

Promoting Social Advocacy through Digital Storytelling: The Case of Ocean Acidification

Chun Chen Yea, Wen Huei Chou

Abstract—Many chemical changes in the atmosphere and the ocean are invisible to the naked eye, but they have profound impacts. These changes not only confirm the phenomenon of global carbon pollution, but also forewarn that more changes are coming. The carbon dioxide gases emitted from the burning of fossil fuels dissolve into the ocean and chemically react with seawater to form carbonic acid, which increases the acidity of the originally alkaline seawater. This gradual acidification is occurring at an unprecedented rate and will affect the effective formation of carapace of some marine organisms such as corals and crustaceans, which are almost entirely composed of calcium carbonate. The carapace of these organisms will become more dissoluble. Acidified seawater not only threatens the survival of marine life, but also negatively impacts the global ecosystem via the food chain. Faced with the threat of ocean acidification, all humans are duty-bound. The industrial sector outputs the highest level of carbon dioxide emissions in Taiwan, and the petrochemical industry is the major contributor. Ever since the construction of Formosa Plastics Group's No. 6 Naphtha Cracker Plant in Yunlin County, there have been many environmental concerns such as air pollution and carbon dioxide emission. The marine life along the coast of Yunlin is directly affected by ocean acidification arising from the carbon emissions. Societal change demands our willingness to act, which is what social advocacy promotes. This study uses digital storytelling for social advocacy and ocean acidification as the subject of a visual narrative in visualization to demonstrate the subsequent promotion of social advocacy. Storytelling can transform dull knowledge into an engaging narrative of the crisis faced by marine life. Digital dissemination is an effective social-work practice. The visualization promoting awareness on ocean acidification disseminated via social media platforms, such as Facebook and Instagram. Social media enables users to compose their own messages and share information across different platforms, which helps disseminate the core message of social advocacy.

Keywords—Digital storytelling, visualization, ocean acidification, social advocacy.

I. INTRODUCTION

THE ocean is the cradle of life. It is threatened by acidification, which is unnoticeable for ordinary people. Due to fossil fuel burning, the pH value of seawater has decreased by 0.1 units. Such a change may be unnoticeable to most people, but substantial changes in the marine environment will not be easy to ignore.

Components in the environment affect one another. Hence, the gradual acidification of the ocean threatens the survival of organisms made of calcium carbonate such as shrimps, crabs, clams, and coral reefs. This might lead to the collapse of interconnected food chains, which will eventually attack the

global ecosystem.

Earth's resources are limited, and our habitat is plagued with all kinds of pollution. If we choose to ignore environmental damage, it will only aggravate. Reducing carbon dioxide emissions is not only the responsibility of industrial factories, but also the obligation of every citizen. Our individual actions are the driving force behind societal change.

This study discusses how to present the impacts of ocean acidification on ecological environments through digital storytelling. Therefore, we present a review of the literature on ocean acidification, social advocacy, and digital storytelling.

The objectives of this study are as follows:

- 1) In the form of digital storytelling, published works centered on ocean acidification in social media;
- 2) Analyze the data on social media users, and evaluate their perception toward social advocacy;
- 3) Based on an analysis of the degree of fit between digital storytelling and social advocacy, investigate whether digital advocacy can increase the clarity, coherence, and influence of social advocacy content.

II. OCEAN ACIDIFICATION

Seawater regulates the carbon dioxide concentration in the atmosphere, thereby moderating the greenhouse effect. However, carbon dioxide will still have an adverse impact even if it has dissolved in the ocean. The pH value of seawater, which measures the acidity and alkalinity of seawater based on the concentration of hydrogen ions, gradually decreases after atmospheric carbon dioxide is absorbed by the ocean. This process is known as ocean acidification [1].

