Deliverable 5.9

Interactive Visualisations and Maps

Work Package 5

Deliverable 5.9

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Project coordinator:

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Interactive Visualisations and Maps

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1. Introduction

In this document we present the Ocean Literacy tools developed under the task 5.9, Interactive Visualisations & Maps. As stated in the proposal, the aim of this task was to "improve on existing means of graphically telling the stories through the use of animation and systems dynamics simulation to deliver animated graphics." We have therefore endeavoured to use our knowledge of simulation and web design and animation to deliver novel and interesting approaches to Ocean Literacy tools. These will be widely deployed and monitoring the next phase of WP5 (Monitoring and Evaluation of Wider Application).

The Ocean Literacy tools documented in the following chapters are:

- Online interactive (kumu) key story presentation on Microplastics from Cosmetics
- Interactive web story on Coastal Tourism
- Systems Simulation Learning Tool
- Ocean Literacy Quiz and Survey Builder and Online Quiz / Survey Tool
- Framework for a Systematic Approach to Measurement of Ocean Literacy and Effectiveness of Tools
- Ocean Literacy Cartoons
    - o Microplastics
    - o Coastal Tourism
    - o Ballast Waters

2. Kumu presentation on MicroPlastics

Description

One of the problems with Ocean Literacy is that we are attempting to alter people's perceptions and opinions on what are often complex systems. Therefore we are trying to convey a causal system to an audience that is largely unaware of such approaches to understanding the world around them and the interactions between human processes and the ecosystem.

In the ResponSeable project we have used the DAPSIWR framework to model the Key Stories in such a way that attempts to clearly illustrate the causal pathway from Drivers to Impacts (both on the Ecosystem and on Human Welfare) and on to our Responses to them.

Based on an underlying causal map data model, we have used the kumu.io online application to create an interactive online presentation that leads the user through the causal chain from Drivers to Responses.

Effectively this means capturing the DAPSIWR causal chain, as described in the ResponSeable Knowledge Base and Key Story documents, in the underlying kumu graph data model. Once this causal graph has been captured, we have added knowledge to the nodes and relationships in this graph, utilising the work done in WP1-3 in particular. This creates a very rich data set which is then used to create a customised online Presentation (https://omolloy.kumu.io/microplastics-in-the-oceans-and-our-response-a-causal-map)   (see Figure 2.1).

Figure 2.1: First page of the presentation

Target Audience

The audience for this tool is the general public. Effectively anyone aged 15 or over should no difficulty in navigating and understanding the tool

Ocean Literacy Goals

The OL goals of this tool are to increase *Awareness* and *Knowledge* of the user (General Public) of not just the problem of microplastics from cosmetics in the ocean, but to also

understand the <u>causal chain</u> of activities and events which leads to the problems and how we are responding.

By increasing awareness and knowledge we expect to change people's *Attitude* and *Behaviour* with respect to the choices they make, as consumer, producer, etc.

Design and Development Process

The kumu presentation was developed through collaboration with the other partners, and has been packaged as the tool itself, but also the expertise acquired has been shared with the partners so that they can use it to use the tool to create further kumu interactive graphs and presentations to educate and inform.

In order to easily modify and customise the underlying graph, it is defined in an Excel spreadsheet as the graph Elements and Connections.

Each Element (or node) in the graph has a number of possible properties, including:

Label (or node name)	e.g. "Refined fuel production"
Type (corresponding to the DAPSIWR node types)	e.g. "Activity"
Description	e.g. "Oil extraction, refinement and heating provide several substances by heating. One of them is called naphtha and is the necessary raw material for plastic production."
Image (the name of the image used to represent the node)	e.g. "https://s3-eu-west-1.amazonaws.com/responseable/refinery.png"

The Amazon cloud web service is used to store the images.

Each Connection (or causal link) in the graph has a number of possible properties, including:

From (directional causal link from this node name)	e.g. "Recommendations from Cosmetics Europe"
To (to this node name)	e.g. "Consumption of cosmetic products"
Type (used in defining how the graph is styled and behaves)	e.g. "response_activity"
Class (used in defining how the graph is styled and behaves)	e.g. "responses"

The graph is displayed and edited simultaneously in the kumu online tool, as shown in Figure 2.2 below. We can also edit the details view for any node (see Figure 2.3) in the graph by clicking on it and editing the content (which is initially imported from the Excel spreadsheet). The editor allows the use of *Markdown* HTML formatting instructions to add images, videos, styling, links, etc.
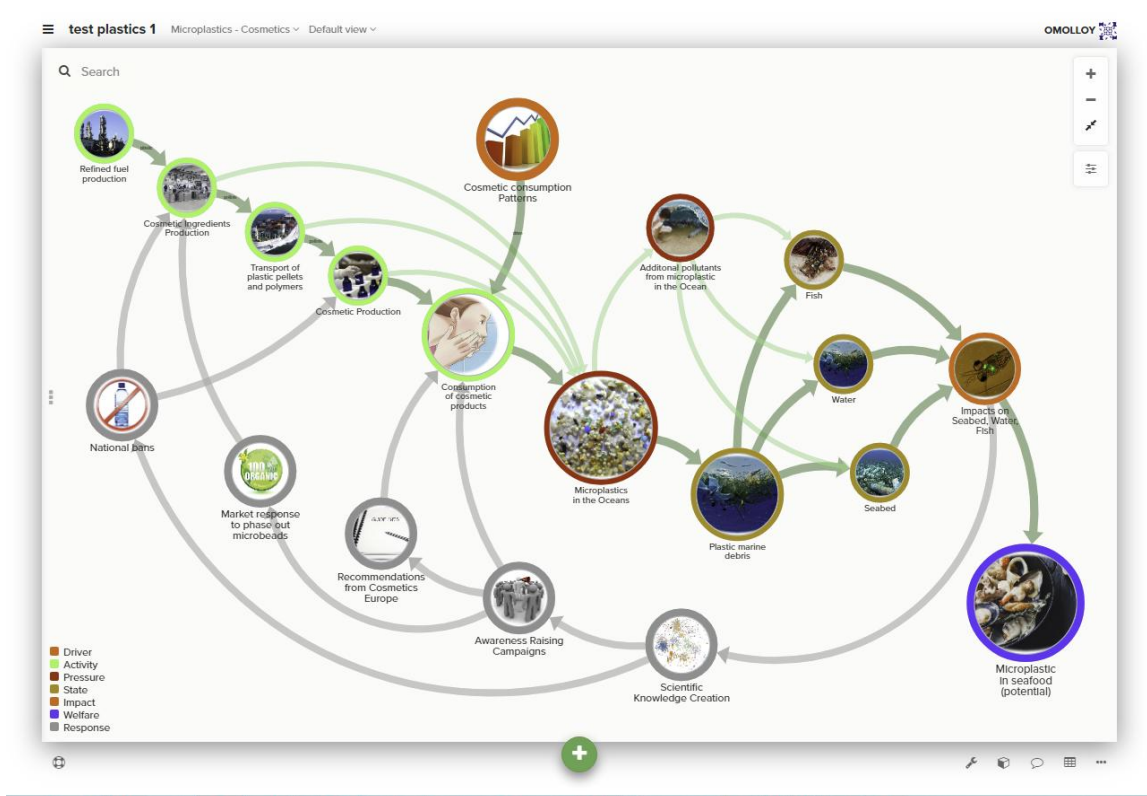
Figure 2.2: kumu editor
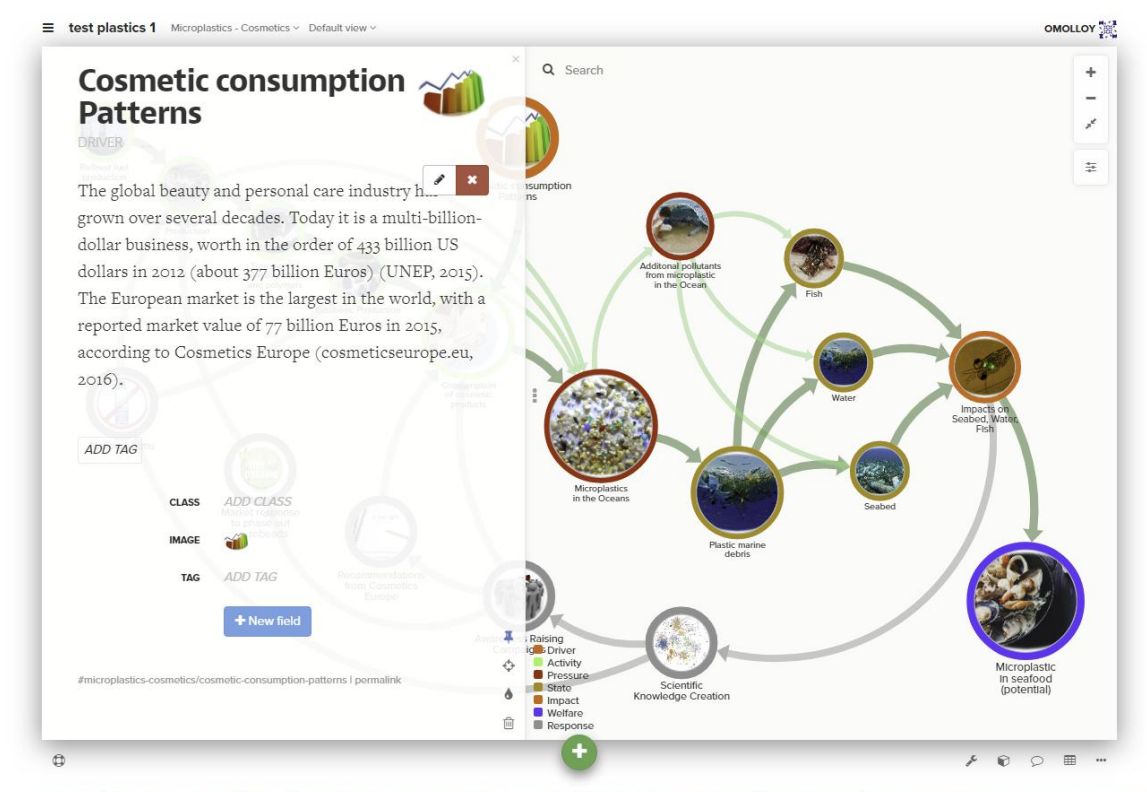
Figure 2.3: kumu edit node details

As the user navigates the graph they can click on nodes and read / watch the content displayed on the left hand side (see Figure 2.4). This allows us to link to both ResponSeable and other providers content (e.g. on YouTube), providing a very rich information environment for the user to learn the story and the underlying causal map at their own pace.

A customised stylesheet was developed and is applied (see Figure 2.5) through the kumu editor to ensure consistent styling and 'look and feel' throughout the application. This advanced view allows us to apply different styles to the different node types (e.g. Driver, Activity) for example.

In order to assist in creating the online presentation, we also created a number of different views of sub-graphs of the overall graph, each with its own specific style sheet. This allows us to direct the user's attention to specific parts of the DAPSIWR, zooming in and focusing on for example, the relationships between a specific Driver and activity (see Figure 2.6).

