The GS Project: A Bubble in Glass – a STEAM Unit of Work for Year 9 English Collaborating with Digital Technologies, Science and Visual Arts

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Abstract: The genre of Science Fiction in English literature has been used for decades to engage students, particularly those with a penchant for Science, Technology, and Mathematics. Growth of the genre in studies at the secondary and tertiary level was seen as a staple for students of Science and Literature with educationalists arguing for combined projects to boost literacy amongst some and scientific method reflected in fiction, though timetabling demands increasingly closed off these opportunities. Recent research coupled with political will has reopened possibilities for collaborative projects, working across the Australian Curriculum, Version 8.1 in 2017. The Generation Ships Project looks at this subgenre of Science Fiction with its particular focii of a small ecosystem struggling for sustainability and a population many years after the launch of their ship who must decide what is worth remembering and what is to be lost – moral choices appealing to middle school students in a problem-solving, constructivist and interactive unit of work. The unit covers classic video and print texts right up to Stephenson’s SevenEves, Syfy’s Ascension and Robinson’s Aurora. Australian Curriculum content descriptors are linked by themes in the subgenre to enable a Year 9 cross-disciplinary study using the STEAM model of Science, Digital Technology, Visual Arts and Mathematics for a timetabled study enacted through different learning areas. The suitability of the texts for their concentration on consistent themes in small world simulations correlates to a Computer Supported Intentional Learning Environment for schools such as Telopea Park in Canberra, the Australian Capital Territory. The Project builds on research with students, arguments for virtual world and technology-rich projects, as well as the use of Technological Pedagogical Content Knowledge for Australian secondary school teachers. Use of the Kinect sensor to interact with student choices in the Project subverts the business use of this input device to support gestural and spatial learning modes and provides valuable analytics to improve individual and collaborative learning. While the Project is built outwards from the English learning area, participation is sought from teachers and content developers across the secondary curriculum for an ongoing use to match the longevity of this fascinating and challenging subgenre.

Educators claim that studying the genre of Science Fiction (SF) engages and motivates secondary and other students (Alexander, 2015). While SF has many, contentious definitions it is proposed here that it is "set in an imagined world that is different from our own in ways that are rationally explicable (often because of scientific advances) and that tend to produce cognitive estrangement in the reader" (Booker & Thomas, 2009, p. 4). It uses an "atmosphere of scientific credibility for its imaginative speculations in physical science" (Moskowitz cited in Stanners, 2009). From the late 1930s SF was "written by technical people, about technical people, for the satisfaction of technical people" (Barthell, 1971, p. 58) with a focus to illuminate the "technological society in which science and technology must be understood and rationally controlled by man" (Schwartz cited in Friend, 1974, p. 6). SF is fascinated with the interplay of "rationalistic, intellectualized concepts" (Barthell, 1971, p. 62) and within this genre 'Hard SF' is seen as most interested in technology with science used as a major character in the narratives while incorporating a clear love of engineering (Chernaik cited in Stanners, 2009, p. 5).

The subgenre of Hard SF is characterised by "elements of factual science and a more optimistic view of scientific/technological knowledge and change" (Stanners, 2009, p. 5). Texts in this subgenre provide "details of a spaceship, an alien artifact, a planet, or a solar system not just as a stage set but to generate motivation and narrative action" (Samuelson, 2009, p. 495). Narrative style in the books, stories, films and other media is "more expository than dramatic, more transparent than opaque, factually exact, even flirting with mathematics, and broadly didactic, extending or confirming a reader's education and typically favoring unfettered application of scientific thought and actions" (Samuelson, 2009, p. 495). Educators see in Hard SF natural links to other curriculum areas not only in secondary but also tertiary education.

Most popular amongst hybrid studies with SF are Science courses, such as the decade of teaching the Bachelor of Science and Science Fiction (Brake & Hook, 2011) at the tertiary level, and at secondary level: teaching ecological sustainability principles through SF (Hollister & Thompson, 1973, p. 17); linguistics through SF with neologisms
and alien languages (Wheatley, 1974, p. 121); technology in shaping future societies (Krilik, 1981, p. 157) and political science (Barton-Kriese, 1981, p. 209). The use of 'Soft SF', where sociological and anthropological concerns through future, alternative or off-world analogies with contemporary problems have also proven useful.

