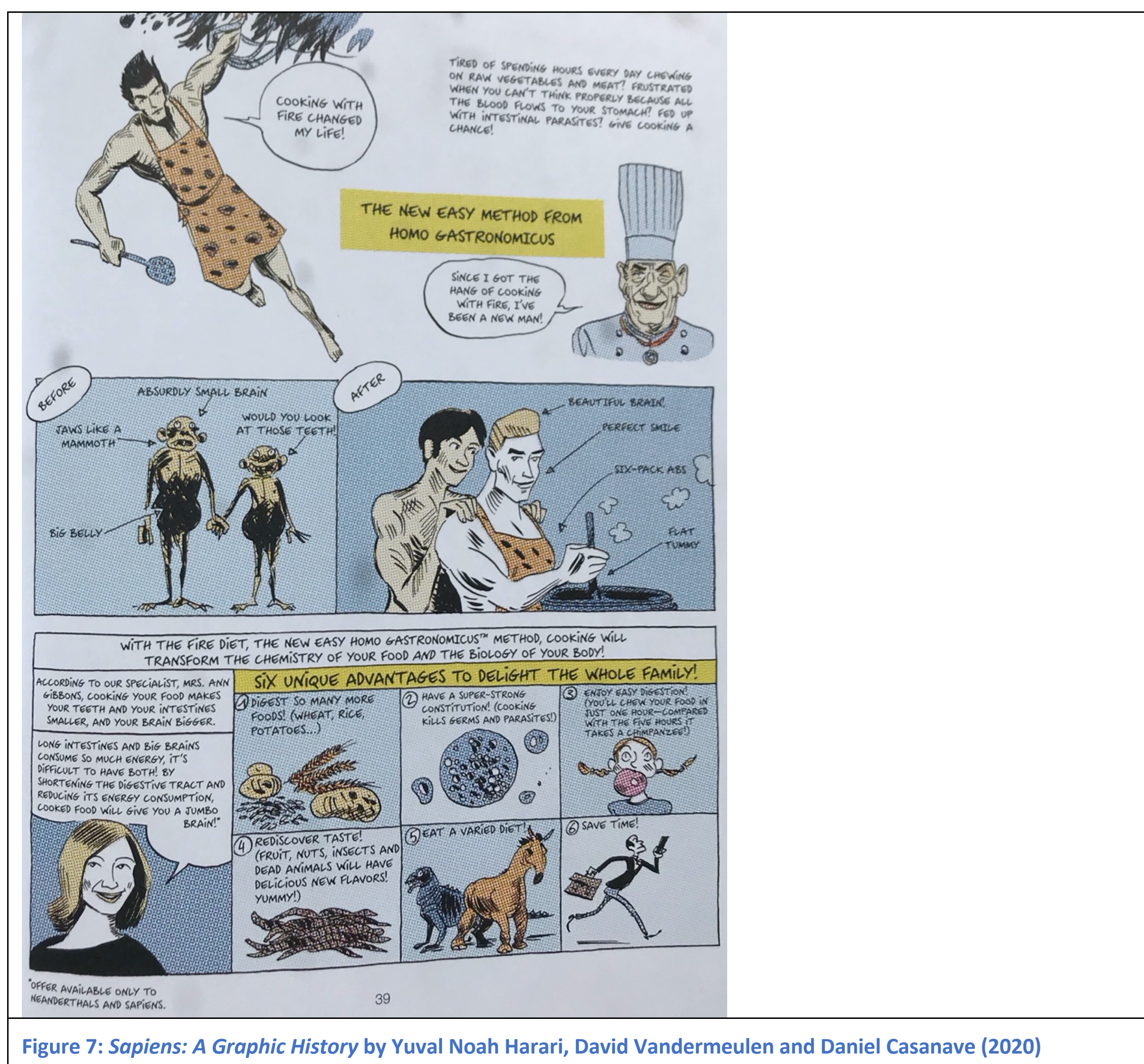


Figure 7: ***Sapiens: A Graphic History*** **by Yuval Noah Harari, David Vandermeulen and Daniel Casanave (2020)**

A different type of reader interpretation or construction is required to read charts, graphs, diagrams or other data visualisations which can be woven into the grammar of comics. In this example (Figure 8) from Dan Zettwoch's *Cars: Engines that Move You*

(2019), the process of fuel combustion is visualised at three levels: the molecular scale is shown in a sequence that is half science illustration and half comic book explosions, while the human scale is shown in a two panel narrative sequence of a family departing in their car, and finally the global scale is braided across the sequence – a diagram shows crude oil extracted from the earth, while the final panel shows how the combustion engine converts the product of that oil into by-products that enter the earth's atmosphere. The text explains the process in basic terms, but a reader with a year-seven level of literacy in molecular diagrams can read into the details Zettwoch supplies in drawing the structures of octane, oxygen, ozone and carbon monoxide.

