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Concepts and practice in the emerging use of games for marine education and conservation

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ABSTRACT

1. Mobilizing marine conservation on a global scale is a tremendous challenge, especially as it involves motivating people who may have no physical connection to marine areas to experience and understand them.
2. Game technology through virtual means, enables players anywhere at anytime, to explore areas they may not otherwise experience, and experience numerous scenarios for the benefit of global engagement in marine conservation action.
3. New game platforms are being developed to teach science, and better connect people to nature, specifically marine environments.
4. *Infinite Scuba* enables players to explore the ocean virtually with Mission Blue Founder, Sylvia Earle.
5. Planet3 is developing a game that will present marine and freshwater ecosystems in the greater context of the Earth system.
6. Games have the potential to play a key role in mobilizing knowledge and conservation action in the future.

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INTRODUCTION

A fierce society recognized for its unprecedented commitment to strength, wit, and camaraderie, the culture of ancient Greek city-state Sparta revolved around developing each child to become resilient and loyal. The Spartans were aware of the simple and obvious fact that the health of their society relied on the citizens that would grow to inherit it. So they constructed an elaborate public education system – the agoge, a regimen to teach boys to be physically agile, strategic, and cooperative, and a similar programme for girls to learn writing, dance, gymnastics, as well as compete in sports (Neils *et al*., 2003). Games were at the centre of this training. Serious games. Each training game had a purpose and lesson, a real-world application that tested survival. As a result,

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all Spartan adults were prepared from childhood to fight for their society.

Games are an inherent part of our human history. They preserve traditions and make a culture grow and develop (Roberts *et al*., 1959). Just as language is a cornerstone of every civilization, games provide a very similar forum of social interaction by operating on agreed-upon rules, context, and affording self-expression. Games allow children to model behaviour as their future adult selves (Piaget, 1965), and they allow adults to improve their skills in a lower-risk environment. The game of doing something, in many cases teaches how to do it for real.

Today, games are seen largely as a social pastime and not a way of imparting survival skills as it once did for the Spartans. Games like chess, football, and charades provide hours of entertainment for adults and children alike. And in more recent years, people engage in these activities from any location and with anyone in the world through online video games. Massively multiplayer online games (MMOGs) connect millions of players in an alternative game space. *World of Warcraft*, for example, as of 2014, has more than 100 million user accounts over the game's lifetime (Sarkar, 2014). The latest expansion of the game, *Destiny*, for example, as of 2014, has more than 25 million registered users who have logged nearly 3 billion hours playing the game online ("Activision Blizzard Announces Fourth Quarter And Full Year 2015 Financial Results," Activision Blizzard Press Release, February 11, 2016).

Today's online environment provides a critical point in history where the opportunity exists to return to the roots of games, to once more use games as a vehicle for the education of survival. But this time, the opportunity exists to engage billions of the Earth's residents.

An age of connectivity has also played a role in improving local and global responses to events. Every person in this world has a voice, and with technology, every voice potentially can be heard, but not every voice yet has access to the technology. A person does not have to have formal credentials to contribute to greater goals and/or make an impact. During the aftermath of the disappearance of Malaysia Airlines Flight 370, ultra-high resolution satellite images covering more than one million square kilometres were gathered and offered to the public for viewing and identification. More than eight million volunteers stepped up to this calling and logged on to identify signs of wreckage, debris, and oil spills (Büscher *et al*., 2014). Like many games today, the process orients the volunteer to the context at hand, trains them in the task, accepts their participation, then serves as an opportunity to learn and perform in a low-risk, high-impact position.

The very real global concern of environmental conservation has also felt the benefits of massive collaborative efforts. Cocos Island in Costa Rica is home to a rich ecosystem of sea turtles, sharks, and fish, protected by a 12 nautical mile no-take zone (Arias *et al*., 2016). Yet, industrial fishers and poachers have been found damaging habitats for personal gain, setting longlines, often more than 60 miles long, with thousands of baited hooks indiscriminately killing all marine life in its path. To spot these fishers and their boats, crowd-sourced volunteers carefully review satellite images, in much the same manner as for the Malaysia Airlines catastrophe, and report any signs of activity (Milton, 2015). Whether finding a downed airliner or identifying illegal fishing, situations such as these illustrate that garnering the help of the Earth's citizens on a massive scale is proving to be a powerful tool for all of humanity.