At the secondary level outside the Australian Curriculum as well as the tertiary level philosophy is taught through *The Matrix* (Wachowski, 1999) studying scepticism and Descartes's Evil Demon as well as the problem of free will through *Blade Runner* (Scott, 1982) by Rowlands (2003) at the University of Miami and *Gattaca* (Nicol, 1997) for ethical and political issues by Schneider (2009). As with philosophy, religion is taught with SF by Alsford (2000) comparing the Western Christian tradition of Platonism via Augustine where the present world is less real than the spiritual realm, or the virtual reality of Cyberpunk narrative. Professor Gregory uses the celebrated SF 'sense of wonder' to discuss the sublime as seen in the works of Wells, Philip K. Dick and Stapledon (Gregory, 2015). Olaf Stapledon’s works extended the sublime into what has become known as ‘Space Opera’, defined by the *Encyclopedia of Science Fiction* (2015) as colourful action-adventure stories of interplanetary or interstellar conflict.

Many texts in the subgenre of Space Opera are notoriously unconcerned with the realities of space flight and travel in our Solar System and even to other systems. Spaceships use gyroscopes, wormholes and warp drives, examining Utopias and Dystopias or colonising distant planets with overpowering technocultural imperialism. While these narratives are certainly soft SF, there are texts within this subgenre that eschew such unscientific fantasies, recognising instead Newtonian and Einsteinian laws and hardening the texts in the unblinking solar flare of the realities of human interplanetary and interstellar travel. Without convenient literary devices like transporter beams and warp drives writers are left with very long periods of travel even to nearby planets as the spaceship accelerates to a maximum velocity then must decelerate to match a distant planet's constant motion. The lack of any choice to this unpalatable truth gave rise to fictive narratives set in vehicles and human habitats that could sustain their travellers for very long periods. The earliest Russian and German rocket scientists designed the craft and later, during the Space Race, German engineers designed Generation Spaceships in post Second World War America. Writers such as the engineer Robert Heinlein created narratives that could be shoehorned, only just, into hard SF as,

Heinlein stories such as "Universe" (1941) and "Common Sense" (1941) pioneered the motif of the "generation starships", in which the long times potentially involved in interstellar travel are dealt with simply by populating the ship with families who live and die on the ship for generations. (Booker & Thomas, 2009, p. 42)

Tropes of GS stories include:

- the starship is huge and the passengers do not realise they are on a starship (Booker & Thomas, 2009, p. 42)
- the travellers have forgotten their original mission and lost their technological prowess
- strange ship-borne cults arise that threaten the mission
- the flight crew become a distant technocratic elite while the rest degenerate
- powerful leaders arise from the passengers and overthrow or subvert the mission
- passengers escape into virtual worlds of cyberspace
- the ship itself as an Artificial Intelligence (AI) turns against its passengers, and
- the enormity of the distance and the isolation bring madness.

These tropes are intertextual over eighty years but while these are clearly sociological in nature, the most important aspect of this encapsulated society is the ever-present and imminent threat of annihilation by any of a myriad human errors, technical problems, or celestial events. In this way the Generation Spaceship narrative can be both a study of genre literature for English students with all that entails in analysis of characterisation, narrative form and style, as well as a verdant source of scientific speculation on ecological sustainability, astronomy, computer technologies, energy sources and many more - perhaps as many as will be found by the the U.S. Defense Advanced Research Projects Agency (DARPA) and the National Aeronautics and Space Administration (NASA) in the *100 Year Starship* project, as supported by former U.S. President Bill Clinton (De Nardo, 2012). The Generation Spaceship is as much a closed system and as worthy of study as Spaceship Earth (Fuller, 1969).

The Generation Starship Project is designed for students in Year 9 at Telopea Park School in Canberra, the Australian Capital Territory (ACT), Australia. Telopea Park School is a binational French-Australian ACT government school running the International Baccalaureate Middle Years Programme (MYP) as an overlay to the
The GS Project was developed through earlier SF studies for Year 9, several SF and Technology-based Enrichment activities over three years and meetings with SF enthusiast Science teachers. The GS Project is designed for the Australian Curriculum, Version 8.1, to be implemented in the ACT in 2017. It is to be implemented through an Inter-Disciplinary Unit (IDU), a cross-faculty, specially timetabled and regular class as part of the MYP. Although many schools encourage content-rich projects across the curriculum, timetabling in middle secondary schools often prohibits much cross-fertilization. It is the Telopea Park School IDU that enables the GS Project as a STEM initiative: a Science Technology Engineering and Maths inclusive project, with even a further, essential ingredient.