Figure 2.4: Detailed view with links to external resources

Figure 2.5: Advanced Editor

Figure 2.6: Advanced View and Stylesheet
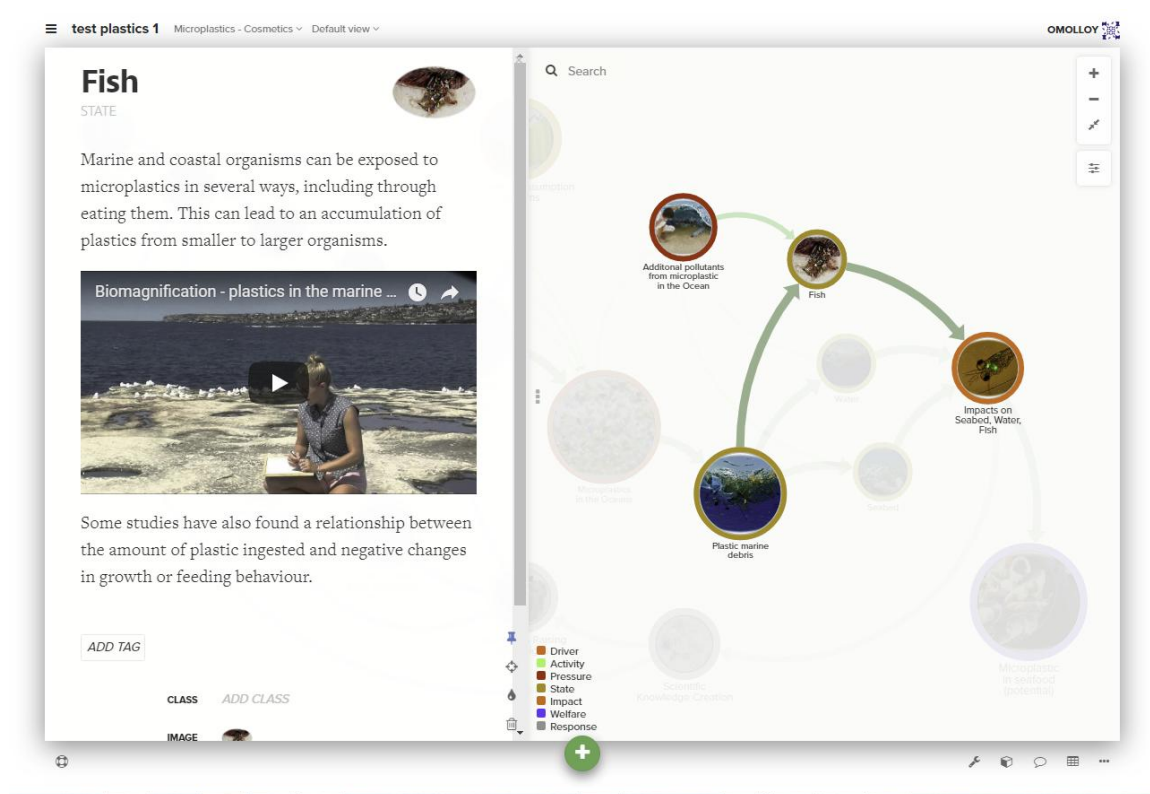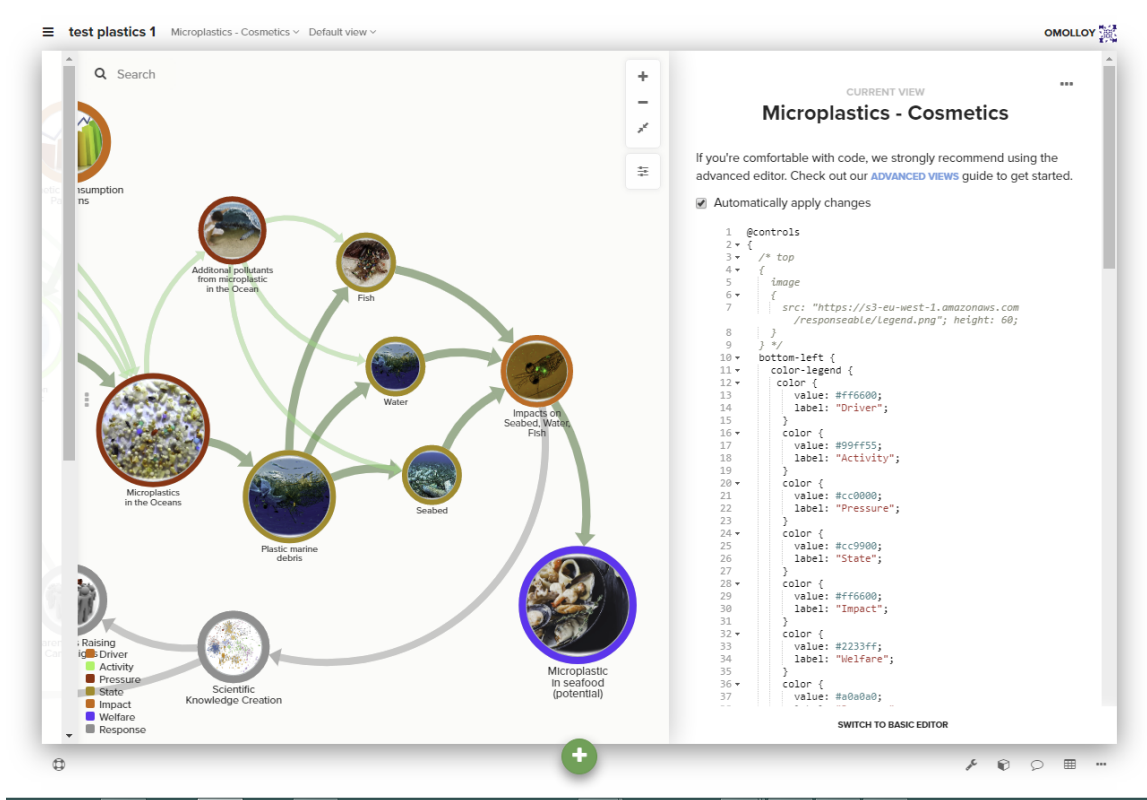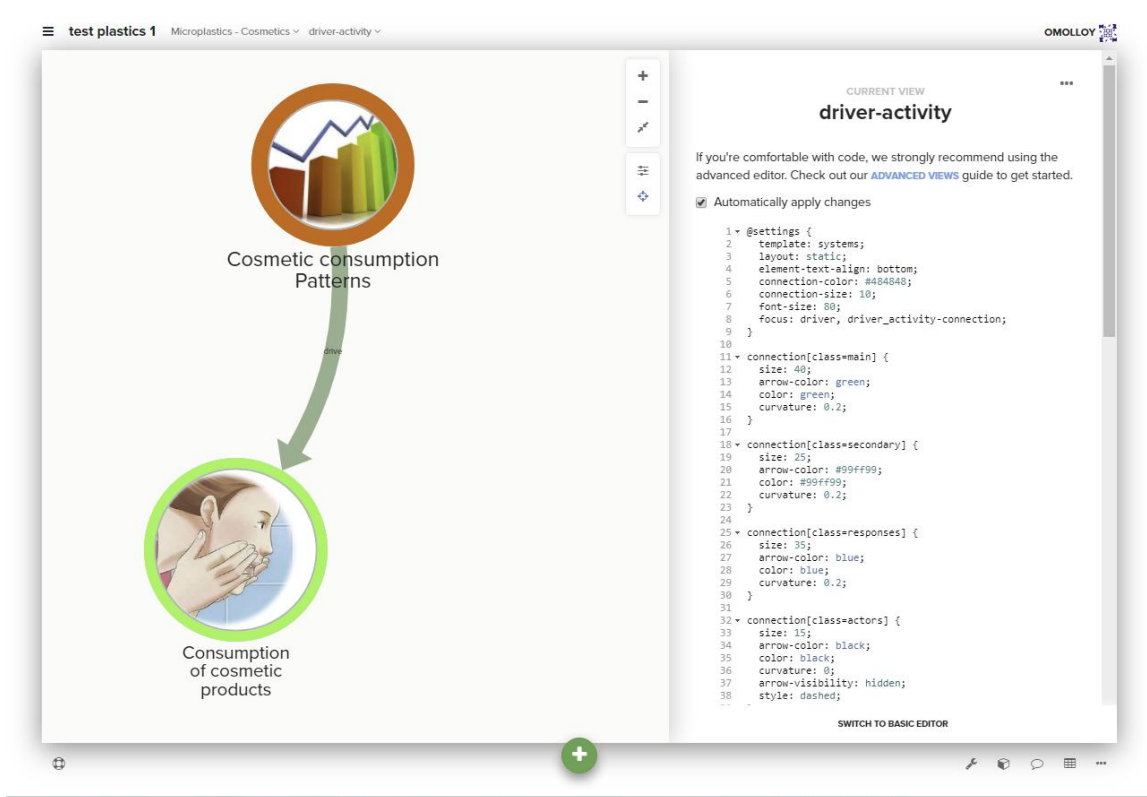
Online Presentation

The secondary important Ocean Literacy product, which is derived from the kumu graph described above, is the online presentation. This is created using the Presentation Editor (see Figure 2.7), and comprises a series of slides (web pages) which contain views of the graph along with content tailored to tell the story of what is happening in that view. It is also possible to include content from other sites.

While viewing the presentation, the user can click forward through the slides, but also take detours through the graph, follow nodes and connections, thereby learning the causal DAPSIWR map at their own pace.

Figure 2.7: Presentation Editor

Kumu Training

In order to make this technology available and useful to the consortium as a whole, NUIG conducted a 2-hour training webinar for the project participants. This was recorded and is available online through the project team cloud (https://www.dropbox.com/s/nn94brbs4vvqpv3/kumutraining.mp4?dl=0). In this way we have made kumu itself a valuable Ocean Literacy tool in the partner's toolbox, and a number of partners are currently developing kumu presentations of Key Stories.

Living Lab Approach

As the tool is aimed at a very wide audience, we recruited a range of colleagues and students to try out the tool as it was developed incrementally. The feedback was absorbed and used as the tool was developed to improve the clarity and ease of understanding of the material being presented. One strong feedback is that the tool depends on an understanding of cause-and-effect and of the DAPSIR approach, so that it will be better understood if presented in that

broader context. Also, the time needed to fully navigate the kumu is quite long (> 20 minutes), but it would be a very useful teaching tool in a classroom situation.

Monitoring of Effectiveness

The use of this tool will be clearly online. Therefore it will be possible to link it with specific campaigns on Ocean Literacy / Microplastics, and through the ResponSeable Social Media presence. We will be using the Measurement of Effectiveness framework (described in the chapter *Systematic Approach to Measurement of Ocean Literacy and Effectiveness of Tools*) later in this document.

    a) The kumu can be used in a classroom type setting where control groups can be surveyed before and after to measure the effectiveness of the tool.

    b) It will be embedded in a web page with a quiz linked to the (end of) the presentation so that the user can be tested on their Awareness, Knowledge and Attitude before and after viewing the presentation and hopefully navigating the DAPSIWR. For this methods of monitoring we will use the Quiz Builder described in the chapter *Ocean Literacy Quiz and Survey Builder and Online Tool* later in this document). Data from the monitoring in this fashion is immediately available for analysis and comparison across different groups, regions, etc.

Testing to Date

To date the kumu has been tested within the consortium and a small group of student and other users. No flaws have been identified to date, so the tool should be ready for testing and wider deployment.

Planning for the next phase: the wider dissemination and evaluation

The language of the tool is English thus far. We will be engaging with other members of the ResponSeable team to assist in the production of language-specific versions of the kumu graph and Presentation. Effectively this requires translation of the text content, and replacement of specific graphics or videos where possible.

Therefore in the next phase of the project, we will develop deployment and monitoring plan. Through the our social media and other dissemination activities and tools, we will direct traffic to the online presentation and quiz, which in turn will generate valuable information on the use and effectiveness of this as an Ocean Literacy tool.