The Spartans used the agoge as a training context for understanding how the real world operates, educating its youth and citizens about real existing dangers and modelling their behaviour for pro-social causes. Much like these early days when training was preponderantly useful for survival, many believe that the global population is at a historical turning point, when people are again fighting to protect their home front and stay alive, as they face a myriad of global challenges. Today for many people, survival isn't based on immediate needs for food or mating, but populations worldwide do face critical, life-threatening environmental deterioration – an alarming decline of biodiversity, rapid and steady climate changes, and energy resource shortages. One key to survival is an educated youth that will have the knowledge and skills to rise up and save the Earth, our only home. To succeed at this task, education must become a survival instinct.

Can conservationists capitalize on this critical time in history, draw on the lessons of the past, and embrace the resilience and commitment as did the Spartans? This will require utilizing innovations and capabilities to nurture a conscientious, intellectually curious, and resourceful youth. Games provide an appropriate platform for getting the next generation of stakeholders to take on low-risk, adult-like roles in science. As students or young people assume more responsibility, they could help create a call to all citizens of the planet to become involved in the global mission. Today's games, world connectivity, and communication technologies are the tools children will need to soar. Games will no longer be seen as a distraction for youth, but as serious training for what's to come – the responsibilities, the power, and the pride that result from being an active forger of humanity's survival.

METHODS

In various places around the world, many young people who grew up in the late 1970s and 1980s recall hanging out at the video game arcade, a fun place to socialize, people-watch, and show off game-playing skills to admiring onlookers. During the golden age of arcades, video games were seen as something akin to junk food for the mind. And the arcades were viewed as unsavoury hangout spots for insubordinate unsupervised youth.

Today, video games have quite a different reputation. A much broader age range of people enjoy games, no longer seen as a strictly juvenile pastime. In addition, today's games have far-reaching impact, serving purposes beyond entertainment. 'Serious games' (Michael and Chen, 2006) are designed to improve human lives by helping people learn new information and skills (Williamson *et al.*, 2005) and overcome psychological challenges (e.g. PTSD (Rizzo *et al.*, 2013), ADHD (Rizzo *et al.*, 2000), and phobias (Walshe *et al.*, 2003)) as well as physical challenges (e.g. weight loss (Göbel *et al.*, 2010) and stroke recovery (Burke *et al.*, 2009)).

While games for entertainment, such as MMOGs, are receiving considerable budgets and enjoy the most advanced graphics and large-scale networks, serious games are striving to gain efficacy and consumer acceptance. There is therefore a great need for research and development of serious games, particularly educational games, to accommodate the learning demands of today's tech-savvy generation of 'digital natives'.

The expansion of serious games for education will require examining the use of interactive media in education, integrating learning principles with game design, and connecting a global network of collaborators.

Many of today's youth are growing up in an age dominated by information technology and interactive interfaces. The digital world is at their fingertips and it speaks back to them. A generation of children raised on interactive games will reach school age and undoubtedly expect the same smart, customized experience in their educational media.

Traditional methods for teaching children in a formal classroom setting, however, particularly maths and science courses, have not kept pace with almost every other global media/content/information sector. For example, the USA is falling behind in both education and innovation. The 2011 World Economic Forum ranked the United States 51st of 142 countries in the quality of mathematics and science education, and only 5th in overall global competitiveness (World Economic Forum, 2011).

Educators must develop new approaches that fully utilize interactivity and connectivity technologies, well-formed learning goals, cognitive principles of learning, game design principles and also support an updated curriculum appropriate within the national framework of standards. Participation in entertainment MMOG is driven by feelings of achievement, social interaction, and immersion (Yee, 2006). A serious game, however, must not only attract players but also provide long-term learning or behavioural benefits.