Australian Prime Minister Malcom Turnbull has argued for more focus on digital technologies in education for several years, differentiating between ICTs and STEM disciplines and arguing for computer software coding even if only up to the end of school years as the "training in logic and the understanding of how machines think will enable them better to engage in any and every course of life and career they pursue" (Turnbull, 2014). As Prime Minister he has reiterated his call for literacy in "STEM subjects … Science, maths, technology - that's the future" (Morgan, 2016). The acronym STEM has gained currency with most politicians dropping the Engineering 'E' but stressing Technology, with both Prime Minister Turnbull and Opposition Leader Shorten arguing for coding to "become an integral part of the national curriculum and taught in every primary and secondary school" (Ricci, 2015). Other nations, such as South Korea, have stressed STEM in education for many years but have now added the Arts to make STEAM education as it "fosters integrative STEM education from artistic perspectives. By merging various subjects and applying it to real life, STEAM intends to develop students' divergent thinking and their excitement about learning" (Jon & Chung, 2013). The Korean Revised Educational Curriculum has altered the weighting of subject areas to "provide time for students and teachers to think about and discuss the matters at hand and to enable a more creative learning environment" (Jon & Chung, 2013). Other educational institutions also stress the creativity of the arts and humanities interpolated with STEM, often from the perspective of assisting the sciences (Saraniero, 2014; Yokana, 2014; Lamont, 2010) and it is this STEAM approach that is adopted for the GS Project, mostly due to the combination of interests at Telopea Park School where the arts department includes Digital Technology. The curriculum areas of Science, Digital Technology, English and Visual Arts are used for the 2017 implementation of the GS Project, with English as a core but involving the other curriculum areas through the special MYP IDU. However, for the sake of decency and abhorring SDTEVA, this writer will follow the Prime Minister's example and ignore some letters while including others, with the acronym STEAM retained.

The ample evidence for the need to include the Arts in STEM education is reinforced for the GS Project by the readiness of the visual arts to use Science Fiction narratives, as seen by the thousands of images for 'Generation Spacships' seen in Google, quite apart from linked images for interstellar colony ships, colony ship concept art, colony spaceships and the separate hundreds of 3D models found in the Google SketchUp dataset. A specific focus for major, international artists using Science Fictional themes is seen in the Museum of Contemporary Arts (MCA) exhibition New Romance - art and the posthuman where artists' works from Australia and Korea "encourage us to ask what it means to be human today, and what it might mean in the future. Drawing inspiration from science fiction, robotics, biotechnology, consumer products and social media, they offer experiences that raise questions around the idea of the posthuman" (David & Choi, 2016). It was the MCA that also exhibited Rafael Lozano-Hemmer's Recorders exhibition (Blackall, 2011) where the artist used Kinect 3D sensors for his interactive, installation artworks that focused on the technology of surveillance and its uses in society, drawing on SF works such as the GS narrative Destination Void (Herbert, 1965). This use of computer-based recognition of, and active intervention in, human group behaviour is found in Lozano-Hemmer's exhibitions in Basel and Mexico City, Zoom Pavilion (Lozano-Hemmer & Wodiczko, 2015), and Robinson's Aurora novel (2015), a central text in the GS Project.
Just as Telopea Park School uses the Australian Curriculum as well as the Middle Years Programme framework, the GS Project also integrates the Technological Pedagogical Content Knowledge (TPACK) framework, (Mishra & Koehler, 2006) a way of thinking about effective technology integration in teaching and learning. TPACK stresses how “technology interacts with pedagogy and content” and assists educators to evaluate quickly “new technologies in terms of how they will present content or facilitate pedagogy.” (Mishra, Koehler & Kereluik, 2009) The TPACK model, seen in Figure 1, above, notes the Contexts in which the curriculum content is negotiated with students. Some aspects of this context can be described by the MySchool website for 2015 that notes the school has 1204 students of whom 65% have a background with a language other than English and only 1% are Indigenous. There were 72% of students in the Top Quarter distribution as against the Australian one quarter and the School ICSEA value was 1161 (myschool, 2016). The GS Project was developed in early stages with streamed, Year 9 classes called Challenge English in which all students had computers with internet access at home and many had several devices for their educational and other use. All students in Year 9 Challenge English expected to proceed to ACT College level and then university study, some aiming at French or other tertiary studies. For the class, trolleys of Windows laptop computers were available with internet-access through wireless connectivity and the teacher had a more hirsute Windows desktop running Microsoft Office with a projector and whiteboard set into the Heritage-listed classroom ceiling. iPad devices and a slew of other educational technologies were available through the school library and students were expected to access an ACT-specific learning management system.