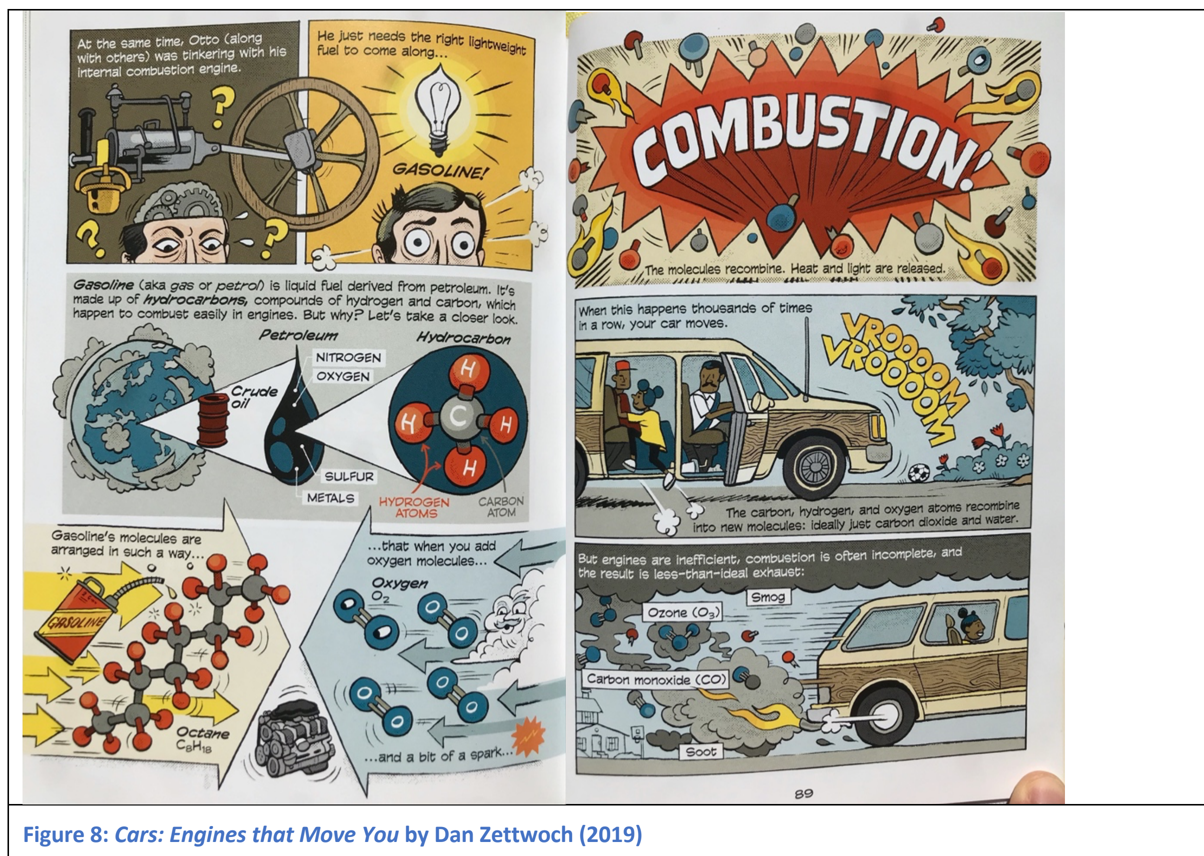


Figure 8: *Cars: Engines that Move You* by Dan Zettwoch (2019)

Elsewhere in the book (Figure 9), Zettwoch uses diagrams, charts and cutaways to visualise the history, culture and mechanics of automobiles. One page maps one hundred years of motor safety improvements onto their locations in a car. Here, the narrative text at the top and bottom of the page is of minor importance, as this is a page that rewards study and exploration from multiple directions.

Figure 9: *Cars: Engines that Move You* by Dan Zettwoch (2019)

Zettwoch's illustrations often use techniques from technical drawing and scientific exploration, but the cartooning idiom 'cools' them down. The loose, minimal 'unreality' of the drawings grounds the images in the subjectivity and personality of the cartoonist. This stands in stark contrast to the 'hot', assembly line diagrams that characterise the imagery of car manufacturers' operating manuals. Cartoony drawing styles can have the effect of decreasing the authorial distance between the reader and the text, creating a sense of casualness and even intimacy that is uncommon in 'hot' lecture-based textbooks.