An effective educational game will provide the ability to explore a context, manipulate parameters to observe consequences, form and test hypotheses, and design solutions. Games that only support rote fact rehearsal or are addictive, but do not promote analytical thinking may lack the fundamental elements of effective educational gaming.

According to Gunter *et al.* (2008), game designers develop engaging games through careful level design – creating progressively more challenging levels in a game. But expert level design does not always ensure that academic content is well taught, revisited, and reinforced throughout the game and encourage application of learned information and skills to new learning contexts.

In addition to exploring educational models for serious game design, educational technology should consider integrating best practices that optimize learning, retention, and transfer, such as spaced retrieval (Landauer and Bjork, 1978), testing (Roediger and Karpicke, 2006), and interleaving tasks (Kornell and Bjork, 2008) to make learning more efficient as well as effective. Research can help reveal appropriate balances between fun gameplay and desirable difficulties in education that will lead to long-term gains in learning and motivational behaviour.

Advances in connectivity, both inside and outside of the formal classroom, can help improve student access to science resources and opportunities to be an integral part of real-world research efforts. Crowd-sourced contributions to help solve a problem is sometimes referred to as citizen science. Many individuals with access to the internet can log on and participate in some task (e.g. object identification, classification, data entry) which aggregate to provide researchers with a large amount of valuable information. Citizen science is especially useful in the case of visual analytics where data scales are growing at an exponential rate and computers are unable to do many tasks that only humans can. Crowd-sourced analytics have been used in research for archaeology (Lin *et al.*, 2011, 2014), space exploration (Lintott *et al.*, 2008), gene mapping (Huilgol, 2014), and disaster monitoring (Barrington *et al.*, 2012). Environmental conservation efforts are prime examples of science endeavours that can benefit from crowd-sourced analytics and visual monitoring of Earth's life, systems, and resources. With more classrooms going online across the globe, students can participate in crowd-sourced science activities to help advance research efforts as well as gain a greater understanding of global issues, new technologies, and scientific research methods.

Network connected projects create a 'learn by doing' model and are paving the way for rich human-to-human and human-to-computer interactive experiences. These experiences may provide more direct mental pathways into STEAM (Science, Technology, Engineering, Arts, and Maths) careers. Engaging students with real-time, real-world data in game-based missions illustrates curriculum concepts while communicating to students that science is not a set of fully discovered concepts but rather an ongoing process that calls for their active participation.

Computer games have evolved a great deal in the past few decades. People have recognized the capabilities of video games and have assigned them new roles to help humans live better lives. New features and technologies have been amended to our former concept of games. A computer game is no longer a solitary activity that robs a person of productivity or social interaction. Quite the opposite, vast positive social change is anticipated to arise from video games.

CASE STUDIES

Two serious games that provide promise for immersing a global audience in exploring marine and freshwater environments for conservation are Cascade Game Foundry (CGF)'s *Infinite Scuba* and a new game platform being developed by Planet3. Both of these games combine the interactive media, learning principles, and connectivity to explore the environment, educate, and motivate action.

Infinite Scuba

Cascade Game Foundry's mission is to enable people to explore the world from home. For their first independent project, the Microsoft Games Studios veterans partnered with renowned oceanographer, National Geographic Explorer-in-Residence, and Mission Blue founder, Dr Sylvia A. Earle, to create a scuba diving simulation game called *Infinite Scuba* that features virtual versions of real-world dive locations and enables people of all ages and ability levels to explore and experience the mystery and beauty of the world's oceans from home (Soper, 2013). In addition to providing inspiration for the project and guidance on the activities real oceanographers do, Dr Earle has provided validation that the game is worthy of attention in the academic community. This has opened doors at environmental conferences and with other scientific organizations.