Links to Online Deliverables

https://omolloy.kumu.io/microplastics-in-the-oceans-and-our-response-a-causal-map

3. Interactive Web Application on Coastal Tourism Story

Description

One of the big challenges in using the DAPSIWR and Key Stories in improving Ocean Literacy is in making the information interesting and accessible. A very popular method, used by leading online media outlets such as the New York Times[1] is Visual storytelling. As Jessic Moon states[2] "*Storytelling is a powerful approach that can, when done right, compel users to convert more effectively than what any amount of optimization, crazy visual callouts, or awesome interactive elements can do otherwise".* It is important to balance the content with the interactivity. Too much game-like interactivity can distract from the underlying message and distract the user. As Josh Stearns says[3] "*Sometimes it is about using the right tools for the story, not every tool in the toolbox.*"

In order to test this medium as an Ocean Literacy tool, we have developed a Web Story on Coastal Tourism. One of the big challenges is what to leave out: there is so much information we could include, from the Key Story document, for example, but it would not necessarily hold the reader's attention.

The web story is presented as a main web document which contains the main information behind the mass tourism key story. This contains links to the other tools used to illustrate the story: the DAPSIWR interactive graph, the online simulation tool, and the quiz.

The following images give a brief impression of the tool. The simulation tool is described separately in the next chapter.

The actual content is easily modifiable, and can be localised for different languages. The overall emphasis is on the Mediterranean mass tourism as per the Key Story. The technology will be offered to the other participants in the project for adaptation as they wish.

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[1] https://www.nytimes.com/interactive/2015/10/27/world/greenland-is-melting-away.html
[2] https://www.dtelepathy.com/blog/inspiration/30-compelling-examples-of-visual-storytelling-on-the-web
[3] https://medium.com/@jcstearns/the-best-online-journalism-and-storytelling-of-2015-6fe3be80ccd1
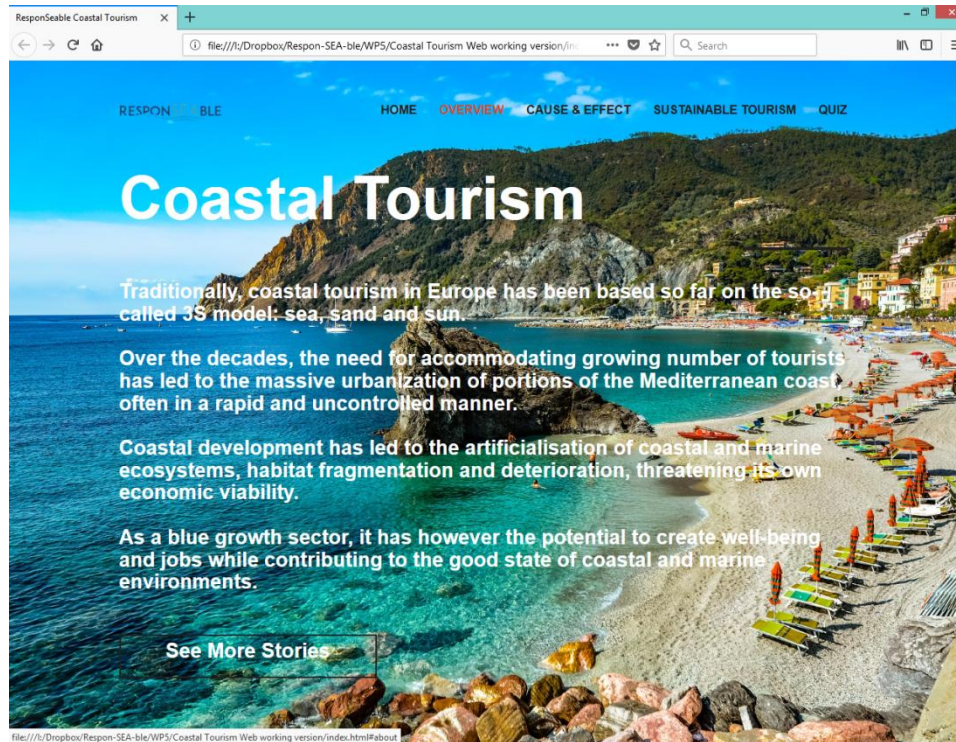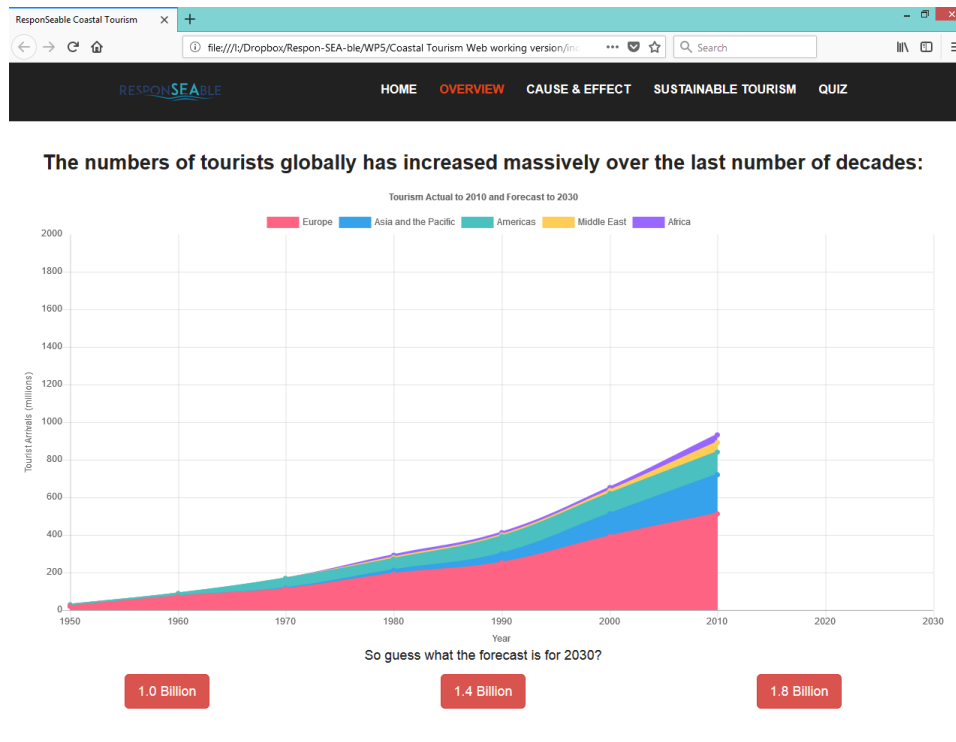
Figure 3.1: Web Story Main Page