The concentration of carbon dioxide was altered during the Industrial Revolution, when manual labor was replaced by machines and substantial energy consumption started to take place. The concentration of carbon dioxide gas emitted during this period was continuously rising. The United Nations report of the Intergovernmental Panel on Climate Change (IPCC) indicated that 15%–40% of the carbon dioxide gas that has been emitted since the Industrial Revolution in the 18th century will remain in the atmosphere for more than 1,000 years. In other words, the carbon dioxide gas released from the burning of fossil fuels will continue to affect the global ecosystem and climate for at least 1,000 years.

With excessive carbon dioxide emissions, ocean acidification threatens marine life. Reference [2] points out that changes in the chemical composition of the ocean affect the speed at which sound travels along the ocean floor; gradual acidification of the ocean will increase the sound volume in the ocean and possibly impact the behavior of marine mammals.

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On the other hand, the shells of organisms such as shrimps, crabs, shellfish, clams, corals, and snails, which contain calcium carbonate, will be eroded by the gradually acidified seawater.

III. SOCIAL ADVOCACY

Social justice is achieved through the communication and interaction between individuals, groups, and the society on an equal footing [3]. Social advocacy has its roots in the late-19th century in the United States. At the time, many social service organizations used social advocacy as their modus operandi to propagate and promote social work.

Social advocacy is a method for helping the disadvantaged fight for their rights, by encouraging citizens to pay attention to their habitat and to participate in the decision-making processes of public affairs. It is achieved by promoting and advocating social initiatives through goal-oriented planning and actions by groups and organizations. Advocacy is an ability. Sufficient understanding of the context of a specific issue can enhance the effectiveness of social advocacy. This presents an opportunity to change the existing societal structure, and influence policy making, and thereby promote social justice [4].

In recent years, with the rapid development of information technologies, new communication technologies such as mobile phones, mobile devices, digital media, and the Internet have emerged. This offers a new advocacy strategy for promoting social initiatives and taking tangible actions: Digital advocacy [5]. Digital advocacy is a method that makes use of digital technologies to connect and mobilize the public. It significantly enhances the efficiency of social advocacy. It is presented in the form of digital media including images, animations, video, music, and interactive technologies, and is rapidly disseminated across various mobile devices and social media. It can serve as an ideal strategy for social movements, and plays an important role both in fundraising for non-profit organizations and political activities.

IV. DIGITAL STORYTELLING

Reference [6] defined storytelling as a series of events, narrated from a certain perspective. The core message is structured into a story, and disseminated through storytelling. Hence, storytelling can be perceived as an art that conveys valuable information. Storytelling can be very infectious; sometimes it can even affect the emotions of the audience, inspire them, and incite intimate feelings [7]. A story is narrated from a specific point of view that encourages discussion. The narrative itself conveys a specific message. Therefore, by whom the story is narrated and how it is propagated are of great significance to storytelling [8].

Traditionally, storytelling is disseminated via written and verbal communication. With Internet's prevalence, it is integrated with multimedia and emerges in digital forms. Such integration enhances the power of storytelling [9]. The integration of digital multimedia and storytelling is termed DST (digital storytelling). Compared to traditional storytelling, DST lowers the cost of dissemination, and the intended

message is more conveniently transmitted via Internet communication [10].

Reference [11] defined DST is an excellent method to document personal experiences, and it can help people discover their inner self and character. DST is rather suitable for practicing social work. An account of personal stories and digitized dissemination are favorable ways of practicing social work [12]. Reference [13] point out that DST not only provides the background context of a story but also describes the core idea of the story through the narrator, so as to convey the intended message. "Reconstructing" narratives through multimedia is a creative process that infuses renewed vitality to the story. A substantial part of the story described by digital storytelling is non-mainstream content. DST provides viewers with an opportunity to witness a scenario that they would rarely experience in-person [14].

In many cases, DST is used to explain specific issues, including women's rights, refugees, orphans, or campus bullying. The subjects of these stories are typically the disadvantaged, the minority, the non-mainstream, or the traditional aspects of specific issues. Digital narrative creates more possibilities and can disseminate stories more rapidly. Thus, DST can be introduced to resolve structural injustice and any other social issues.