With the curriculum context of the Australian Curriculum: English (AC:E) the GS Project follows TPACK advice for the teachers to,

- synthesize their knowledge of curriculum content, teaching strategies and the affordances and constraints of technological tools and resources. Layered behind and underneath these three intersecting domains of knowledge is the context of the classroom, including social, political, and cultural factors, plus student learning styles and preferences, among many other considerations. (Hofer & Harris, 2010)

As it is recommended to choose the most effective technology last, (Hofer & Harris, 2010) it is important to then turn to the content of the GS Project as texts used, their thematic links to each other and to other literary genres and of course to the AC:E. Some links to curriculum content descriptions are seen in Figure 2, below, with speculative links to Science, Digital Technology and Visual Arts content descriptions offered as a baseline for the students’ Inter-Disciplinary Unit. Texts for study in clear view of the AC:E Year 9 descriptors are chosen as
differentiated into three ability levels according to the strength of the particular student or small student group, named Ark, Aniara and Vanguard in homage to GS texts. Of the 61 novels and short stories listed by Boaz (2016) and another six since that publication, suitability to Year 9/10 is a first filter, the cost is also important for small sets or class sets, and a more profitable thematic link that engages these particular students is required. The application of this thematic link is made possible by modifying Caroti’s analysis (2011) of the GS in Science Fiction.

![AC-E content descriptors and links to other curriculum areas](image)

**Figure 2: AC-E content descriptors and links to other curriculum areas**

The tropes of GS narratives noted when introducing the Space Opera subgenre are discussed in depth by Caroti (2011), who analysed narratives where humans:

- are frozen in cryogenic sleep for the journey
- where humans are represented only as gene banks to be activated on arrival
- where the GS ship never actually leaves Earth but is a ruse to examine behaviour in a closed society (as in “Thirteen to Centaurus” (Ballard, 1962) and Ascension (Black, Levens & Cruz, 2014))
- where the GS travels for only a few years but billions of years pass due to relativistic time dilation as the Leonora Christine ramjet of Tau Zero (Anderson, 1970) approaches the speed of light meaning the “flight is a one-way journey to the future” (Caroti, 2011, Kindle Loc. 697).

Instead, the GS Project follows Caroti’s shorter treatment (2009) where the narratives are linked through the ‘theatre of memory’ and this is extended. The GS Project looks specifically at the role of memory in the narratives requiring of GS texts that:

a) the traveller/s be sentient,
b) the travellers are generally awake and aware,
c) the journey is multi-generational
d) the GS vehicle is, or seems to, voyage to a supposedly habitable place in another solar system.

Using the system of MYP focus questions, the students are asked the global questions, ‘What is worth holding onto
over the generations?”, commensurately, ‘What must be discarded for the voyage?’ And ‘Can life be sustained in the GS? …Or on the Earth?’ Caroti’s texts (2009, 2010) are available to the educators as is a text used by both Caroti and novelist Stephen Baxter (2009) for imagining the realistic, Hard SF speculations of a GS voyage to Alpha Centauri, Gilster’s (2004) Centauri Dreams with its ongoing, collaborative website.