A particularly 'cool' style of drawing characterises the work of First Dog on the Moon (alias Andrew Marlton), whose recent book *The Carbon-Neutral Adventures of the Indefatigable Enviroteens* (2020)is an adventure story about fighting climate change. First Dog has built a career on tackling serious topics with drawings that are equally simple and absurd. A chapter on the science of climate change opens with a diagram (Figure 10) that in some ways calls to mind Friere's 'Banking Model' by claiming that the reader only needs to internalise the chapter's information in order to become educated. However, Marlton's irreverent doodles poke fun at this notion, as readers are instructed to be sure to only consume the chapter with the proper "face holes" (eyes and ears, rather than nose or mouth). The simple drawings and somewhat sloppy font go against the regimented "gymnastics of handwriting" and polished presentation that typically demote hierarchical authority.

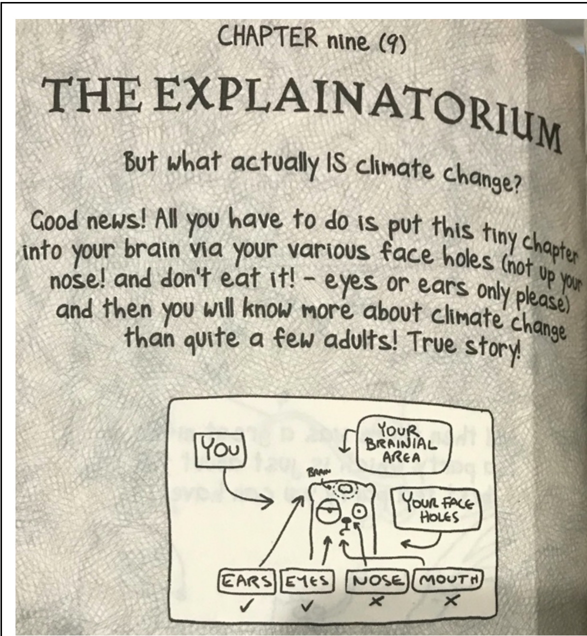


Figure 10: The Carbon-Neutral Adventures of the Indefatigable Enviroteens by First Dog on the Moon (Andrew Marlton) (2020)

Later in the chapter, a graph showing global temperature change includes the caption "hand drawn graph is mostly accurate" (Figure 11), is both a joke about the crude art style, and an acknowledgement of the work that Marlton has put in to understand and re-present the material he is discussing, which helps to position the author as a 'co-investigator' with the reader.