Mission Blue is a global initiative of the Sylvia Earle Alliance, a non-profit organization, which was formed in response to Dr Sylvia Earle's 2009 TED Prize-winning wish:

> I wish that you would use all means at your disposal — films, expeditions, the web, new submarines — and campaign to ignite public support for a global network of marine protected areas — hope spots large enough to save and restore the ocean, the blue heart of the planet. How much? Some say 10 percent, some say 30 percent. You decide: how much of your heart do you want to protect? (https://www.ted.com/participate/ted-prize/prize-winning-wishes/mission-blue)

CGF's goal is to build virtual versions of each of the 57 (and counting) Hope Spots (Figure 1) identified by Dr Earle and Mission Blue. Thus far, the team has released two dive sites based on Hope Spots: Chuuk Lagoon in Micronesia, the biggest graveyard of ships in the world, and Glover's Reef, a partially submerged atoll located off the southern coast of Belize that forms part of the outermost boundary of the Belize Barrier Reef.

There are no weapons — no spear guns, no slingshots, no nets, no traps – featured in *Infinite Scuba*; the team has steadfastly refused to include weapons in the game even though it is an oft-repeated request from some of the game's users. Instead of being rewarded for using weapons for killing things, players are instead rewarded for finding, identifying, and photographing different species of fish and other marine animals in each of the dive environments. This focus on non-combative exploration may reflect an exploding trend in the gaming industry: since 2012, there

Figure 1. A world map with Mission Blue's current Hope Spots highlighted.

has been a discernible shift away from mainstream games that 'force-feed players cut scenes, shootouts, and set pieces' (Donnelly, 2014).

Players are presented with new information in the game through the following delivery mechanisms:

Tutorials – This information is presented while the player is in the water. The goal of the tutorials is to teach new skills incrementally. For example, the first time a diver enters the water, the player will have to complete the 'Learn to Dive' tutorial that teaches how to move the diver in the water. Later, the first time a diver goes below 18 metres (60 feet), a tutorial explaining the basic concepts of deep diving appears, e.g. you burn more air the deeper you go, you will get nitrogen narcosis when you go deeper than 27 metres (90 feet), and this will effect your vision and motor skills, etc. (Figure 2).

Field Guide Pages – These encyclopedia-style topics are unlocked as the player explores the dive site and identifies fish, corals, and artifacts (Figure 3).

Loading Screen Tips – These short, informative tidbits of historical and cultural information are presented on the loading screen as the player is waiting for the game to load (Figure 4).

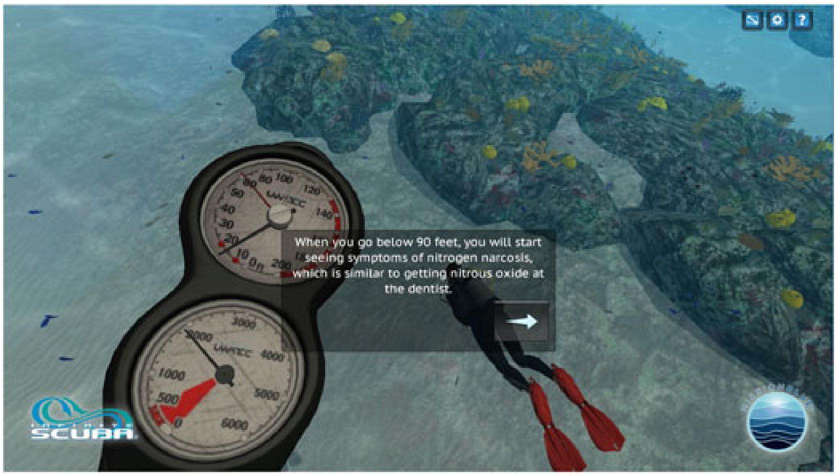

Figure 2. *Infinite Scuba* tutorials communicate key concepts as the player plays the game.