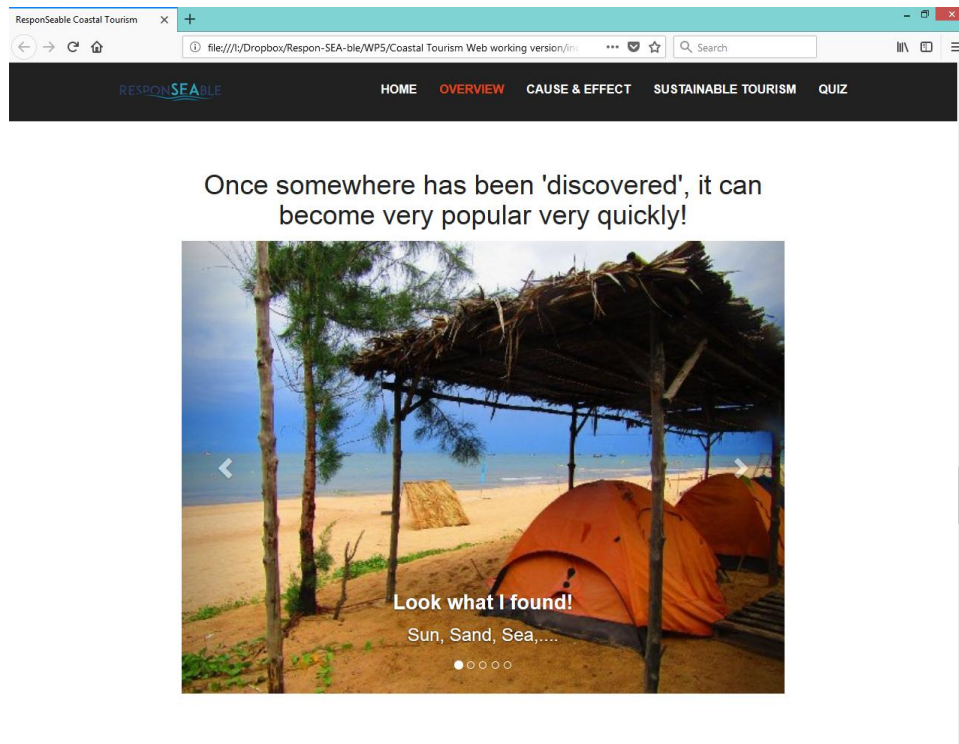*Figure 3.2: Interactive Graph*

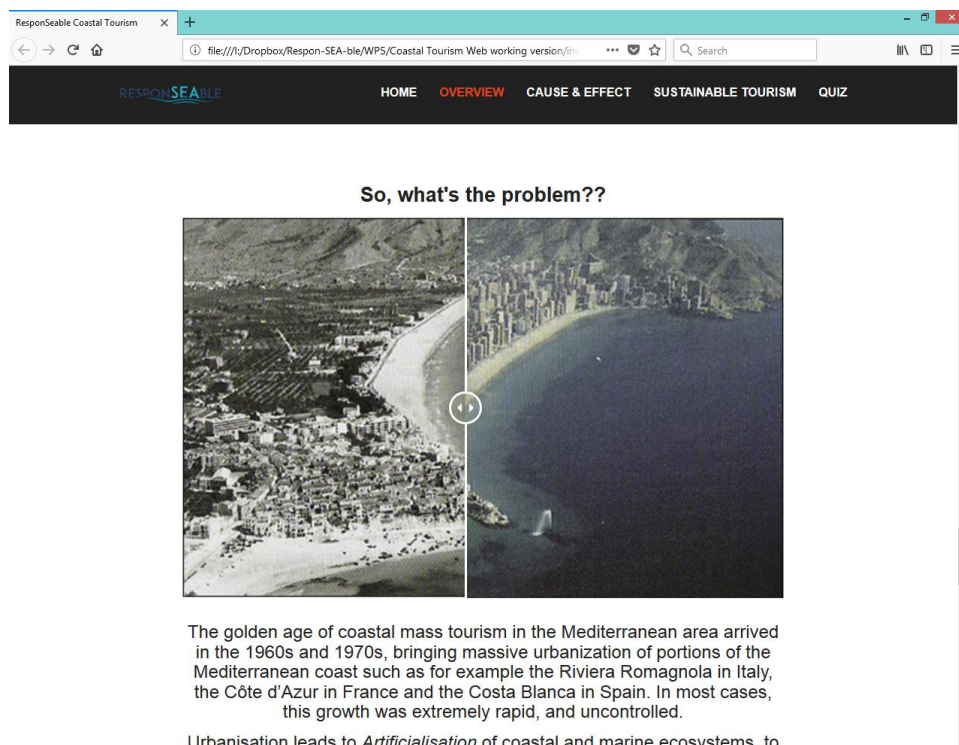*Figure 3.3: Carousel of Story Summary*

Figure 3.4: Image Slider showing 'before' and 'after' images

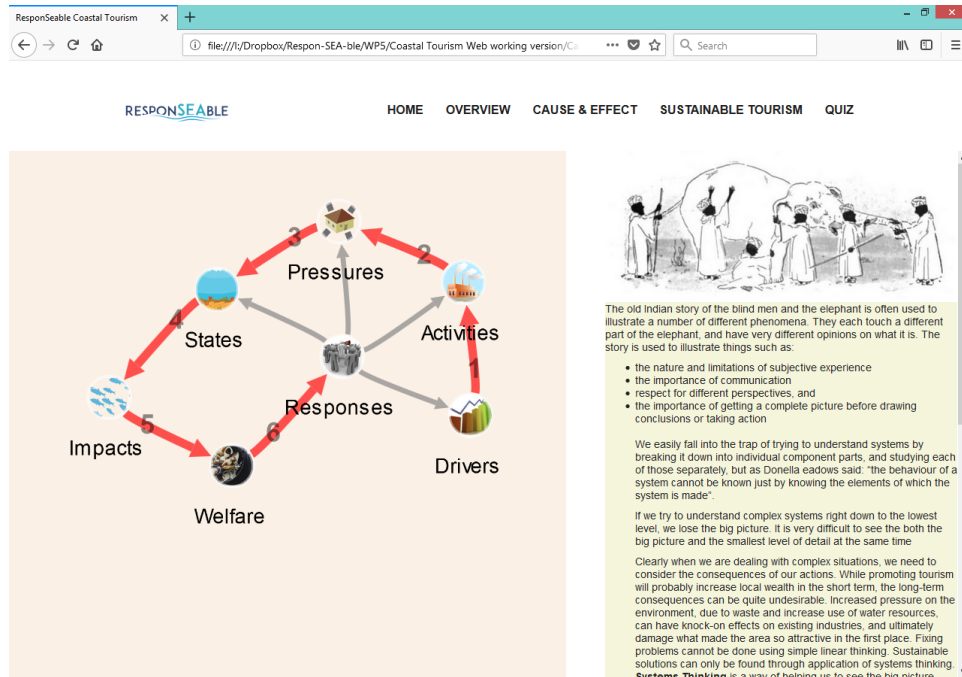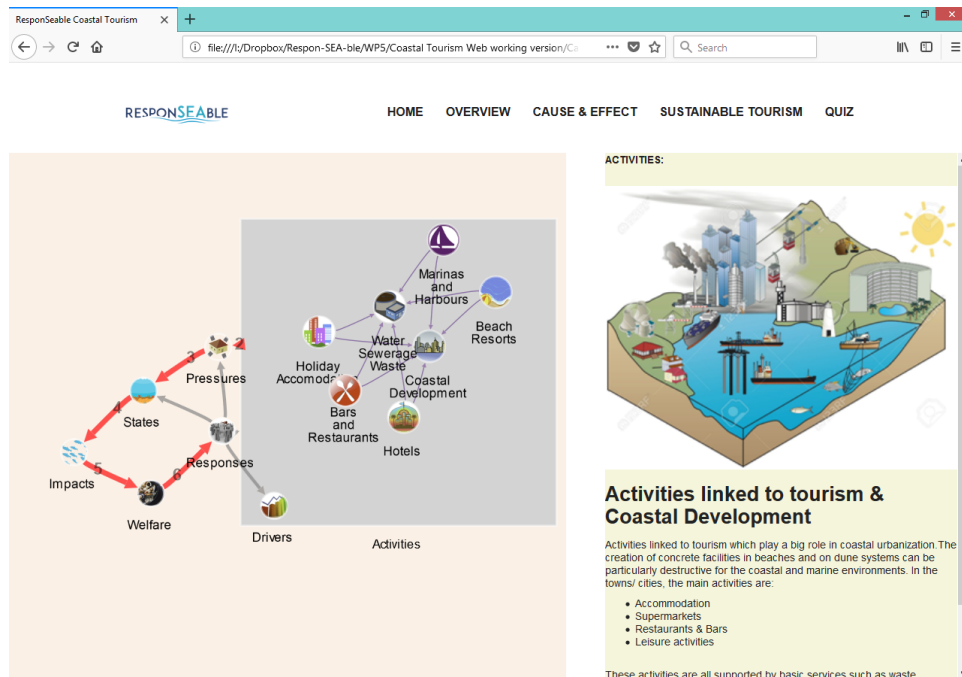*Figure 3.5: Interactive Dynamic Graph illustrating DAPSIWR*

Figure 3.6: Navigating and Drilling Down into DAPSIWR

Figure 3.7: Drilling Down into Story on the Right Hand Side

Target Audience

The target audience is the general public, from young adults upwards. Anywhere that a link to the web story can be shown, from social media to other websites, emails, tweets, etc., is a possible means of attracting users to the web story. The Key Story team have documented the key messages and proposed target actors as follows.

Key messages from the KS

The current 3S mass tourism model is increasingly problematic and unsustainable. Environmental and social impacts –including landscape degradation- are not only threatening the attractiveness of tourist destination, but the overall economic sustainability of the sector: the long-term costs associated with high congestion and coastal development patterns outweigh the short term gains represented by the number of visits. In addition, although the number of visits is increasing, average expenditure per night and average number of days spent in the destination is decreasing, revealing the on-going decline of the 3S model.

Tourism is a particularly complex and fragmented sector, often lacking synergies among different stakeholders as well as an overall governance system able to bring together all actors and components. In contrast, an innovative and sustainable tourism model could only be established through comprehensive strategic tourism development planning, taking into account the carrying capacity of the local systems and allowing for benefit-sharing among all stakeholders. In turn, this would call for an overall governance system based on the cooperation and the informed participation of all stakeholders, supported by a strong political leadership.

According to our findings, the fragmentation of the sector, the lack of coordination among the different actors and the lack of an overall governance system are the main challenges for reaping the full potential of the sector for blue growth. These challenges hamper the establishment of tourism strategic development plans addressing both economic and sustainability/ environmental aspects of tourism.

Thus, one key goal of ocean literacy will be to improve coordination among the different actors and overcome current sector fragmentation.

Actors

Actors involved in the development of the tourist sector at the local and regional scale

These would include:

- Institutional actors: policy makers in the field of urban planning, tourism management, environmental protection/ conservation/ management
- Private actors: hoteliers, restaurant owners and managers, beach resort owners and managers, marinas managers, construction companies
- Environmental NGOs, e.g. WWF
- Protected areas and park managers

Why they should be targeted?

In order, through increase Ocean Literacy, to change attitudes and behaviour to reduce environmental and social impacts, which are not only threatening the attractiveness of tourist destination, but the overall economic sustainability of the sector.

Desired Behaviour change

The concept of tourism growth, meant as a mere increase of number of tourists in a destination, should be overcome and substituted by a more comprehensive concept of tourism development, allowing for an increase of local income and employment and the sharing of benefits among all (local) stakeholders). This calls for the development of alternative, innovative business models for the touristic sector, taking into account the sustainability of the sector and the carrying capacity of the local system. And it can be achieved through strategic planning, able to promote an innovative, sustainable and high-quality offer, implying tailor-made local and regional strategies. Strategic planning at the local and/or regional level should be supported by an overall governance system including all public and private actors involved in the tourism sector.

Tourists

There is an opportunity to leverage an ongoing perception shift on the part of tourists. In 2015, around half of the respondents to an EU survey on tourism declared that the natural features of a destination – such as landscape and weather - were seen as the main reason for wanting to return to the same place for a holiday. This suggests that healthy coastal and marine environments are seen as important touristic assets, and that tourists are increasingly concerned by sustainability aspects.

Wish: ocean literacy campaigns will also need to target tourists, with a dual objective: on the one hand, ocean literacy can raise tourists' awareness on the impact of mass tourism and on how they can mitigate their own impact; on the other hand, it can inform local actors on tourists' feedback on the environmental quality of a destination, and learn about their expectations and wishes for a healthier environment –thus creating a virtuous cycle.

Why should they be targeted?

Through their choices, tourists can: (i) decrease their environmental impact by changing their practices; and (ii) as consumers, they can influence the touristic offer through their choices.

Main message to be conveyed

At present, tourists wanting to make environmental-friendly choices can find it hard to find information on hotels, resorts and destinations applying sustainable and environmental-friendly practices, touristic destinations managed in a sustainable way, existing environmental and sustainability certification systems, and so on. And sustainable practices/ activities are not sufficiently promoted. At the same time, many tourists might not be aware of the importance of sustainable practices, and the consequences for the environment of unsustainable practices.

Behaviour we want to reach

First of all, if information on environmental friendly practices and sustainable management is easily accessible, it will be easier for tourists to make sustainable choices about their holidays –and choose, for example, a hotel with a certified environmental management system rather than an uncertified hotel. In addition, we want tourists to be more aware of the consequences of tourism and, in turn, of their holiday choices.

Ocean Literacy Goals

The Ocean Literacy goals for the Web Story tool are to increase **Awareness**, **Knowledge** and **Attitude** towards mass tourism, and in particular it's impacts via coastal development.

Design and Development Process

The web story was developed incrementally through design and feedback from test users. A number of different approaches to story-telling and imparting the knowledge in the DAPSIWR and Knowledge Based / Key Story were considered.

The main components of the web story are:

- Use of interactive images and graphs to convey information / trends of mass tourism
- Before / After images and Carousel displays to convey the impact of mass tourism on destinations
- Interactive / Dynamic graph-based model of the DAPSIWR which the user can interact with and follow the path of the DAPSIWR, as well as dig down into the graph and view more detailed information.
- Staged introduction of the Cause-and-Effect mechanisms at play in the interaction between Tourism and the Environment. This is illustrated with 3 Systems Dynamics models, from very simple to complex. These models are fully active and run within the browser. The user can interact with them, observing the trade-offs necessary to achieve sustainability.
- Configurable and Customisable in-browser Quiz module. Using this quiz the user can answer any number of relevant questions, and the answers are returned to a central web server for analysis by the ResponSeable team.

Living Lab Approach

The development of this story took place quite late, and there has been limited opportunity to do the living lab approach. However, it has been demonstrated and discussed with a number of enthusiastic colleagues and students and they have been instrumental in modifying the design in favour of simplicity, smaller volumes of information, and gradual introduction to topics.

Monitoring of Effectiveness

The web story can be used in a group setting and the users observed and interviewed to gauge the impact on their Ocean Literacy. Effectively this would use the Survey-based approach detailed in the later chapter in this report "Systematic Approach to Measurement of Ocean Literacy and Effectiveness of Tools".

As the tool contains a configurable Quiz module, the main means of monitoring of effectiveness will be via the responses to questions online, and their analysis via the centralised system.

Testing to Date

To date the system has been developed and preliminary testing has been performed. More in-depth testing will be performed as the system is released.

Planning for the next phase: the wider dissemination and evaluation

The reach of the web story tool is at the moment confined to English-speaking countries. IT is therefore important to translate to languages for countries with significant mass tourism and familiarity with the Mediterranean and Black Sea resorts studied. Therefore we will be working to produce multilingual versions of the web story, all modules.

The system will be made available online in country-specific versions are they are made available.

Traffic to the site will be encouraged through publicising the site via social media and all other dissemination opportunities such as conferences and open days involving the project partners.

Targeting of specific (non-general public) actors will require specifically targeting them via social media. We will also, where possible, organise a number of group sessions with the actors listed above in order to monitor and assess effectiveness using traditional means.

Links to Online Deliverables

Working version at http://danu6.it.nuigalway.ie/o_molloy/ct_story/.

Final live version will be hosted via the ResponSeable website.

4. System Simulation Learning Tool

Description

During the lifetime of the project so far, we have conducted a significant amount of research into the problems of 'teaching' *ocean literacy*. In the broader context, *ocean literacy* can be seen as a subset of *environmental literacy*, which in turn is closely related to / part of *systems literacy*. Much research has been published over the years on how to teach systems literacy, but as far as we know, there has been relatively little work done on how to apply *systems thinking* to improve ocean literacy. We believe that this approach has great value. In fact, there are tools such as Stella and InsightMaker which attempt to use system models to tell a story. We have experimented with these tools, but neither was flexible enough to be further extended as we might see fit. At the 2016 EMSEA conference we presented our concept of using systems thinking as a vehicle for teaching understand of the DAPSIWR and ocean literacy in general, and the presentation was very well received.