V. DESIGN PROCESS

The project entails the collation and analysis of the relevant literature in three areas: The causes and effects of ocean acidification; the design of digital storytelling; and, the definition of social advocacy. The impacts of ocean acidification on marine life are illustrated through the contextual narration of digital storytelling to increase social awareness about the issue of ocean acidification, and consequently, to promote social advocacy. The research framework of the design process is shown in Fig. 1.



Fig. 1 Research framework

The Four phases of the design process are as follows:
Phase 1: Literature analysis

This phase involves the discussion of the definition of DST and social advocacy, and the causes and effects of ocean acidification, as well as the clarification of the associations between them and the application strategies that form the foundations of the digital story design. Literature review reveals that the public is either unaware of ocean acidification,

or lacks a clear understanding of its causes and effects. This is exactly why social advocacy is the suitable method for raising awareness about the issue.

In previous cases, digital storytelling was conducted from a specific perspective to expound on a non-mainstream topic (e.g., disadvantaged groups and minority problems); in other words, digital stories were expected to clarify a topic and describe its present status. Based on the definition of DST and suggestions on digital storytelling [15], the characteristics of digital storytelling are summarized as follows:

- 1) Graphic thinking: Graphic thinking can arouse people's deepest instinct, leading them to understand the meaning of story content from graphs.
- 2) Text narratives: As an integral part of digital storytelling, texts must be concise and expressive as well as free of unnecessary plots, so that audiences are attracted by the main storyline.
- 3) Non-mainstream topic: The views of authors and the content of digital stories are key issues that can attract the attention of audiences.
- 4) Reconstructing narratives: Centered on specific issues, digital storytelling is a process to reconstruct narratives through others.
- 5) Digital advocacy: Social advocacy is practiced digitally (e.g., through Facebook and Instagram) on the Internet.

Phase 2: Research framework

This study commenced in April 2018. In the initial stage, the characteristics of digital storytelling were defined based on a literature analysis. In the middle stage, a digital storytelling design was conducted with respect to ocean acidification. Unlike texts, images can surmount linguistic barriers and narrate stories in an intuitive manner. Therefore, the project is mainly narrated through images, though it contains text as well. The project profile mainly comprises the following three parts:

- 1) The causes of ocean acidification: The combustion of fossil fuels is the main cause of ocean acidification. A design of digital storytelling is conducted accordingly.
- 2) The effects of ocean acidification: Primarily, ocean acidification has changed the pH value of seawater and produced a direct effect on organisms composed of calcium carbonate. In addition, ocean acidification has changed the propagation speed of sound in water, thus affecting cetaceans that identify locations by sound.
- 3) Environmental advocacy: Ecological change will affect the global environment through ecological chains. Oceans are the cradle of life. Therefore, it is imperative that all mankind should envisage the environmental problems and reflect on environmental sustainability.

After the design of DST, the next step is digital advocacy. Information can be diffused rapidly over the Internet. Digital media is a powerful means of information diffusion and can convert didactic knowledge of ocean acidification to easy-to-understand graphs and texts through digital storytelling. Such graphs and texts are released on social media. Related contents include the causes and effects of ocean acidification, environmental advocacy, and so on. In September and October 2018, Facebook and Instagram were selected as advocacy

platforms to increase the environmental concern about ocean acidification continuously. As a result, people can realize that the environmental situation can be changed somewhat through their own efforts, and such change can start with carbon abatement. To this end, each step we take will provide a driving force for changing the social problem and improving the environmental situation.

Phase 3: Importing the knowledge of ocean acidification through digital storytelling

In this study, a series of images are produced through visualization-based digital storytelling. The core of digital storytelling is to select and then study a particular topic; specifically, from the perspective of environmental advocacy, a digital story with emotional appeal is written to set forth the causes and effects of ocean acidification, so that digital images become the narrators of the digital story. After the images are generated, they are mapped to the characteristics of digital storytelling, and the project content is checked item-by-item.