Using the global, focus questions with the further filtering of the four constraints (a to d as noted, above) and based on the theme of the theatre of memory the texts used at this stage of the GS Project are the short stories: “The Living Galaxy” (Manning, 1934); “The Voyage that Lasted 600 Years” (Wilcox, 1940); “Rescue Party” (Clarke, 1941); “Thirteen to Centaurus” (Ballard, 1962); “Goat Milk Cheese, Three Trillion Miles From Earth” (Yoachim, 2015); “The One Mission” (Russo, 2015); and “Spacebred Generations” (Simak, 1952). Novels used are: The Space Born (Tubb, 1956); Non-Stop (Aldiss, 1958); Tau Zero (Anderson, 1970); Captive Universe (Harrison, 1969); Orphans of the Sky (Heinlein, 1963); Destination Void (Herbert, 1965); Ark (Baxter, 2009); Voyage from Yesteryear (Hogan, 1982); SevenEves (Stephenson, 2015) and Aurora (Robinson, 2015), with the last two the most important for student studies linked to the IDU. Digital video texts used are: “Mission of the Darians” (Austin, 1975); “For the World is Hollow and I Have Touched the Sky” (Leader, 1994); “Voyage of Discovery” (Hart, 1973); Ascension (Black, Levens & Cruz, 2015); “The Long Dark” (Di Meo, 1994); “The Disease” (Livingston, 1999); “The Pisces” (Orrestein, 1973); and “The Ark in Space” (Bennett, 1975). Poetry used for the GS Project is the extraordinary and influential poetry cycle Aniara: an Epic Science Fiction poem (1999) by Swedish poet Martinson, the original space opera, with its actual operatic performance of Aniara by Blomdahl (1959). It is Martinson’s Aniara (1999) that influenced the subgenre profoundly and provides the title for this paper, likening a ship’s journey to another solar system as the passage of a bubble in glass,

O would that we could turn back to our base
now that we realize what our space-ship is:

a little bubble in the glass of Godhead.

I shall relate what I have heard of glass
and then you'll understand. In any glass
that stands untouched for a sufficient time,
gradually a bubble in the glass will move
infinitely slowly to a different point
in the glazen form, and in a thousand years
the bubble's made a voyage in its glass.

Similarly, in a boundless space

a gulf the depth of light-years throws its arch
round bubble Aniara on her march. (Martinson, 1999, p. 49)

This last poetry cycle also provides the best links into scientific, computational and mathematical theories as the poet's Nobel-winning work was in recognition of his blending of Science with poetry.

With the curriculum content negotiated and the content descriptors linked to the AC:E identified, the procedure using TPACK is then to look to teaching strategies with the “affordances and constraints of technological tools and resources” (Hofer & Harris, 2010). AITSL Standards are adopted, with several Standards covered above but Standard 2.1 and 2.2 to be decided (AITSL, 2016), and for this Standard 6.4 is used to explore the use of improved past practice as well as new, effective teaching strategies.

Students working with 'flipped learning' for an earlier, Year 9 Challenge English class expressed approval for the approach (Sisley, 2015). Washington (2013) described flipped learning as was implemented in a trial at Telopea Park School, as where,
… students are in school, they work on their homework. When they go home, they watch recorded lectures. This flipped model gives students who have struggled with the traditional lecture approach an opportunity to succeed, since it gives students more control over how they learn. By using recorded lectures, parents can learn with their kids and help guide them as they navigate the lesson (Washington, 2013).

For this earlier action research two of the five modes of multimodality (Anstey & Bull, 2010) were explored in more depth: gesture and space. For this focus, just as with Rafael Lozano-Hemmer's Recorders installation (Blackall, 2012), Kinect 3D sensors were used for two purposes, to record immersive teacher videos with layered media for flipped learning, and for students to record their own multimodal talks, with Moyle (2006) noting the need to support students "to create multimodal texts with ICT". Given the limited approval for the immersive flipped learning videos, this approach is continued for the GS Project. Again following the TPACK model, the teacher videos are changed to reflect the GS subject matter, employing a starfield simulation and other moving space images projected into a black space that is clearly a three-walled room painted black, with a backlit doorway out of the room. This allows for a clear 3D space in which the image of the teacher is presented and, when necessary, text and images are superimposed on a top layer of the image. The Kinect sensor records the display using Personify for Presentations <http://personifyinc.com>. In this way the flipped video presentation from the educator features the teacher situated and gesturing in a defined space over which might be projected a field of stars moving towards the gaze with occasional images appearing in the foreground, as seen in Figure 3. This use of digital video available through the school intranet and online is an enhancement of earlier and apparently effective trials (Sisley, 2015).