One of the challenges in producing a general tool is the ability to make it available online and to embed it in other web pages. We have chosen an open-source library / simulation tool called sd.js[4], which uses an emerging file standard for exchange of systems dynamics simulation models, called XMILE[5]. The use of the this in-browser simulation tool opens up endless possibilities for teaching systems thinking and directly addressing the *Knowledge* level of our Ocean Literacy Framework.

Any simulation model which can be created in or imported into Stella can easily be exported as an XMILE file, which we can import and run within a browser. We are using it initially in illustrating the Coastal Tourism story through 3 models which gradually increase in complexity, but also allow the user to ***interact*** with the model, exploring the tradeoffs and interactions inherent in human-ocean systems.

The first model is a very simple model which shows the untouched environment which will go through the normal cycle of regeneration if left alone.

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[4] https://github.com/sdlabs/sd.js
[5] https://www.oasis-open.org/committees/xmile/

Figure 4.1: A simple illustrated model

This is a very simple model, but it allows us to introduce the user to the notion of changing the variables / rates of change within the system, and viewing the effects in **_real-time_**.
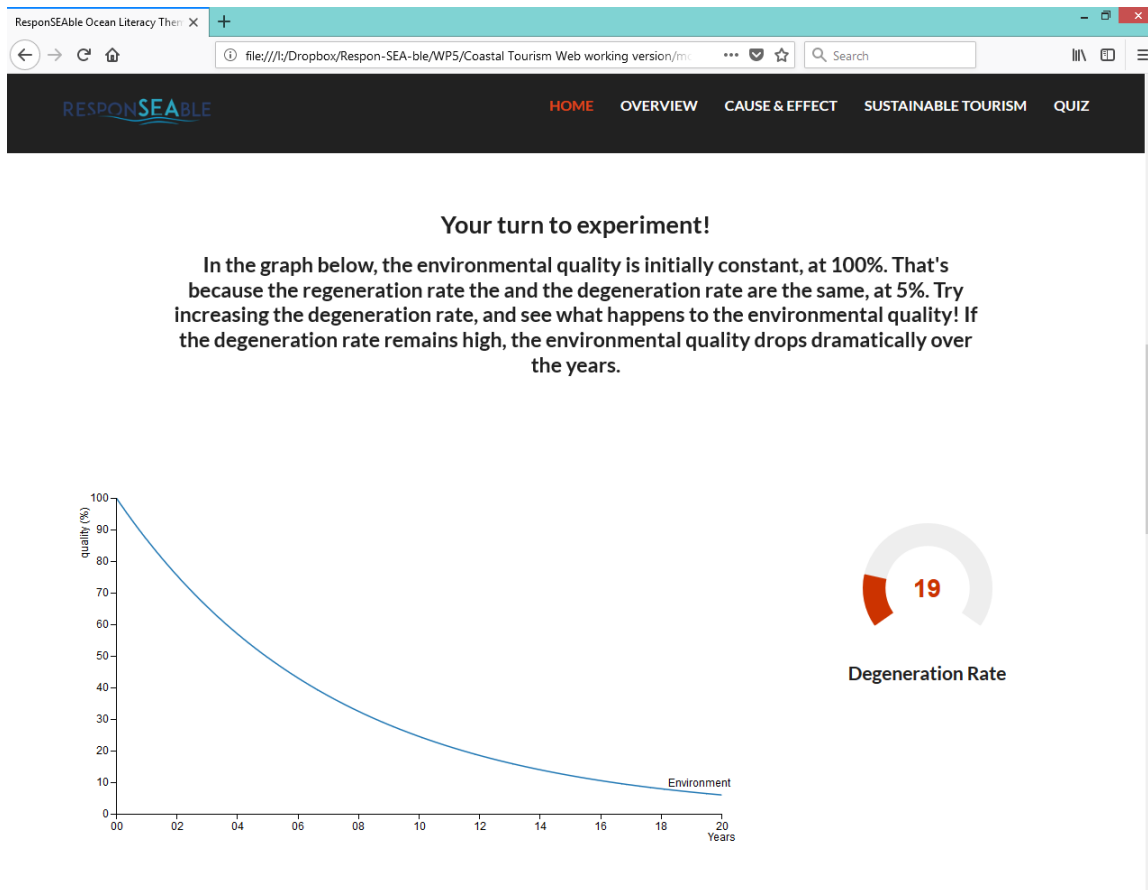
Figure 4.2: Interacting in real time with the model

We are not particularly limited in terms of the complexity of the model which can be used, but of course this will not necessarily be attractive to the user. The following figure shows our 3rd model, which is probably at the limits of complexity useable in a general online context. On the other hand, if we can use this approach in a more controlled environment, such as a classroom, we could well use more sophisticated models.

Figure 4.3: A more complex model

At this stage in the development process, we are experimenting with the realism of the models. While the models illustrate trade-offs, effects and trends, the numbers generated are quite generic and do not model any specific situation. These 'normalised' models, based on the System Zoo models of Hartmut Bossel[6] are widely used in teaching systems thinking. Further work is also necessary in developing a range of models corresponding to the other Key Stories. We have models on Sustainable Fisheries and could incorporate them into a web story on this topic.

In this first version of the tool, we select specific model parameters which the user can modify and the system re-simulates and presents the results immediately.

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[6] http://www.hartmutbossel.de/
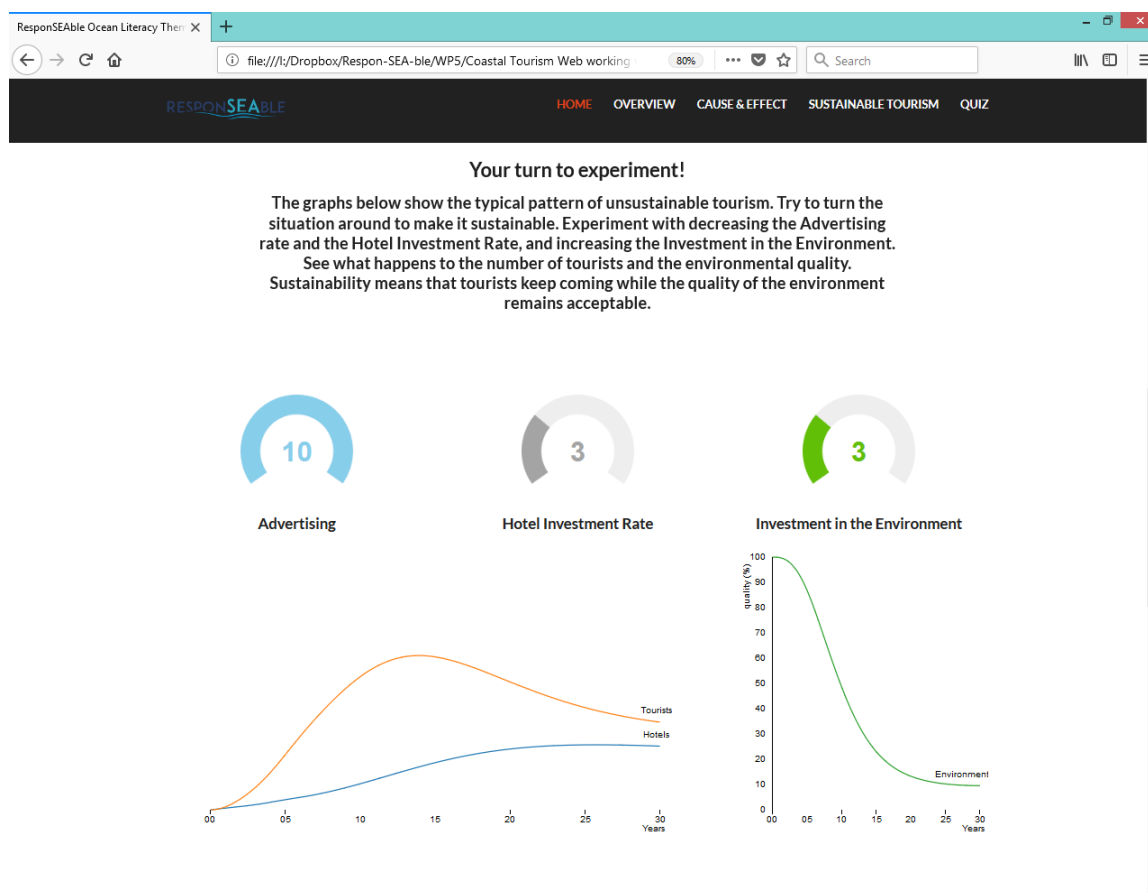
Figure 4.4: A 'virtual lab' to learn in

Target Audience

This is a completely generic tool which is being made available as a resource for all OL tool developers. It can be used to illustrate systems to everyone from school children to policy makers. The differences will be in the sophistication of the models and the type of language used in describing the systems and trade-offs.

Ocean Literacy Goals

The OL goals for this tool are numerous. We believe that this tool can be used to improve Awareness, Knowledge, and Attitude related to any Key Story for which we can produce useful models. We are currently considering whether we can use the system to monitor behaviour – if it is possible to present users with scenarios and to pick the outcomes which best suit them by 'gaming' with the system model, this could be instructive in predicting their actual behaviour.

Design and Development Process

The design and development process has involved developing suitable models and working with the sd.js code to make it suitable for our purposes.

Living Lab Approach

The development of this tool happened rather late in the work package, as we spent a great deal of time researching the available tools and trialling them before finding and choosing sd.js. A large amount of energy and time has been devoted to understanding the software and checking verifying that it outputs correct simulation results. We have worked with a variety of sample users in getting feedback on the understandability of the system, and the main feedback has been that it takes some time to actually read into the story topic and understand the various causal links in the models.

Testing to Date

Testing to date has focused on usability of the system, and verification of the accuracy of the simulation results. No significant issues have arisen so far.

Monitoring of Effectiveness and Planning for the next phase of WP5

There are unanswered questions relating to how this tool should be deployed, and how far up the Ocean Literacy ladder it can be used. We will therefore be designing a number of experiments in collaboration with our partners, to test it across a number of contexts, from unaided online for the general public, to targeted group sessions with specific key story actors. Over the next month we will be designing and planning those experiments, and then plan to execute them across as wide a range of regions and actors as possible.

Links to Online Deliverables

A demonstration version will be made available here are part of the CT web story:

http://danu6.it.nuigalway.ie/o_molloy/ct_story/.

This and further stories and models will be created and made available via the ResponSeable website.

5. Ocean Literacy Quiz and Survey Builder and Online Quiz / Survey Tool

Description

There are numerous opportunities across most of the ResponSeable Ocean Literacy tools to use short quizzes to gather feedback and data on effectiveness. As many of the OL tools will be deployed or made available online, it is a good opportunity to link them with an online quiz or indeed to embed the quiz within the content. This latter possibility is feasible where the tool is presented with a web page.

We are therefore created an online questions and quiz creation tool which utilises the services provided by the back-end systems described in the chapter "Systematic Approach to Measurement of Ocean Literacy and Effectiveness of Tools".