Fig. 2 Lose course

- 1) Graphic thinking: Carbon dioxide discharged by factories harms the oceans. This serves as an alarm to environmental advocacy.
- 2) Text narratives: Ocean acidification has changed the propagation speed of sound on the seabed, thus affecting wholphins that identify locations by sounds. This increases their difficulty in predation and makes them disoriented in the sea.
- 3) Non-mainstream topic: The courses of ocean acidification, an environmental concern, are used as topics for discussion.
- 4) Reconstructing narratives: Carbon dioxide emitted from the burning of fossil fuels dissolves into the atmosphere. This pollutant is agglomerated into an image of a whale, implying that wholphins are suffering because of harmful pollutants.



Fig. 3 Poor coral

- 1) Graphic thinking: In an exaggerative way, the effects of ocean acidification are reflected at the moment of embrittlement of corals.
- 2) Text narratives: Every year, oceans absorb nearly 10 billion tons of carbon dioxide. Due to the chemical reactions caused by carbon dioxide, oceans are acidified. Then, the acidified oceans erode the existing coral skeletons, causing the corals to produce new skeletons.
- 3) Non-mainstream topic: The effects of ocean acidification, an environmental concern are used as topics for discussion.
- 4) Reconstructing narratives: The coral shell, which is made of calcium carbonate, is undoubtedly the first victim of ocean acidification.



Fig. 4 Stranded whales

- 1) Graphic thinking: Stranded whales are just like humans who live without air, so they seem to be particularly feeble.
- 2) Text narratives: Ocean acidification will change the propagation speed of sound in oceans, thus affecting the sense of orientation of wholphins and even causing a sense of urgency. Therefore, wholphins are prone to disorientation and confronted with a higher probability of being stranded.
- 3) Non-mainstream topic: Whales, a type of marine organism, are used in the lead role, but are not viewed from the perspective of humans.
- 4) Reconstructing narratives: Oceanic noises are increasingly severe. This poses a great threat to wholphins, which rely on sound to locate other objects, prey, and partners. Therefore, a wholphin sits weak and limp on a chair, implying a sense of despair due to its being stranded.



Fig. 5 Discussion on how to cooperate

- 1) Graphic thinking: To address global environmental concerns, it is imperative that all humans reflect on and discuss the issue and reach a consensus.
- 2) Text narratives: The United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol and the Paris Agreement intend to address the great environmental change and the global environmental situation of the future is in the hands of all humans.
- 3) Non-mainstream topic: A great environmental change takes place due to the increase in greenhouse-gas emissions.
- 4) Reconstructing narratives: Since the Industrial Revolution, greenhouse-gas emissions have changed the global environmental situation. The United Nations has become aware of this problem and has tried to seek a solution.

Phase 4: Digital communication

Social media are an important channel of digital communication. First, users take the initiative in editing content, and this design orientation is beneficial to the interaction between platform users. Second, social media allow cross-platform sharing, thus increasing the content's exposure rate. Therefore, the images of digital storytelling are uploaded to social-media platforms (e.g., Facebook and Instagram), and then such images can be diffused over the Internet.

To promote the digital communication of environmental advocacy, we built a major visual image of ocean acidification, and used three elements (i.e., whale, ocean, and carbon dioxide) to create a major vision, as shown in Fig. 6.



Fig. 6 Facebook: OceanAdvocacy

An exclusive Facebook space is created to concentrate on the major visual image, thus promoting environmental advocacy, as shown in Fig. 7. Since its founding in 2004, Facebook has registered an amazing growth in the number of users and is a social media platform with the largest number of users worldwide. In the interactive communication part, data are constructed for posts in a hierarchical manner, and each post can be responded to in three ways, including the five emotional icons, sharing count, and leaving word (they are all important elements of social media). These functions enable people to interact as if they are in the real world. In terms of functionality, Facebook allows social media interaction mainly through posts. Posts can comprise photos, audio and video data, feelings, labeled friends, and plans, thus reducing the psychological distance between users, as shown in Fig. 8. Therefore, users can

express their opinions about environmental issue by leaving word. Due to the sharing function between social media, users can be linked across different platforms, thus increasing their contact rate.