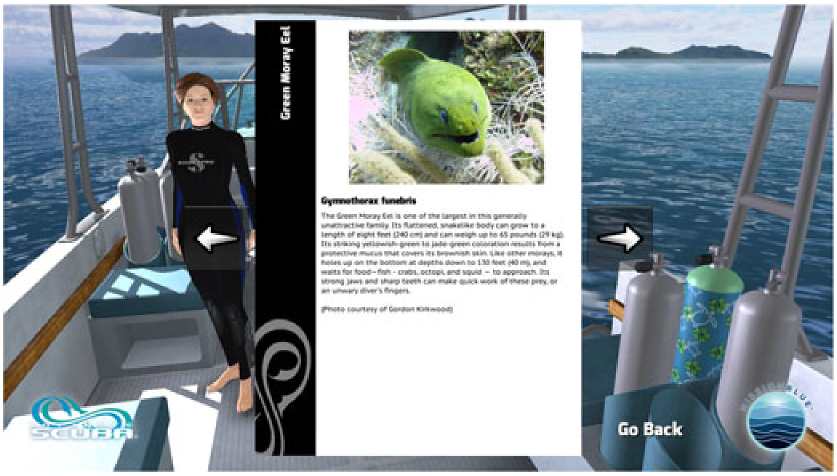

Figure 3. *Infinite Scuba*'s Field Guide includes detailed information on the creatures and plants featured in the game.

Figure 4. Loading screen tips provide short, informative snippets of information related to the game.

Players can earn badges for identifying all of the wildlife on a dive site, finding all the artefacts on a dive site, taking photos, completing dives without running out of air, and so on. The team also has the ability to track what players are doing in the game, so they can monitor what activities people do, what badges/certifications they earn in the game, how much time they spend in the water, and so on.

As noted above, the Field Guide includes encyclopedia-style articles that address topics like the history of each location and information on the plants, animals, and other organisms that live in particular parts of the ocean. Players can unlock these topics by completing certain tasks in the game. For example, in the Belize dive site, players can unlock a series of Field Guide articles on invasive species by identifying and tagging lionfish as they explore the environment. The topics on lionfish as an invasive species do more than just describe a certain type of fish – they also address the root of the problem, the history of the lionfish's invasion of the western Atlantic Ocean and the Caribbean Sea, the threats posed by lionfish (with no natural predators and a voracious appetite, a single lionfish can reduce juvenile fish populations by 79% in just 5 weeks (Côté *et al.*, 2013)), and the controversy surrounding how best to tackle this monumental problem (Eat them? Train local sharks to eat them? Leave them alone?). The goal is to provide a balanced and informative context for the challenges faced by marine life and the oceans in different parts of the world.

Collecting trash is another major activity for players of *Infinite Scuba*. As with the lionfish, players unlock Field Guide topics addressing issues related to the pollution of the world's oceans.

Infinite Scuba's Field Guide also includes an extensive profile of 'Her Deepness', Dr Earle, chronicling her amazing history as an oceanographer, explorer, scientist, author, lecturer, and submersible pioneer. As an extra bonus, players can choose to dive as Dr Earle herself in the game, complete with her signature ruby-red flippers.

CGF donates a portion of the sale price for each game sold to Mission Blue. The team has also travelled extensively with Dr Earle to diving conventions, film festivals, and ocean conservation summits to demonstrate the game and to provide vivid and tangible support to Dr Earle and Mission Blue's message. CGF hopes this unusual collaboration and mutually beneficial relationship between a game developer and a non-profit organization will serve as an example to other organizations who want to use game-development skills to advance marine education and conservation.

CGF also does major outreach to schools and summer camps, providing live demonstrations of the game and giving students of all ages complimentary access codes so that they can play the game for free and provide feedback to the team on their experiences.