The tool is effectively a 'wizard' that leads the user through the creation of the questions and quiz, culminating in the creation of the code necessary to embed the quiz in a web page and provide the connectivity to the back to gather response data.
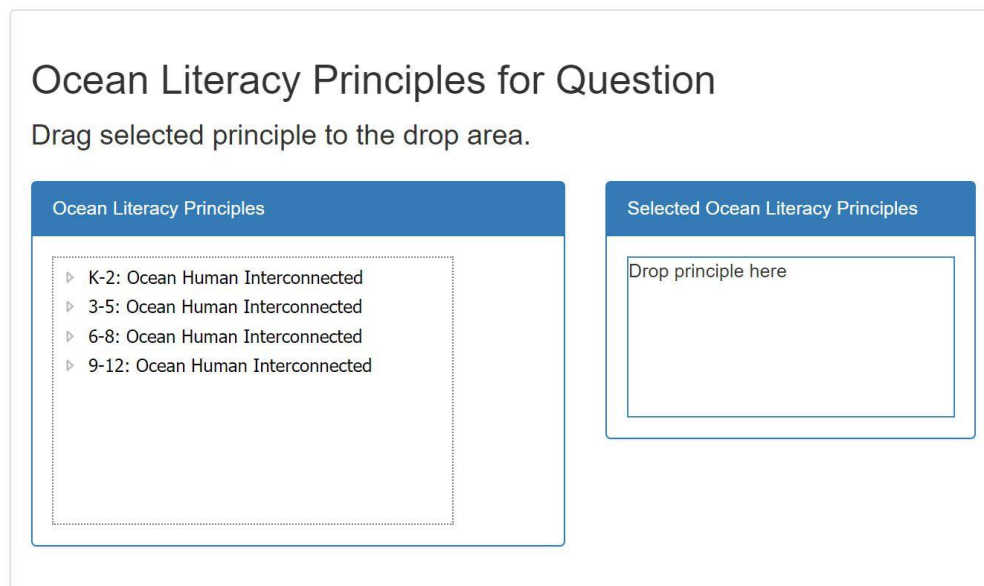
Figure 5.1: Linking question to Ocean Literacy Principles

As explained in the chapter "Systematic Approach to Measurement of Ocean Literacy and Effectiveness of Tools", each question can be linked to specific Ocean Literacy Principles (see Figure 5.1) and / or elements within the DAPSIWR classification hierarchy (see Figure 5.2). In the latter case, the user can link the question either to a specific Driver, Activity, etc., or to the causal link between Driver-Activity, Activity-Pressure, etc.. In this way, as we gather response data from across our OL initiatives as we deploy and monitor, we will gather as rich as possible a data set.

Figure 5.2: Linking question to DAPSIWR

Each question requires an objective / purpose and a level of difficulty. Also, we can associate a 'Knowledge Bubble' with each question – a short text containing an explanation of the question and correct answer – which may be used to give hints to users or tell them more about the question.

Figure 5.3: Question Area Information

The next step is to enter the actual question text, and the 4 options, from which the user chooses one. We also enter the correct answer number.

Question Body

Please enter your question text and enter four answers.

What is your question?

> Enter question text...

Setup your answers

1	Answer 1
2	Answer 2
3	Answer 3
4	Answer 4

Select Correct Answer

> Which Answer is Correct   ▾

Figure 5.4: Question Area Information

Once the questions have been created, they can be published as a quiz for online deployment. Effectively this means that the code needed to embed the code in a web page is generated by the wizard and made available for the web page designer to copy and paste into their page. This is a very simple task for most people familiar with creating web pages.

Scripts and Styles

```
<!-- Your platform (jquery) scripts. -->
<script src='https://cdnjs.cloudflare.com/ajax/libs/survey-jquery/1.0.13/survey.jquery.min.js'></script>
```

HTML

```
<div id='quizsurveyContainer'></div>
```

JavaScript

```
Survey.Survey.cssType = 'bootstrap';

var surveyJSON = {title: 'NUIG quiz 1',pages:[{name:'1',elements:[{type:'panel',name:'Quiz 1',elements:[{type:'radiogroup',nam

function sendDataToServer(survey) {
    //send Ajax request to your web server.
    alert('The results are:' + JSON.stringify(survey.data));
}

var survey = new Survey.Model(surveyJSON);
$('#quizsurveyContainer').Survey({
    model: survey,
    onComplete: sendDataToServer
});
```

Figure 5.5: Code Generation

Target Audience

This is a completely generic tool which is being made available as a resource for all OL tool developers. Therefore all potential target audience can be reached, although the immediate audience is the OL tool developer.

Ocean Literacy Goals

To gather measurement data on Ocean Literacy.

Design and Development Process

The design and development process followed largely from the design process followed for the overall Measurement of Effectiveness framework.

Living Lab Approach

The tool itself is totally generic and customisable, so it was not a suitable candidate for the LL approach. Rather, the actual quiz content itself will need to be subject to a LL approach going forward, to ensure that the questions we ask are suitable for specific demographics.

Monitoring of Effectiveness

We will be monitoring the take-up and usage of the Quiz Wizard as well as the spread of deployment and the velocity and volume of response data being gathered. The effectiveness of this tool will be measured in terms of:

- Ease of use
- Adoption
- Frequency of use

Testing to Date

The tool has been tested online and preliminary test data generated by testing on the prototype Interactive Platform. Test response data has been successfully sent from Norway and stored on the server in Galway.

Planning for the next phase: the wider dissemination and evaluation

All partners with online resources will be encouraged and supported in using the wizard, deploying quizzes and gathering and analysing the response data.

We will work with all partners to support multiple languages in the questions and quiz presentation.

The quiz itself will be deployed on the Interactive Platform.

We will investigate the possibility of linking directly to the quiz from social media platforms such as Facebook and twitter.

Links to Online Deliverables

Working version at http://danu6.it.nuigalway.ie/o_molloy/ct_story/quizsample.html

Final live version of the Quiz Wizard will be hosted via the ResponSeable website.

6. Designing Systematic Approach to Measurement of effectiveness of OL Tools

Description

In this chapter we describe the concepts, methodology and design underpinning our approach to the measurement of effectiveness of our Ocean Literacy tools.

Underlying we have adapted the Environmental Literacy Ladder[7] (see Figure 6.1) which very well describes the evolution of literacy from basic awareness of a concept, through to changes in attitude and behaviour, and potentially active engagement activism for change.
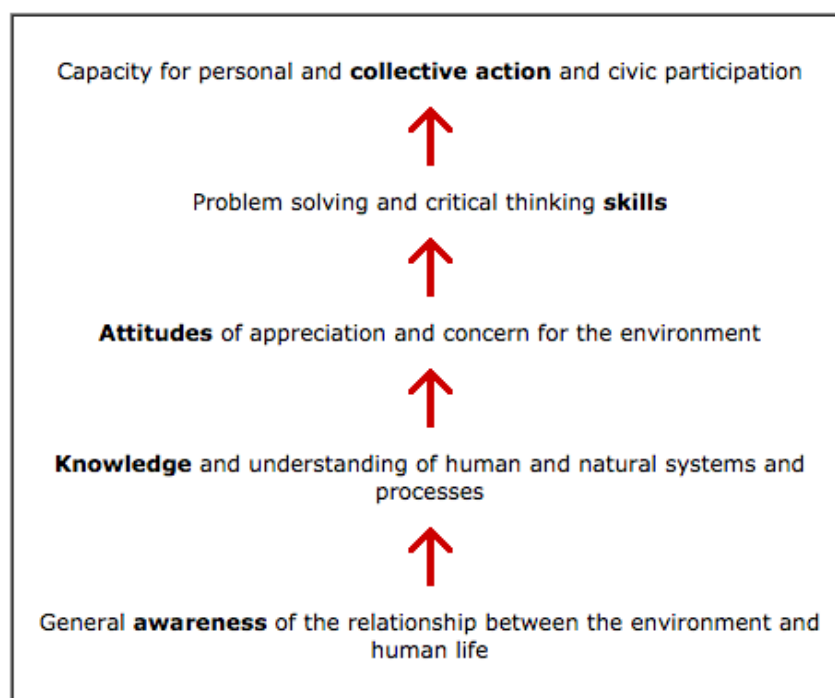
Figure 6.1: Environmental Literacy Ladder

Our framework builds on this, but also takes into account work done by UPM on similar frameworks. In particular we add *Communication*, that is, the level to which we actually communication *about* specific topics with our friends, family, etc.

The following section summarise the framework and the ocean literacy monitoring and measurement mechanism, which support both online data gathering, and group surveying methods. Based on research and previous work carried out in NUIG and UPM, we propose the following framework on levels of Ocean Literacy:

– **Awareness**

  • Being aware that something (e.g. a problem or concept) exists.

– **Knowledge**

  • What you know about a topic or links between topics.

---

[7] http://www.fundee.org/facts/envlit/whatisenvlit.htm

- **Attitude**
    - Agreement with a particular position, for example, agreement that a change in 'behaviour' is a good thing / is effective.
    - With respect to the DAPSIWR, it's more related to the Impacts, and Welfare and agreement that:
        - They exist
        - They are important
        - That a Response is needed
- **Communication**
    - Actively engaging in communication around issues.
- **Behaviour**
    - Decisions / Choices / Actions / Habits relating to specific situation / activity (in the context of the KS / DAPSIR) in everyday life. The activity of a person as an actor.
- **Activism**
    - Actively campaigning to bring about political or social change.

Evaluation Framework

The evaluation framework is aimed at evaluating the effectiveness of the ResponSEAble Ocean Literacy (OL) tools. It will combine the components of the seven OL principles NMEA (2013) and information contained in the ResponSEAble key stories. The framework consists of the following areas:

The seven OL principles and their components
The DAPSIR classification
The ResponSEAble key stories
Creation of questions/statements to measure Awareness, Knowledge, Attitude, and Behaviour
Software system to store the evaluation data received from the OL tools
Analysis of the data
Display of resulting information

Our principal means of assessing someone's ocean literacy is of course the use of questions. Questions can be of many types, for example:

- Yes / No
- (Multiple) choice, e.g.
    - "*My knowledge of eutrophication has been informed by the following sources*"
- Scales, e.g.
    - Level of knowledge (from very low to very high)
    - Level of agreement (from totally disagree to totally degree)
    - Percentage
- Answer, e.g.
    - Name a region

- Name / Pick an alien species

- Estimate fish stocks

- Name 3 issues

– Links, e.g.

- Link the causes to the effects

– Time, e.g.

- I recycled plastic in the last week / month / year / never

So we can use a wide variety of questions, quizzes, surveys etc. in querying people's awareness, knowledge and so on regarding ocean literacy topics. As we build a database of questions and associated knowledge, there is clearly an opportunity to link questions and responses back to the related ocean literacy principles, Key Stories, and indeed, particular topics and causal links within the Key Stories. By simply doing this, we ensure that all response data gathered has as wide a context as possible, and will be comparable with ocean literacy data gathered in other studies worldwide.
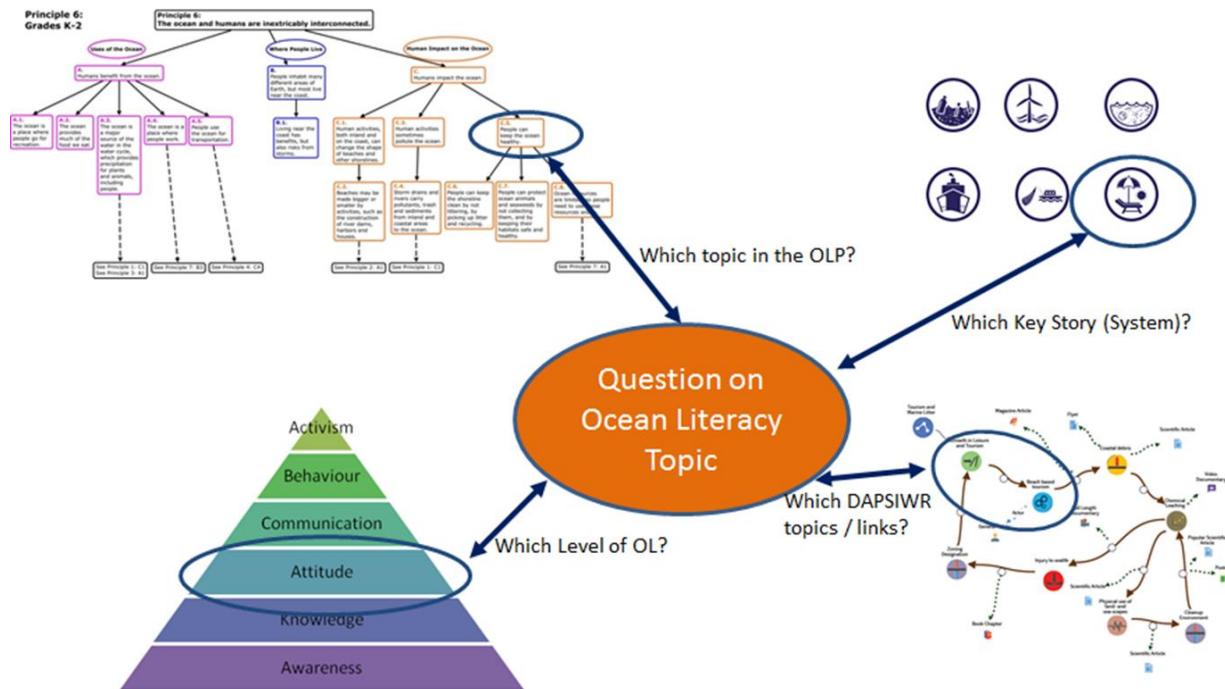
Figure 6.2: Linking Ocean Literacy Questions (and Responses)

Sample Questions

In this section we briefly give examples of the types of information we can get with different question types.