![Figure 3: Use of the Personify software for 3D presentations](image)

Continuing research with TPACK for Language Arts and English is found in Research on Technology in English Education (Young & Kajder, 2013). As seen in Figure 2, above, several AC:E content descriptors align with chosen texts in the GS Project. The descriptor ACELY1746 requires students to "Create imaginative, informative and persuasive texts that present a point of view and advance or illustrate arguments, including texts that integrate visual, print and/or audio features" (ACARA, 2016). This relates to GS texts such as Robinson's *Aurora* (2015) and Stephenson's *SevenEves* (2015) where the struggle to maintain a sustainable biosphere in the GS argues for a much greater understanding of Earth's complex and life-sustaining ecology. Indeed, the end chapters of *Aurora* (Robinson, 2015) argue persuasively to abandon thoughts of colonising space in favour of repairing an Earth devastated by global warming. This theme is verdant for use with English argumentative writing and also relates to several other areas of the Australian Curriculum.

Beach and Doerr-Stevens argue in “A TPACK Perspective on Learning to Engage in Dialogic Argument Through Participation in Online Role-Play in the English Classroom” (2013) for the use of online forums as "social networking sites provide students with multiple audiences" where important issues, such as environmental concerns could be discussed as collaborative arguments where "students are learning to build on and develop their positions through responding to or commenting on each other's positions. Students cannot simply present their opinions; they are called upon to explain their positions through prolonged interactions with other role-play
participants." (Beach & Doerr-Stevens, 2013) These social networks allow students to,

- participate both in class and outside of class
- engage in both face-to-face caucuses and online interactions
- include both classroom participants as well as participants from outside the classroom
- readily identify names and/or faces of participants on the screen
- send messages to and respond to everyone or selected audiences
- link to other posts or online material, and
- have a repository of posts for further reflection on posts (Beach & Doerr-Stevens, 2013).

These technological affordances foster literacy practices as well as digital literacies of "interactivity/connectivity, multimodality/identity construction, and hyperlinking/hypertextuality to engage students in productive, collaborative arguments." (Beach & Doerr-Stevens, 2013) These are strong recommendations from an University of Minnesota study published by Young and Kajder (2013), major players in the TPACK movement worldwide. Accordingly, the GS Project uses an Edublog site at <https://gsproject.edublogs.org> with materials loaded, and argumentative queries based on the last of the MYP global focus questions, 'Can life be sustained in the GS? …Or on the Earth?' for use by English and other students from the school and any outside expert entrapment may snare.

As with the use of social network sites to build collaborative arguments based in topics of importance to students, there was strong evidence for the use of virtual world explorations in English. Wells' (2013) "Virtual Worlds for Literary Study: Technological Pedagogical Content Knowledge in The Village of Umuofia and Other Literary Worlds” described the creation of a virtual world using the LambdaMOO engine for students of Things Fall Apart. (Achebe, 1962) The virtual world was visited online and while it was a simple, five-room MOO site written by the teachers with support, the Village of Umuofia was evaluated by students as helpful, engaging and enjoyable. Students noted,

- It made the character come alive and allowed me to imagine myself in that time and environment.
- The music and the images really helped to make me feel more a part of the village and my character.
- It was interactive, fun, and much better than a traditional lecture.
- It helped me to get a better understanding of the book.
- It made the material easier to relate to for me.
- It reminded me of class discussion, but this took those discussions to a whole new level. (Webb, 2013)

As seen in the comments from students (n=34) in the study above, the Village of Umuofia included music and images to match the strong cultural elements of a traditional Nigerian village. The background music created "significant increases in remembering factual aspects of …environments" (Richards, 2008). Use of important images linked with congruent music strongly influenced how the media was remembered (Webb, 2013, p. 242)

Use of the Village of Umuofia MOO site was seen as a worthwhile extension to more traditional analyses of the novel Things Fall Apart (Achebe, 1962) particularly because of the nature of the text with its emphasis on African cultural practices. The limited, programmed, virtual world was the result of a design process directly aligned to the content learning that was sought by the students' educators. Using the TPACK process, the virtual world was an 'evolving artifact' that stretched understandings of "methods, content and purposes" (Webb, 2013).