CGF includes a topic called 'What can I do to help save the world's oceans?' in its online Frequently Asked Questions (FAQs), which covers the most commonly asked questions about the game. The topic covers a wide range of actions that individuals can take such as declining to use a drinking straw when dining out (to try to discourage the use of single-use plastics that are not recyclable), to supporting organizations that are working to protect the world's oceans. The FAQ includes links to National Geographic's '10 Things You Can Do to Save the Ocean' web page (http://ocean.nationalgeographic.com/ocean/take-action/10-things-you-can-do-to-save-the-ocean/), The Ocean Conservancy's 'Take the Last Straw Challenge' web page (https://secure.oceanconservancy.org/site/Advocacy?cmd=display&page=UserAction&id=795), and MarineBio's '101-Plus Ways to Make a Difference' web page (http://marinebio.org/oceans/conservation/local/). CGF will incorporate this information into the game's Field Guide in future releases.

CGF also uses social media, including Facebook and Twitter, to publicize and support Mission Blue's efforts. This social media presence is valuable for both Mission Blue and CGF because CGF's video-gaming credentials help Mission Blue gain credibility with a younger audience. It's also valuable because it improves efficiency and sustainability and expands the value proposition for both organizations (Stengel, 2013).

CGF is working to add a Scholar Challenge feature to the game. With Scholar Challenges, players can earn special badges that indicate mastery of certain topics. Mastery will be proven by passing a multiple-choice test based on information presented in the Field Guide pages. For example, players could earn the Chuuk Naturalist Scholar badge by answering 25 of 30 questions related to the wildlife of Chuuk and local/global environmental challenges. The incentive to do this could be unlocking an exclusive piece of gear (e.g. wetsuit or fins) that the player could not earn any other way. The development team will recruit players to try the challenge via social media and school outreach.

In support of this feature, CGF plans to review the information presented in the Tutorials, Field Guide pages, and Tips and update it to support the Scholar Challenges. CGF's goal with this work is to provide a more formal testing mechanism inside the game, in addition to the gameplay mechanics in the water and browsing the Field Guide pages. Long term, CGF hopes to work with academic experts to incorporate elements of the Common Core curriculum into the game.

Planet3

Marine and freshwater ecosystems will be introduced within the wider context of Earth science in Planet3's educational technology platform.

Scheduled for beta testing in autumn of 2016, the Planet3 platform is designed to deliver Earth science curriculum to students aged 10 to 14 through a combination of game-based virtual immersion, storytelling, and real-world interactions with most current and relevant events of the global scientific community. The larger story that frames the curriculum is centred around the themes of conservation, environmental awareness, and improving the planet. As shown in Figure 5, students travel down to Earth via the Planet3 POD to investigate Earth systems and interrelationships. Marine biodiversity, ocean systems, and weather, are all pervasive topics taught throughout the platform to convey the importance of vastly interconnected phenomena.

Planet3's strategy is organized around three specific factors: Preparation, Contextual Storytelling, and Emergent Gameplay.

The Planet3 instructional model pulls from numerous robust and well-researched frameworks, models, and education principles to form a comprehensive system for engaging and educating students. The Planet3 platform consists of *missions* which are similar to chapters of a textbook in that they organize content by topic, but go far beyond those capabilities to offer students action-oriented digital engagements that facilitate scientific practices, and interaction and communication with peers and the wider community. Each Planet3 mission consists of *mission challenges* that pique student curiosity, help students form questions, and carry out scientific investigations.

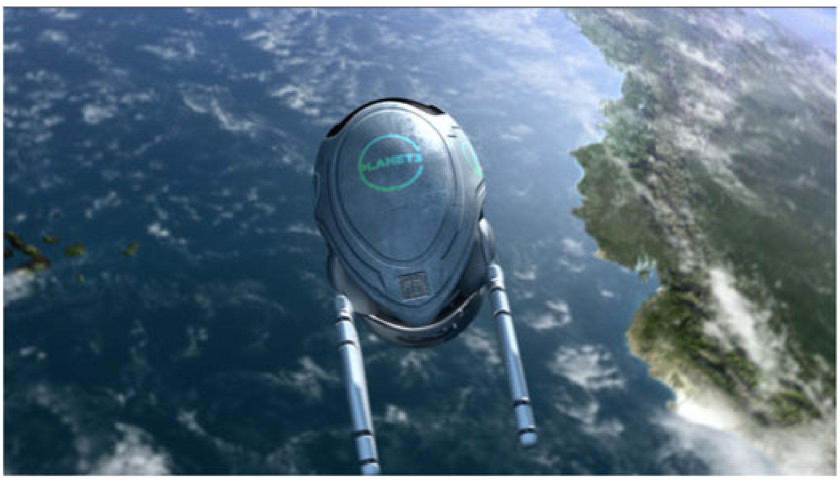

Figure 5. A Planet3 POD travels down to Earth for the next mission.