Awareness

With awareness of a topic, we simply want to establish whether a person has heard of a topic, or is aware of a particular issue, without necessarily being able to explain it. Sample questions would include:

- Have you heard of 'X'?

  o If so, where from?

- True or False
  - E.g. is this statement true or false: "Some areas around the UK coast are designated as marine protected areas."
- Name 3 important environmental issues linked with the oceans.
- Which of the following ocean issues are due to human activity?
  - Could have checkbox, but could also have a scale
- Link Causes and Effects – to show awareness of links between things, or awareness of causal links between pressures, impacts, etc.
- Finish the Graph – to show awareness of trends

Knowledge

Here we are attempting to establish the person's level of knowledge with respect to a particular topic or causal link. For example:

- True or False: 'A' causes 'B'
- Knowledge about the 'A'->'B' mechanism.
  - Tick all sources of microplastics in the ocean
  - Fertilizer running off the land into the ocean can cause: (choose from list)
  - Algal bloom is caused by : (choose from list)
  - Dead Zones are areas where: (choose from possible definitions)
- Do you agree with the statement, e.g. A causes B
- Given picture of fish and region, identify the alien species

Attitude

Here we are trying to gauge a person's attitude towards a specific topic or issue. Typical questions would include:

- Should plastic microbeads be banned from cosmetics?
- The impacts of Coastal Tourism are of concern to you and need to be addressed.
- Do you agree with this statement, e.g. "Sustainable Fishing is necessary".
- Prioritise particular Responses to Impacts (for example with respect to effectiveness, costs, impact on humans. If we know a person is a specific actor, could choose responses appropriate to that actor / or in role play for a specific actor.
- List issues (Impacts) and ask how urgent / important the user thinks they are.

Communication

Communication about topics which are important to us is a useful way to gauge a person's engagement with a particular topic. Communication involves exchange if information and influencing and being influenced by other people. It therefore has potential multiplier effects beyond simple awareness or knowledge about important ocean literacy issues. Through simple questionnaires and surveys, it is possible to learn a lot about how we interact with our peers and other social groups. Typical information gathered will include the use of questions like:

- In the last week / month / year, I discussed with my peers / family / other group, using the following communication methods (select from Face-to-Face, Social Media, Email, Other).
- My Awareness / Knowledge / Attitude about issue X has changed because of communication with others.

- I have looked for information on topic X in the last day / month / year from the following sources (tick all that apply from, e.g. TV, radio, podcast, blog, twitter, social media, news,..)

Behaviour

Although it is quite difficult to verify, it is useful to gather self-reported information from people regarding how they behave or have changed behaviour. As well as *reported* behaviour, we can also gather information regarding *intended* behaviour – that is changes which the person intends to make. Questions could include:

- When I buy fish, I make sure it is sustainable certified.
- I check cosmetics to ensure there are no microbeads.
- When I book my next holiday I will change my proprieties based on sustainability.

Behaviour Change Model

Moving up the 'literacy ladder', UPM have developed a methodology for the application of the Behaviour Change Model developed in health research, to Ocean Literacy. A step-by-step planning and evaluation model has been created and initial trials carried out in collaboration with the Education for Professionals and Children's ocean literacy tools / workshops.

This model was originally aimed at directing change/behaviour change processes in health promotion, and has been widely adapted in environmental awareness programmes. A systematic approach applies a "Theory of Change" framework, to establish objectives, and indicators of success, for each of the ELL steps, and stages in the behaviour change model.

A "Theory of Change" is defined as "a systematic and cumulative study of the links between activities, outcomes, and contexts of the initiative". Indicators of success at each stage, include change in responses of participants to survey questions, repeated before and after interaction with tools, as well as uptake of tools and analysis of social media campaign activity.

The ideas and insights that can be drawn from this model are very useful in the field of sustainability or conservation, and it can be a helpful tool for changing processes in these areas. It consists of six steps in two phases:

- The **first phase,** the **design phase**, consists of three steps: define the goal, analyse the influencing factors of behaviour, and choose the appropriate instruments.
  - o **Step 1:** Problem orientation and specifications of goals and objectives;
  - o **Step 2:** Analyses of determinants and target groups;
  - o **Step 3:** Design of the intervention.
- The **second phase**, the **implementation phase,** also consists of three steps: **implementation, monitoring and evaluation** of the programme.
  - o **Step 4:** Implementation of the intervention and start of the monitoring: Has the intervention been carried out as planned? What were the barriers that had to be dealt with?
  - o **Step 5:** To what extent has there been a change (improvement) in the determinants of change? Among which target groups?
  - o **Step 6:** To what extent were the ultimate and intermediate goals achieved? (Impact evaluation).

There are a number of factors involved in behaviour change. Firstly we have the **motivating factors**, which lead to an intention to perform the desired behaviour. They are internal, intrapersonal factors, including:

- Awareness
- Knowledge
- Attitude
- Social and personal norms
- Self-efficacy

We also have **enabling factors.** Motivation by itself, however, is not enough; one also has to be able to perform the desired behaviour. The change-oriented approach therefore also focuses on "enabling factors". These factors are external to the individual. Motivating and enabling factors can influence individuals to start the desired behaviour.

Finally, if we want a change in behaviour to be permanent, it requires reinforcement. **Reinforcing factors** include feedback from peers, experts, authorities and customers. These factors are also external to the individual.

Applying the behaviour change model to ocean literacy tools

The theory of change frameworks allow for steps in the behaviour change model to be associated with a specific issue, key story or OL tool. Specific behaviour change aims can be identified that can be associated with an intervention / tool. These behaviour change objectives can be identified that can be measured by indicators.

Indicators can be either quantitative data (such as change in weight or % of fish species caught by a sustainable / unsustainable methods, number of requests for information from a sustainable fisheries accreditation scheme or website) or qualitative data (such as change in knowledge of fishermen that know of environmental and economic benefits of sustainable fisheries accreditation).

The table on the following page details a sample behaviour change model for an ocean literacy intervention focused on the microplastics issue.

The primary means used to date in measuring the indicators identified in the behaviour change model are surveys. Surveys can be conducted with a group undertaking an OL tool, either before and after, or just after the tool asking their opinions and perceptions. Surveys can also be repeated some months after the participant has undertaken the tool. A draft Survey template is shown in Appendix A.

Ocean Literacy Awareness Raising	Problem Awareness	Knowledge	Attitude	Interpersonal Communication / Social Norm	Barrier Removal	Behaviour Change
Key Story: Theory of Change AIM	i) Participants recognise threat to marine environment and human health/well-being.	Participants have knowledge of the issue, (including the drivers (causes), impacts, pressures, state, impact, pressure, response)	Participants recognise: 1. The response will benefit marine environment and human health/wellbeing. 2. If they undertake a behaviour or action it will be effective at reducing the impact.	Participants increase communication about the key story topic and the benefit of a certain repsonse.	Participants are aware of the repsonse (behaviour change) and how to undertake it to reduce the impact.	Participants adopt a given response / behaviour.
Microplastics example	i) Consumers to recognise threat to human health. ii) Consumers to recognise threat to marine environment.	Consumers have knowledge that: i) cosmetic consumption drives microplastic use. ii) Microplastics can be identified form the ingredients list on products (and which ingredients to look for), iii) microplastics large contributor to marine litter in ocean. iv) microplastics can leak toxins into the water and food chain. vii) Microplastics have negative effects on health of marine life. viii) Potential for microplastics to negatively affect human health	Consumers recognise i) There is an issue with use of microplastics in cosmetics. ii) That reduction/elimination of use of products containing microplastics will benefit a) the marine environment and b) human health. iii) That thay if they, and others reduce/eliminate use of these products it will reduce the env. and health impact.	1. Consumers communicate i) with friends and family about the threat of microplastics 2. Consumers seek information on i) the topic of microplastics ii) the threat of microplastics.	Knowledge to idenfity microplastic from product ingredient lists.	Reduce/eliminate use of products containing microplastics.
Measurable objective (indicator)	Pre-post or Retrospective post survey - Analysis over time.	Pre-post or Retrospective post survey - Analysis over time	1. Pre-post or Retrospective post survey/Analysis over time. 2. Social media and communication analysis:	1. Social media - communication analysis. 2. Pre-post or Retrospective post survey - Analysis over time	See Knowledge	Pre-post or Retrospective post survey - Analysis over time 1. *Quantitative indicators.* 2. *Qualitative indicators* Survey intended / reported behaviour.
Result						

Target Audience

The framework is aimed at Ocean Literacy tool builders and those using the ocean literacy tools in determining their impact.

Ocean Literacy Goals

The framework is designed to assist in defining, monitoring and measuring ocean literacy levels.

Design and Development Process

The framework was initially concept-designed at the partner meeting in Torino in October 2017. This was followed by a brainstorming and design workshop involving NUIG and UPM in NUIG in November 2017.

The draft framework was circulated to the project consortium during December 2017 for feedback and comment.

Testing to Date

The system has been developed and basic integration testing and testing of the web services interfaces have been conducted. Further testing with the live Quiz builder and Quiz tool on both the Interactive Platform and the serious Game must be performed over the next weeks.

The surveying methodology, developed by Matthew Ashley in UPM, has been widely tested in collaboration with the developers of D5.5 (Education – Professionals) and D5.6 (Education – Schools).

Planning for the next phase: the wider dissemination and evaluation

We will be working with ALL WP5 Ocean Literacy tool developers to assist in designing their Measurement of Effectiveness programs. For example, UPM will work closely with ProSea on monitoring the effectiveness of the training programs, with the Marine Foundation and AZTI on the effectiveness of the children's workshop, and with TVE on designing and implementing measurement events relating the ocean literacy films. NUIG will be working closely with the Interactive Platform and Serious Game developers in gathering response data from the games and quizzes. All partners will be encouraged to create, publish and drive traffic towards online ocean literacy quizzes using the Quiz Builder.

7. Ocean Literacy Cartoons

Description

AZTI has produced three cartoons, based on three of the key stories developed by ResponSEAble: ballast waters and alien species, microplastics and coastal tourism. Their general objective is to make aware and change the attitudes of citizens in face to marine environment problems. With an artist, specialized in environmental and social topics, AZTI produced this series of three cartoons (around 5 minutes each), in which the same characters show to the audience a methodology to assess the problems and take management actions. They have been conceived as a series of chapters, which can be completed this year with the other three key stories. The cartoons are available in English, Spanish and Basque.