The GS Project with its several visual texts and unique environment of the interior of a spaceship is well suited to a limited and programmed digital simulation. The smaller number of main characters, frequent use of a shipboard Artificial Intelligence (AI) and identified tropes, as noted above, make an initial and basic simulation ideal. For this simulation the affordances of the Kinect sensor, as used for the flipped video teacher presentations, is utilised to create a program, named Aniara. Aniara leverages and subverts a commercial product (Hughes & Scharber, 2008), in this case a sensor for playing Xbox games, to use in an interactive simulation created using Visual Studio 2013 (now known as Visual Studio Community <https://www.visualstudio.com/en-us/visual-studio-homepage-vs.aspx>), a programming suite designed for the Kinect with Xbox One <http://www.xbox.com/en-us/xbox-one/>. Just as with The Village of Umuofia MOO site (Wells, 2013), the Aniara simulation includes some texts, fragments of texts, images and sound effects including music such as Blomdahl's opera (1959). During 2017 simple problems for students to solve will be introduced, including a micro-meteorite strike and failure of the oxygen-generation farm. Solutions for these problems are found in texts such as Stephenson's SevenEves (2015) and Robinson's Aurora (2015). As with the MOO site, the Aniara simulation would be an "evolving artifact" (Wells, 2013) built over time by the educators with student coders as a collaborative project. As seen in Figure 2, this would relate to the AC: Digital Technologies content descriptors ACTDIP039 and ACTDIK034 (ACARA, 2016). The first of these content descriptors relates to the interface for the simulation and for this again the commensurate descriptions...
of computer interfaces are used from GS texts, including gestural recognition and voice recognition made possible by the affordances of the Kinect sensor. This use of gestures for processes with simulations derives from Philip K. Dick's *Minority Report* (1956) as visualised by Spielberg (2002). Also as seen in Figure 2, Visual Arts students would collaborate to improve the aesthetics of the 'Minority Report' gestural interface, as seen in content descriptor ACAMAM077 (ACARA, 2016), as part of the Telopea Park timetabled IDU.

Complementary with the GS Edublog and the *Aniara* simulation is the use of digital video by English students. Following the recommendations of Myers (2013) in “Negotiating the Privilege of Print with the Affordances of Digital Video Authoring”, students construct models of a GS that are not based on examples as seen in the visual texts. Emphasising the scientific speculation inherent in the model, students would have to justify each part of the model and film it on its voyage between the stars. Students would have exemplars in the models of *Starlost* (Hart, 1973), “The Ark in Space” (Bennett, 1975), “Mission of the Darians” (Austin, 1975) and “The Disease” (Livingston, 1999). Indeed, models in these texts suspended on fishing line and floating against a black backdrop in the pre-1990s episodes may be excelled by contemporary students' efforts with their mobile phones or iPads. Models could be constructed of used hose pieces and silver-painted plastic (as are this writer's exemplars, see Figure 4, below) or with computer software such as the free SketchUp <http://www.sketchup.com/> then animated and saved as a digital video. As noted by Myers (2013), video authoring facilitated four groups of students in a study,

...to contextualize ideas in everyday activities and symbols. The video authoring gave a space for the multimodal interplay between various symbolic systems including images, interactions, gestures … language, music, and print text, as all of these were engaged interactively in the design process. (Myers, 2013, p. 228)

Students were engaged with the process of video authoring and all four teachers noted that "digital multimedia technologies afford students with representational tools that help connect their lived social worlds to the story worlds of the classroom texts." (Myers, 2013, p. 228) As with Myers' (2013) studies with digital video authoring for modern historical studies, it is the written or oral argument associated with the final film of the model that is important for evaluation in the AC:E, just as with creative responses for novels as paintings, with a written or oral rationale.

![Figure 4: model of a revolving habitat as part of GS Orion](image)

Based on both past studies of student success and engagement with the genre of Science Fiction as well as trials at Telopea Park School employing the TPACK methodology for particular students in their particular contexts, the GS Project is recommended as a STEAM initiative across the Australian Curriculum for Year 9 students. Educators working in disciplines who may see parallels with their own teaching areas are invited to collaborate in the GS Project. All texts, activities and responses to tasks not under copyright will be shared as Creative Commons online for Australian educators.
References