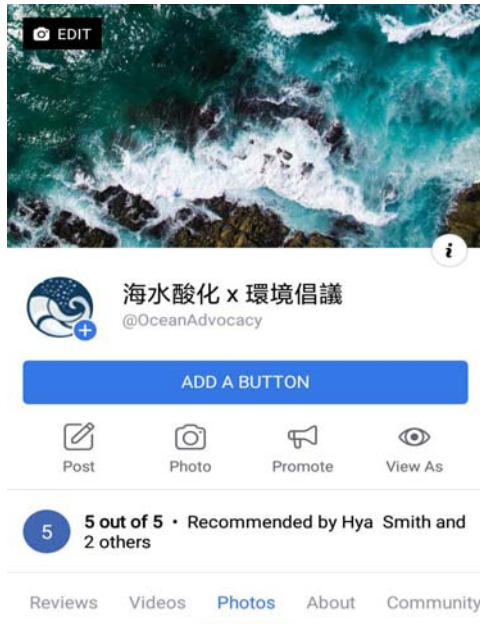


Fig. 7 Facebook: OceanAdvocacy



Fig. 8 Facebook: OceanAdvocacy

Functionally, another edition provides many similar free Instagram applications. When Instagram was launched in 2010,

[16] analyzed the complexity of simplified interfaces and added the filtering function, allowing users to perform module registering quickly upon taking photos and presenting individualized pictures. This project also has an exclusive account (ID: oceanadvocacy2018) on Instagram, as shown in Fig. 9.



Fig. 9 Instagram ID: oceanadvocacy2018

The images of digital storytelling are uploaded to Instagram for sharing and are linked to Facebook, thus increasing their contact rate. This platform design accelerates the sharing of photos between users. After taking photos, users can use the sharing function to link such photos with other platforms (e.g., Facebook, Twitter, and Tumblr), thus increasing the contact rate of users from different platforms. This will attract those people with environmental concerns and promote interaction between users, thus influencing more people, as shown in Fig. 10.

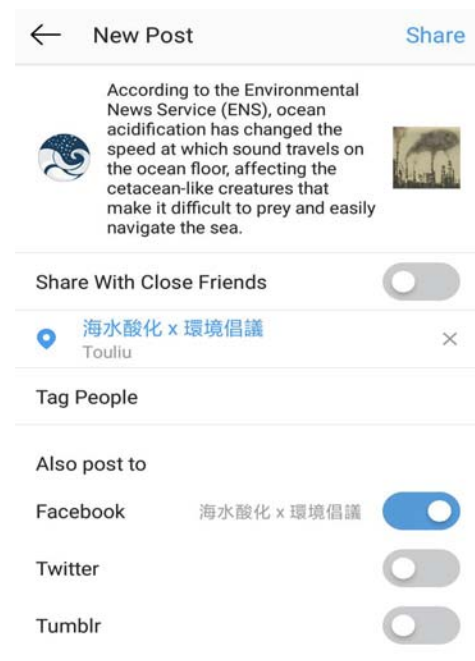


Fig. 10 Sharing function

The project was planned in April 2018. Subsequently, literature data were collected and works of digital storytelling were generated; the Facebook and Instagram platforms officially went live in September 2018 to publish storytelling

works on ocean acidification. In the later stage, users are periodically traced through the Social Media Analysis tool and the digital data are used to analyze how to improve social media

strategies; the analysis tool helps to reduce the time-cost and error of manual analysis, thus accelerating data statistics, as shown in Fig. 11.

