Ocean Connections Pilot 1 Evaluation
National report DENMARK

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Introduction

This draft report synthesises learning from the initial data collection for the Danish Pilot 1. Pilot 1 was conducted with 22 Year 8 (aged 14-15) pupils from Søren Kanne Skolen, Søndre in East Jutland, Denmark. The pilot was planned to take place as a five-week project in week 8, 10, 11, 12 and 13 in 2020. However, the pilot was significantly affected by the COVID-19 pandemic. The first two week were according to plan, but in mid-March 2020, Danish schools were put on strict COVID-restriction. The pilot was therefore put on hold as the pilot required in-person attendance. The pupils did not reengage with the pilot before the end of May 2020. A 10-week pause did take away a lot of momentum and did nothing good for pupils' commitment and ownership.

Pilot 1 was planned as a transdisciplinary, problem-based project mostly involving both biology, geography and physics/chemistry. The overall problem was decided by the teacher and formulated as "Biodiversity in the ocean".

Pilot 1 started with an introduction week (week 8, 5 lessons of 45 min) with focus on ocean literacy (OL), and more specific on biodiversity and how we as humans affect biodiversity in the ocean, and how the ocean is a major influence on weather and climate (among others focusing on ocean currents and salinity). In the second week (week 10, 5 lessons of 45 min), the pupils visited the aquarium to make 360-film from the lagoon and explore adaptation. The weather condition made visibility in the lagoon close to zero, so filming with 360 cameras had to be done in one of the large fish tanks in the aquarium. While filming, the education team at the aquarium facilitated an exploratory session focusing on behaviour of fish (at one point the fish is fed) and how we humans affect their behaviour. The students also had session with education team at the aquarium in the wetlab exploring salinity and discussing adaptation and how salinity in Kattegat affects the species we have in the lagoon. Back in school, the pupils investigated the 360-video recorded from the fish tank. The video was uploaded to the Ocean Connections VR-platform and viewed using a VR headset. The students also investigated the water samples collected from the lagoon. The pupils were then asked to formulate their own questions arising from their experience at the aquarium and the introduction week. The intention was for pupils to use the Ocean Connections VR tool to edit their 360-film and add some embedded biodiversity content. This was not done because of the Covid-19 locked down. The substantial. Break in the project between March and May, and the fact that the summer holidays were starting soon after the return from lockdown meant that the project was adjusted such that it was finalised with a visit from Kattegatcentret and some laboratory work.

Data was collected by researchers from the project across four visits, one to the aquarium and three to the school during 'Oceans' project lessons. Data sources for this report include a pre-post questionnaire (**PreQ-DKP1**, **PostQ-DKP1**), pupil focus group interview (**FG-DKP1**), field notes (**FN-DKP1**), photographs/glow-moments (**Ph-DKP1**).

The report is laid out according to the different strands of evaluation undertaken, the questions framed within each strand, and relevant themes identified within the data. These themes are driven by both the educative principles underpinning the project (see IO1: State of the Art Synthesis Report) and emergent themes that arose during the piloting of the projects.

STRAND 1: Evaluation of pupils' outcomes in terms of learning about, and attitude to, Ocean Literacy

1a. What do pupils learn about OL through engaging in the pilot projects?

[Data sources: PreQ-DKP1, PostQ-DKP1, FG-DKP1]

Data from the pilot allows us to conclude that the pupils overall has learned about OL to some degree, and that the learning outcome in light of the covid-restrictions must be considered above average. From the post-questionnaire (N=20) 80 % of pupils indicated "Medium" when asked to "describe how much you learned by participating in the Ocean Connection project", while the rest (20 %) indicated "A lot" (PostQ-DKP1-Q3). In the open question "Write 1 or 2 things you have learned since being in the project" (PostQ-DKP1-Q4), we find statements like "I've … learned a lot about the ocean" and "I've learned a lot about fish and what biodiversity is". The open reflections e.g. indicate the perceived importance of the work on the aquaria, and the arts/crafts/VR in particular are also is emphasized. In a factual question "Where is most of the water on Earth?", only half (52 %) of the Danish pupils indicated the correct answer "In the ocean" (PreQ-DKP1-Q15), increasing to 80 % in the post-test (PostQ-DKP1-Q14), allowing us to conclude that there has been a increase in their basic ocean knowledge.