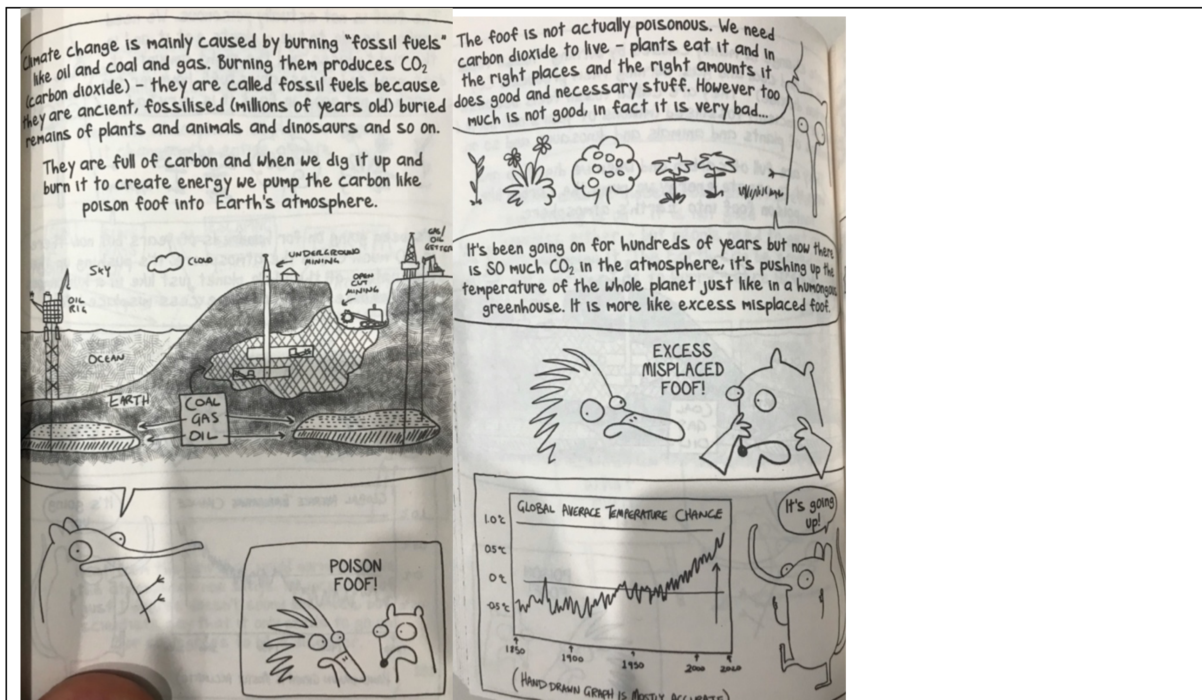


Figure 11: The Carbon-Neutral Adventures of the Indefatigable Enviroteens by First Dog on the Moon (Andrew Marlton) (2020)

The lack of a visual lecturer or guide can serve to increase the level of construction or interpretation required of the reader. Meanwhile, looser and more cartoony styles can have the effect of decreasing the authorial distance between the reader and the text. However, both of these strategies require additional work by the reader, which means it is important for creators of educational comics to use clearly defined organisational structures. The illustrated lecture is an easy structure to use, but often replicates the hierarchy of the banking model, which has the effect of limiting the readers' opportunities for discovery and praxis. A potential alternative is to design educational comics to have multiple, parallel structures that the reader can navigate between. The advantages of this kind of structure can be seen in the graphic novel *Landing With Wings* (2020) by cartoonist Trace Balla. The book is structured as narrative about a young girl named Miri who is learning about the Goldfields of New South Wales, but this narrative is supplemented with labelled drawings of the region's floral and fauna. Miri keeps a notebook of her observations, and at times Balla's drawings resemble the character's field notes, including details like transcriptions of sounds made by birds and frogs. In one section (Figure 12), the characters joke that the Goldfields, named because of mining, could also refer to the abundance of yellow plants in the area. Additionally, an attentive reader will also note the many yellow-coloured birds described on these pages. In addition to being a story about the goldfields, *Landing with Wings* works as a manual about paying attention to the natural world by carefully observing plants, animals and geology. Like the best educational comics, it doesn't just depict information, but visualises systems of knowledge and ways of knowing.

Figure 12: ***Landing with Wings*** **by Trace Balla (2020)**

Conclusion

In Fellini's words, the comics form "benefits from the collaboration of the readers: one tells them a story that they tell to themselves; with their particular rhythm and imagination, in moving forward and backward" (quoted in Groensteen 2007). Comics require the reader to make connections between the panels and other elements on the page that exist in a network that Groensteen (2007) dubs the spatio-topia. The process of discovering connections between the visual and textual elements that are distributed spatially throughout spatio-topia may be non-linear and iterative, a process of interpretation that Groensteen calls braiding. This kind of interpretation may lead to a greater engagement in the work through action and reflection of praxis (Freire 1972).

The theories of Friere and McLuhan suggest that educational comics might facilitate learning which is more student-centric than traditional modes of instruction, such as teacher-centric lectures and textbooks. Comics' formal and cultural properties depart from the banking/transmission model of education critiqued by Dewey (1916, 1938), Freire (1972), Vygotsky (1967) and the field of educational constructivism (Biesta and Miedema 2002; Biggs and Tang 2011; Garrison 1995; Kanner and Wertsch 1991; Kolb and Kolb 2012; Smith 2001), and can instead help to challenge traditional thinking about pedagogy, especially as it relates to the interrelated concepts of authorship and authority. This can help in achieving the

constructivist goal of “changing the orientation of education from transmitting knowledge to creating environments where students can create their own knowledge” (Innes et al. 2015, 31).

Readers of educational comics are encouraged to play with and co-create the meanings of comics in part because their formal properties, such as visual abstraction and fragmented narratives which mark them as “cool” media in McLuhan’s terms. Comics can relate information in ways that are distinct from the paradigms of authority, authority and literacy that commonly characterized the mode of delivery used in lectures and textbooks. Educators and publishers created educational comics throughout the 20th century, but those comics could not be easily conceptualized within existing frameworks of pedagogy that were built around the authority of the lecture and the authorship of the lecturer.

The more recent acceptance of comics in education is due in part to the fact that the philosophy of pedagogy built upon lecturing is eroding on several fronts. Critical philosophies of education, such as constructivism, have seen a shift toward understanding learning as student-centred. In addition, as the cultures and technologies of communication are becoming more visual, education is being increasingly understood as multimodal. Comics are a perfect multimodal publishing format for this shifting culture of education, and as this thesis has demonstrated, they have the potential to be transformative works at the highest levels of teaching at learning.

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