Planet3's overarching goal is to educate young people about the Earth and give them the tools to improve it, thereby becoming agents of change. Because the central theme of Planet3 is Earth conservation, the Planetary Boundaries (Rockström *et al.*, 2009; see Figure 6), which are measures of Earth's environmental stability, are incorporated into Planet3 instruction and discussed throughout the Planet3 missions and within each activity. It also draws from the Next Generation Science Standards which specify environmental concerns as critical to science education, emphasizing the study of human impact, limitations of natural resources, and global climate change (NGSS Lead States, 2013). Planet3 frequently addresses environmental concerns because not only is it a pressing concern for Earth's inhabitants, it also serves as a strong motivator for students to learn science, technology, engineering, and maths (STEM) and help mitigate humans' impact on the Earth.

Students often ask 'Why do I need to learn this?' in STEM courses (Rhodes, 2011). Planet3 missions are designed to incite empathy and responsibility, so that students deeply understand why they should be curious and receptive to new information. Affective drivers that appeal to students' emotions can have a profound impact on learning (Krathwohl *et al.*, 1964). Each activity in a Planet3 mission aligns with a level of the Bloom's Affective Domain hierarchy. The progression of the activities gradually affects students' feelings toward specific issues in science that drive purposeful learning, decision-making, and behaviours.

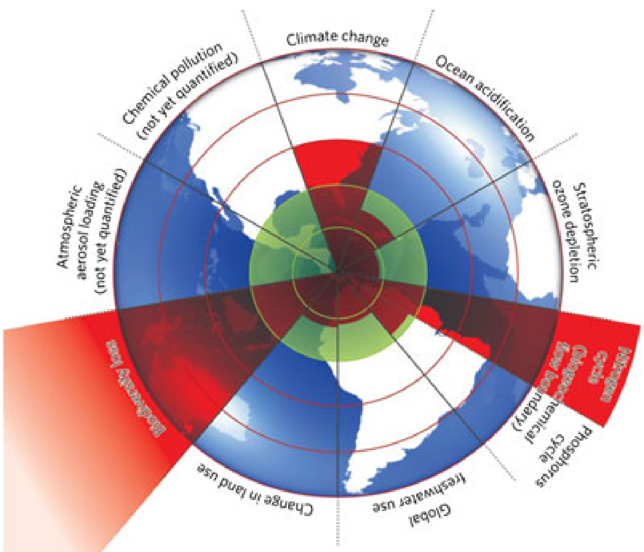

Figure 6. Rockström's Planetary Boundaries.

Planet3's instructional model also incorporates educational practices in reflection (Canning, 1991) to promote the internalization of challenges and possible solutions. John Dewey defined reflection as the 'active, persistent, and careful consideration of any belief or supposed form of knowledge' and that this process helps people learn from their experiences (Dewey, 1933). Kolb (2015) stated that we learn by doing and reflecting on what we have done, and that this process is continual and cyclical. Exercises in reflection allow people to take a moment to process new information and how they have changed as a result. In education settings, reflection is an opportunity for students to externalize and assess their reactions to new information. As discussed previously, the Planet3 instructional model is guided by affective learning principles and involves student affective responses to support learning (Krathwohl *et al.*, 1964). Although it is difficult to define intended affective outcomes because a teacher should not set out to inculcate students with specific opinions, beliefs, and attitudes (Smith and Ragan, 1999), reflection exercises can help students understand the importance of thinking and feeling in the process of learning (Gano-Phillips, 2009).