Within the educative principles identified for the project in the state-of-the-art, four core strands of ocean literacy common to the curricula of England, Denmark and Spain were highlighted:

1. Humans and the Ocean are inextricably linked
2. The Ocean supports a great diversity of life and ecosystems
3. There is one big Ocean
4. The Ocean is a major influence on weather and climate

There are a number of individual statements from pupils in the post-questionnaire indicating that "**The Ocean supports a great diversity of life and ecosystems**" is the most expressed OL-learning outcome. In the open question "Write 1 or 2 things you have learned since being in the project" (PostQ-DKP1-Q4), biodiversity is mentioned explicitly by 50 % of the pupils with statements like "I've learned what biodiversity is", "there is a lot of diversity within 1 km2 ocean ..." and "that there is so many different species of fish". A more factual question regarding "The most abundant life form in the ocean" 45 % of the Danish pupils answered incorrectly either "Fish" or "Shellfish" in the pre-test, but only 15 % did so in in the post-test (PreQ-DKP1-Q17 & PostQ-DKP1-Q18). In the post-test 63 % of the pupils would rank "Phytoplankton" as the most abundant and 20 % "Microbes". This is in line with other data indicating that their knowledge of the diversity of life and ecosystems in the ocean has increased during the pilot. A key activity within the pilot project that engaged pupils with this OL principle was a fish dissection, shown in the photograph below. The class is dissecting herrings and it was obvious that the pupils were quite engaged and concentrated in the activity. It was the first time that they hold a fish in their hands and dissecting the fish was a big challenge to many of them (FN-DKP1).

There are a few individual statements from pupils in the post-questionnaire indicating that "**Humans and the Ocean are inextricably linked**" is also a valued OL-learning outcome. One pupils response in this way to the open question "Write 1 or 2 things you have learned since being in the project" (PostQ-DKP1-Q4): "I've learned how the ocean and humans are interconnected and what kind of animals live there." This is a quite strong, reflected statement coming from a 14-year-old girl, and allows for an optimistic view on the impact of the pilot. In the pre-questionnaire, "only" 63 % of the pupils would hold the statements "Some populations of ocean animals are declining, so people should choose carefully which to eat" as true (the rest holding "There are plenty of all the kinds of ocean animals that people normally eat" as true). In the post-test, this increased to 90 % of the pupils having the understanding that what we choose to eat as humans impact life in the ocean. The post survey might suggest that in some way, the human influence on the ocean has been overstated in the pilot. In the post-test more pupils incorrectly stated that an increase in ocean salinity was caused by "Human activities have changed ocean temperature and pH" (PostQ-DKP1-Q20). It is difficult to interpret the Danish pupils' response to the tuna-case in the pre- and post-questionnaire. In the pre-test almost all pupils (95 %) would "Slightly disagree" or "Strongly disagree" with the statement "It's O.K. for a person to buy Bluefin tuna" given the information "fishing has caused a sharp decline in the population and great concern for the survival of this species" (PreQ-DKP1-Q25). In the post-test (PostQ-DKP1-Q24) this was reduced to 79 % "Slightly disagree" or "Strongly disagree". It is worth mentioning that, both in the pre- and post-test about ⅓ of the pupils would be comfortably buying tuna in the themself at the local fish market/shop (PreQ-DKP1-Q24 & PostQ-DKP1-Q23). In the pre-test open question about whether its ok or not to buy tuna, the arguments are quite novice in line with "If you have to buy a tuna you have to buy a tuna.", "Because tuna tastes good", "It's dead, so there's no difference whether it's me or someone else buying it." and "Would never really buy fish by myself, so it will probably not be just me who buys fish". In the same post-test open question we also find similar arguments from those who would like to buy tuna themself: "if mother has asked me to pick up tuna, then that's what I pick up" and "because I love tuna", but also more reflected arguments like "when you buy it in a fishing shop you have to assume that they are in control of it and it has been done in a proper way" and arguments about food waste like "it is dead and it must be eaten. then there is no food waste" (PostQ-DKP1-Q23b). Similar arguments for not buying tuna is ranging from novice arguments like "it tastes bad" to the majority of arguments in line with a moral/sustainability argument: "because you do not know how it is caught, and if nothing can be said about it, it is foolish to buy it.", "because I thought it was important that we take care of nature", "because you should know where what you sell comes from and how it has lived and how / where it is caught", " would [only] buy from a dealer who had control over what he was selling or come up with something to eat instead of the fish." and "If it has not been caught in a sustainable way, it is both bad for our climate and a bad for the fish." and "If the seller does not know anything about the fish, I would not buy fish, as it does not say anything about what life the fish has had". It is clear from these responses that the pupils had a more nuanced perspective on the relationship between humans and the Ocean that before the pilot.

The principle "**There is one big Ocean**" has not been an expressed learning outcome for the Danish pilot. In the data from pre and post questionnaire from pilot 1, there is no clear tendency towards a better understanding of this principle. Although there is more pupils answer correctly "There is one ocean, it is large, it is finite, and the resources are limited" in the post test (60 %) compared to the pre test (52 %) (PreQ-DKP1-Q17 & PostQ-DKP1-Q16), the trend is reversed for PreQ-DKP1-Q13 & PostQ-DKP1-Q14. 63 % of pupils state that the "Water in the Atlantic Ocean basin will eventually circulate to all other ocean basins" in the pre-test, only 40 % did so in the post-test (instead pupils tends to choose the answer "Ocean water circulates throughout the northern hemisphere, but will not cross over to the southern hemisphere").