Target Audience

All the society, focusing specially in young people, since the cartoons have some funny presentations.

Until now the cartoons have been seen over 5500 times, being the most watched that of microplastics, followed by that of ballast waters and coastal tourism.

Ocean Literacy Goals

YouTube and Responseable web page have been used for the distribution and control of views and downloads. Twitter has been used to announce them and create expectations. We have used them in some talks and will be used in a special session in SETAC conference next May, in Rome.

Design and Development Process

For the design we have followed the leaflets of each Key Story, developed by ResponSEAble. We have studied each story under the DAPSIWRM approach, looking, in each case to:

- Drivers: which is the main economic driver for this problem?
- Activity: which is the main human activity producing this problem?
- Pressures: which are the main pressures that this activity is causing in the oceans?
- State: which are the main changes that the pressures have caused in the ecosystems?
- Impacts: which are the main impacts that those pressures and the resulting changes of state have produced at sea?
- Welfare: which are the main affections of those pressures and impacts on the human welfare?
- Responses: which are the technological, legislation, education, etc. responses that we can implement to reduce, minimize, or remove those pressures?
- Management: how can we monitor and look if those changes have been achieved?

Each cartoon finalized with a positive message to move the audience to change attitudes and behaviours.

To undertake that we followed next steps:

- AZTI provided the artist with the key story leaflet and some additional material
- He made a first story board of the cartoon, as pdf.
- We had several interactions until fixing the message

- After that, the story board was sent to the Steering Committee and the responsible of the key story for further feedback
- With these feedbacks the artist made a first version of the cartoon
- We had several interactions to polish the message and ensure consistency
- The Steering Committee gave the last agreement
- The artist made the three versions in English, Spanish and Basque
- AZTI publish the cartoon in YouTube, providing copies to the coordinator of the project

Monitoring of Effectiveness

We think that they are effective in disseminating the KS and moving people to think about the problems that oceans are facing. We have received feed-back of people saying that for the children the cartoons have helped them to think on complex issues

Testing to Date

No further testing has been done

Planning for the next phase: the wider dissemination and evaluation

We have had a meeting with Eleonora Panto for a wider dissemination of the cartoons. They have been integrated into the web page.

Links to Online Deliverables

The links to each cartoon and language are included below.

- Ballast Waters and alien species:
  o English: https://youtu.be/rajH-qmUJg8
  o Spanish; https://youtu.be/vw4KYzEuMJM
  o Basque: https://www.youtube.com/watch?v=kEHx6PPIPMY
- Microplastics:
  o English: https://youtu.be/TdbpYswVaz0
  o Spanish: https://www.youtube.com/watch?v=KhPrHynr-7A
  o Basque: https://youtu.be/1_lqumdo2SU
- Coastal Tourism:
  o English: https://youtu.be/LRTQOvz4kts
  o Spanish: https://www.youtube.com/watch?v=dA8XGlqOcIs&t=18s
  o Basque: https://www.youtube.com/watch?v=b8rrrYdrbRA&t=4s

Appendix: Draft Survey

The draft survey below is teacher or course leader / facilitator led. The survey would take place before the course (baseline), and would be repeated after the course.

Please make the participants are aware of the following:
This survey forms part of a study being carried out to evaluate the effectiveness of ocean literacy (awareness raising and training) materials developed under the ResponSEAble project. This work is funded by EU Horizon 2020.

The survey should last no longer than 10-20 minutes. Answers given will **remain confidential** and only anonymised and grouped data will be used in the analysis and reporting. By taking part in this survey you are consenting to your data being used as part of this study. You have the right to withdraw from this survey or to request your data are removed from the project at any time by emailing your request the survey date and survey number to matthew.ashley@plymouth.ac.uk. You do not have to answer any individual question if you do not wish to do so.

By ticking the following box, you indicate that you have read and understand the information provided above, that you willingly agree to participate and that you may withdraw your consent at any time and discontinue participation.

☐

(To be completed by the teacher / facilitator / course leader / interviewer)
Date:

Interview location:
Survey number*:*
Year / Age of Class:
Gender of pupil completing the survey:

Background information on Microplastics: *(if the survey is provided to classes before attending an event the teacher may want to explain what 'microplastics' are to avoid confusion with other words. The information below is from the ResponSEAble key story text, and educational text produced by NOAA https://oceanservice.noaa.gov/facts/microplastics.html)*

Plastic can come in all shapes and sizes, but those that are less than five millimetres in length (or about the size of a sesame seed) are called "microplastics."

Microplastics come from a variety of sources, including from larger plastic debris that degrades into smaller and smaller pieces. In the ResponSEAble key story we are discussing, microbeads, a type of microplastic that are very tiny pieces of manufactured polyethylene plastic that are used in a number of personal care and cosmetics products, like: some toothpastes, skin creams, baby products, sunscreens and shaving creams.

A: Problem awareness and concern.

1. Do you think the effects people are having on the sea are a problem?

No at all a problem   Very large problem

0   1   2   3   4   5   6   7   8   9   10
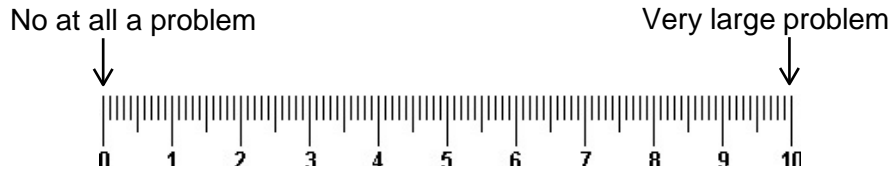
2. Do you think microplastics (very small plastic particles) in the sea are a problem?

Not at all   Very large problem

0   1   2   3   4   5   6   7   8   9   10
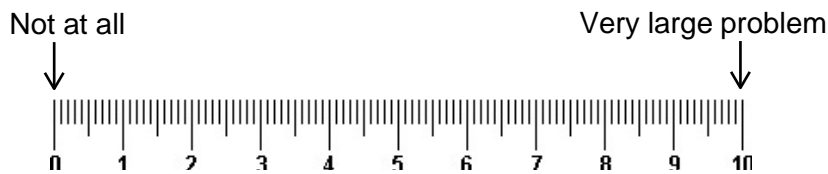
3. Are you worried about the problems that microplastics in the sea might cause?

Not at all   Very worried

0   1   2   3   4   5   6   7   8   9   10
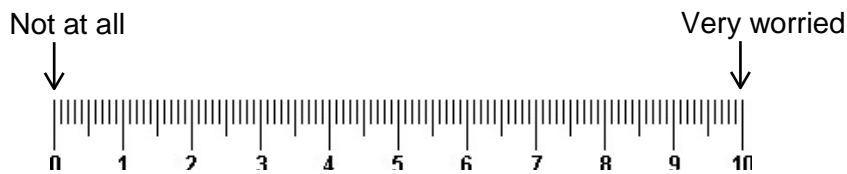
B: Perceived knowledge

4. On a scale of 0-10, where **0 = completely disagree** and **10 = completely agree**, to what extent do you agree with the following statements:

'*I have good knowledge about the effect of microplastics on the marine environment.*'

Completely disagree   Completely agree

0   1   2   3   4   5   6   7   8   9   10
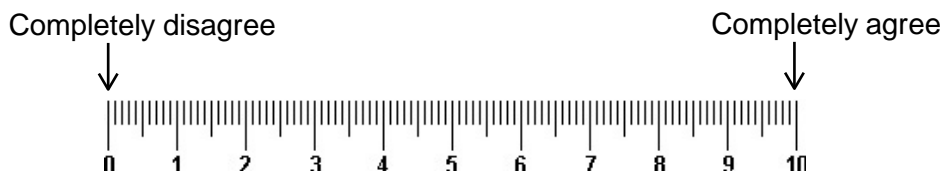
5. '*I have good knowledge about the effect of microplastics on human health.*'

Completely disagree   Completely

                                    agree

0   1   2   3   4   5   6   7   8   9   10

C: Perceived impacts

6. Do you think microplastics in the sea are bad for: (*Please indicate on a scale of 0-10, where **0 =***
*completely disagree and **10 = completely agree***)

a) Marine Wildlife: ☐

b) Tourism: ☐

c) Human health: ☐

d) The fishing industry: ☐

e) The appearance of beaches and the coast: ☐

f) Other: (*if there are any other impacts from microplastics you can think of, please add* ☐
them here) _____

D: Perceived causes

7. Why are there microplastics in the sea? (*Please indicate on a scale of 0-10, where **0 =***
*completely disagree and **10 = completely agree***)

a) Because cosmetic producers have been allowed to use microplastics in products. ☐

b) Because microplastics in cosmetics can get washed into the sea. ☐

c) Because businesses (cafes, restaurants, shops) use products with
microplastics. ☐

d) Because microplastics can't be removed from the water we use. ☐

e) Because people choose to buy cosmetics that contain microplastics. ☐

f) Other: (*if there are any other causes of microplastics in the sea you can think of,*
please add them here) _____ ☐

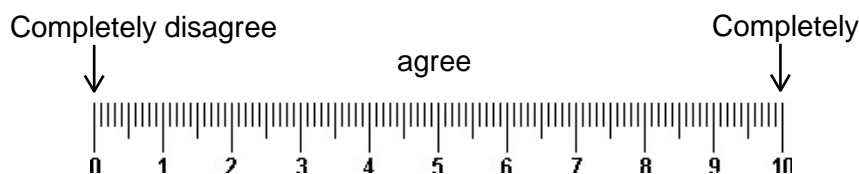8. On a scale of 0-10, where **0 = completely disagree** and **10 = completely agree**, to what extent do you agree to the following statements:

'*There will be a benefit to health of the ocean environment and also human health if people reduce or eliminate use of products containing microplastics*'

Completely disagree   Completely agree

      ↓   ↓

`|||||||||||||||||||||||||||||||||||||||||||||||||||||`

0   1   2   3   4   5   6   7   8   9   10

Please comment on why you have suggested the level 0-10 you have (optional)

_____

F: Reported behaviour

9. How recently have you done the following activities? (*Please indicate on a scale of 1 = Never, 2 = In the last year, 3= In the last month, 4= In the last week).*

a) Looked for health and cosmetic products (toothpastes, soaps, face scrubs, shampoos, sunscreens) that do not contain microplastics (PE, PET, PMMA, PP). ☐

c) Talked to your friends and family about the effects of microplastics on the marine environment and human health. ☐

c) Talked to your friends and family about buying products that do not contain microplastics. ☐

d) Looked for more information about microplastics in health and cosmetic products. (e.g. *in newspapers, on television or the internet*) ☐

e) Encouraged other family and friends to do any of the things above. ☐

10. What solution can you suggest you or others can do to reduce the use of microplastics?

_____

11. Where did you hear about this solution? (you may select more than one)

a) Television programme ☐   b) Book ☐

c) Film ☐   d) Internet or Social media ☐

e) Radio ☐   f) Newspaper or T.V. News ☐

g) From information in a lesson, lecture or presentation ☐

h) Visit to the aquarium ☐   i) Other source (please describe below) ☐

_____

12. **Challenge:** With the permission of the people you live with, make a list of all the products in your house that you can find that contain microplastics. _Look for the ingredients: POLYETHYLENE (PE), POLYPROPYLENE (PP), POLYETHYLENE THEREPHTHALATE (PET), POLYMETHYL METHACRYLATE (PMMA). (if you like you can take a photo of all the products you find on a table)._