Planet3 will offer real-world science projects that will guide teachers and students to identify a research question around a specific topic, explore their surroundings, collect data, draw conclusions, and devise solutions. Active participation in science projects that connect students with their surrounding helps to improve their sense of agency and control (Basu *et al.*, 2009; McNeill and Vaughn, 2012), enhances intrinsic motivation to participate in science research (Basu and Barton, 2010) and identification with science roles (Nasir and Hand, 2008; Barton and Tan, 2010), and affects the likelihood of lifelong participation in science (Roth and Lee, 2004). Planet3's curriculum and embedded projects are designed to facilitate student resourcefulness and autonomy in science and research roles. The development of agency is an iterative and generative process, requiring multiple opportunities for leadership and decision-making as well as ongoing human interaction and mentoring connections. Repeated and continued experiences with real-world science challenges can affect student career goals and decision-making (Basu *et al.*, 2009; Hiller and Kitsantas, 2014). By offering multiple opportunities for research and problem-solving throughout its platform, Planet3 anticipates the improvement of both immediate learning outcomes and life-long endeavours in science.

DISCUSSION

Games present great potential for reaching new audiences, creatively delivering educational content, and introducing and promoting marine conservation. Game platforms such as *Infinite Scuba* and Planet3, not only are breaking new ground by applying proven game techniques for education, but each intends to engage student and general audiences alike in exploring the ocean and the planet. With billions of players around the world engaging in games daily, the design and execution of educational game platforms focused on the oceans and the Earth systems can only add to the existing repertoire of approaches to educate and promote conservation.

As much as exploring the oceans and planet is very different in natural and virtual environments, many similarities exist in the classroom versus game context. Where a teacher leads lessons in a traditional classroom, National Geographic Explorer, Sylvia Earle, guides students through real-life dive locations in *Infinite Scuba*, introducing new geographic locations and species along the way. Traditional lessons are replaced by missions in the Planet3 game delivering foundational content before branching out to more advanced concepts. Just as traditional classroom education relies on testing to determine whether students are grasping concepts, game mechanics constantly capture and measure student knowledge by determining time spent on a certain topic or challenge in the game.

However, it is the differences between the traditional learning environment and game offerings that provide the greatest promise for advancing conservation awareness and action, especially in the oceans area. The dynamic and high definition game environment allows the player or student to travel ‘virtually’ anywhere at any time. Unlike a classroom setting, the player determines when to play and for how long. Play and learning stops and starts at the player’s discretion, a teacher and classroom are not required. Rather than static textbooks, games immerse the player in an environment – in this case the ocean or a marine protected area – allowing them to see different species of fish. In the future, games may show the impact of warming temperatures on the marine environment such as changes in coral reefs or coastal erosion due to severe weather events.

Perhaps most importantly, games can allow the player to be the decision maker in real-life scenarios and based on those decisions see the impact on the ocean environment. Games could have students exploring impacts of overfishing or illegal fishing scenarios in numerous areas around the world, determining how to manage marine protected areas better, or reduce plastics in the ocean. This is the opportunity for the ocean community – to apply proven learning techniques in an exciting, fun, and accessible way not only to improve peoples’ knowledge of the ocean, but to explore the oceans and address problems and solutions virtually that may have real-world benefit.

As the ocean covers 70 % of the Earth’s surface, the prospect of using game technology to enable people anywhere at anytime to explore, learn, and connect with marine environments must continue to grow. *Infinite Scuba*’s ability to allow players to swim alongside Sylvia Earle, be introduced to various fish species, and examine coral, is a major first step in illustrating the power of games. Planet3’s plans to exploit their game platform to introduce marine (and freshwater) concepts within the context of Earth system science holds great promise to not only teach but to motivate conservation action by allowing players to play key roles as decision makers in their high-definition world.

Just as the Spartans prepared their youth for adulthood using games, educational games such as *Infinite Scuba* and Planet3 hold great promise to inspire a new generation of knowledgeable, informed, and prepared adults that respect and care for the ocean.

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