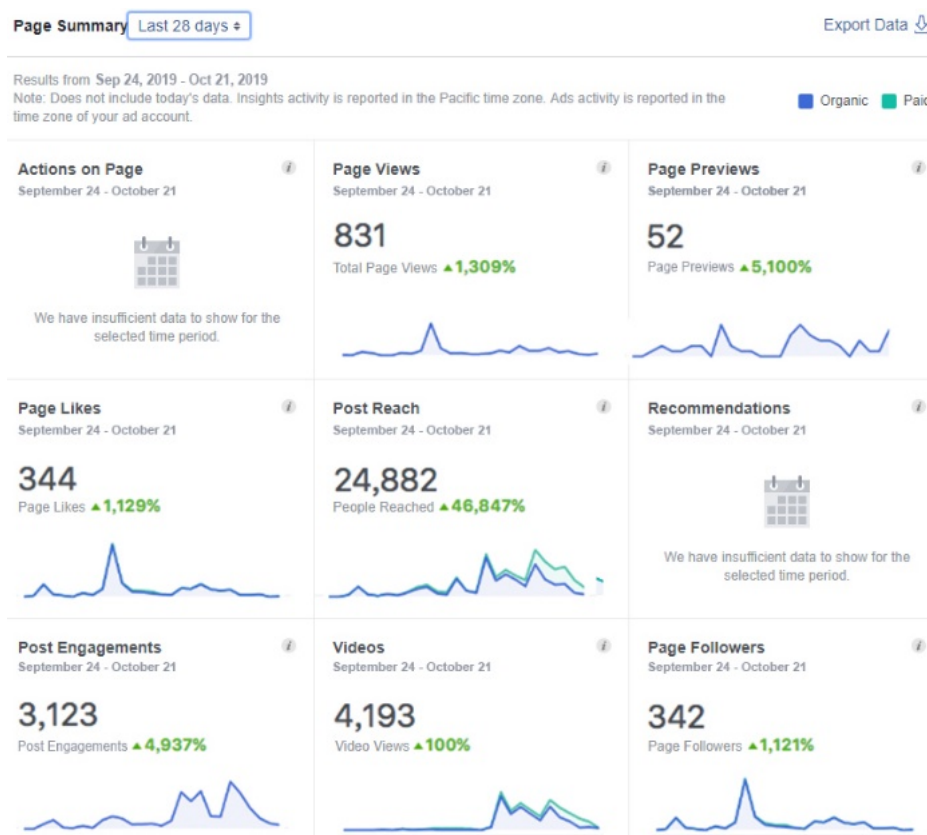


Fig. 11 Social media analysis tool

With the help of artificial intelligence, the analysis tool can analyze social advocacy data centered on the topic of ocean acidification. Statistics about praise are used as the reference for contact rate of related information. As shown in Fig. 11, from September 24 to October 21, 2018, contact rate increased significantly because the fan page had been operated for a certain period in the later stage and posts were released frequently. This reveals that platform operation takes time. Through the sharing function among fans, more users can receive information regarding environmental advocacy centered on ocean acidification. Based on the messages left by users, we can analyze ways to improve digital storytelling.

VI. CONCLUSIONS AND RECOMMENDATIONS

Social media platforms are characterized by rapid distribution of information and a large number of users who actively compose messages and browse information. These features add impetus to social advocacy. The dissemination of digital storytelling images on these platforms can help promote social advocacy on ocean acidification. In this study, the demonstrative images made using digital storytelling were uploaded to social media platforms like Facebook and Instagram, and since then, it has been shared across various social media platforms. Social media platforms distinctively

allow users to actively compose messages. Those who have read the information about ocean acidification on the Internet can leave comments to offer the most direct feedback on this study, and through these comments, exchange their sentiments regarding environmental issues. Cross-platform sharing can also significantly enhance the reach of the video.

In terms of recommendations, it is suggested that digital storytelling images about ocean acidification can be incorporated into teaching plans of environmental courses. They can serve as a practical foundation for developing social advocacy concerning ocean acidification, or provide references for the design of environmental advocacy using digital storytelling. Experts should also be consulted for advice on the integration of digital storytelling into social advocacy so as to provide references for the subsequent improvement of social advocacy.

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