The principal "**The Ocean is a major influence on weather and climate**" has not been an expressed learning outcome for this pilot, and there is not a lot of data pointing towards students learning about this principle, as one might expect. From the pre-test (PreQ-DKP1-Q19) we know that the majority of danish pupils (63 %) think that the cause of sea level change is that seawater expands. Only 25 % of the pupils also explain this with melting ice caps. In the post-test (PostQ-DKP1-Q20) there is a change, so now 35 % have the correct answer. At the same time the majority (55 %) think the melting of ice caps is the (only) cause of sea level change in the

pre-test. However, there is worth mentioning that there is a lot of data pointing to environmental responsibility and attitudes among danish pupils (se research question 1b).

1b. What impact does engaging with the pilot projects have on pupils' attitudes to the Ocean, and to environmental responsibility?

[Data sources: PreQ-DKP1, PostQ-DKP1, FG-DKP1]

There is no clear impact in the survey (PreQ-DKP1 & PostQ-DKPI1) – comparing pre and post - in the items asking about perceived attitudes to the Ocean, and to environmental responsibility, however noting, that the the dansih pupils find those issues quite important. Response to the question "Do you generally find environmental issues like air and water pollution, recycling and climate change to be important?" 85 % of the danish pupils reply "Quite important" or "Very important", and only 15 % reply "Not very important" (PostQ-DKP1-Q11). This is slightly up from the post-test (78 % answering "Quite important" or "Very important") (PreQ-DKP1-Q12). With N=19 & 20, the difference is too small to be significant, but points us to believe that we are affecting pupils to find environmental responsibility important. In the open reflections, there is a tendency for more focus on yourself being a part of the generation living on the earth in the future, and therefore having to act - compared to pre-test. And a little less focus on scenarios like "we are all going to die". Statements like "this is my future", "our generation shall live here", "it is my future, I cannot just ignore it" or similar is found among 30 % of the students. Statements like "Something has to be done" are also quite frequent (4/20%), "It affects the earth", soft terms (4/20%), "prevent extinction" (3/15%). There is only one statement directly addressing the ocean in regards to environmental responsibility: "Because we are responsible for plastic in the ocean - and therefore responsible for killing fish". Only 2 answers (10 %) are more indifferent like "Don't care, not important for me" and "because I am not interested in this". (PostQ-DKP1-Q11b)

In the focus group interview, the pupils talk about engaging in environmental issues and they have all been a little engaged in environmental issues before the project started. One pupil put it this way: "*It might also be a bit of a luxury, but being able to go to the beach and swim without being overwhelmed with plastic. It may not be many years before we can do it, if we just keep throwing out plastic, then we may have it here in Denmark as well.*" (FG-DKP1). The pupil replied on this follow-up question "have you always felt that way about the Ocean": "*I also felt this way a little before, but it has become more after the project. I have seen signs that say you must not throw rubbish in the sea, but I have become more aware to avoid it.*" (FG-DKP1)

1c. To what extent is this impact (on learning/attitudes) maintained over the short and medium term?

[Data sources: FG-DKP1]

Due to Corona-restrictions and its implication for pilot time-schedule, a second focus group interview was not conducted. The findings regarding 1b is therefore limited. We can argue that the findings for 1b is also relevant for 1c.

Strand 2: Evaluation of pupils', teachers' and aquarium educators' perspectives on the innovation (combination of digital technology and creative pedagogies for teaching OL)

2a. What are participants' (pupils, teachers & aquarium educators') perspectives on the effectiveness or otherwise of the combination of creative pedagogies and AR/VR to teach Ocean Literacy?

[Data sources: FG-DKP1. Note that the teacher and educator interviews, reporting on their perspectives will take place after both pilot projects and appear in the final evaluation report]

In post-questionnaire, pupils were asked to write 3 things that they thought had been really good in the project (PostQ-Q6). In particular Danish pupils highlighted visiting Kattegatcentret (50% mention this visit explicitly, and several other students mention activities done on the visits there). Common statements were "That we have been to Kattegatcentet and had teaching in a different way" and "we collaborate with Kattegatcentret that we learn so much about nature". Many students were also emphasising that they were learning science in a way that was different from what they normally experienced. "To do something that was not in school but still teaching. To do some experiments. To cut into fish.", "That it has been a slightly different teaching than we usually do. It has been an exciting teaching." and "that we not only have to sit still on a chair but that we also have to do some projects." and "A lot of activity". Many of the comments were about specific activities: "When we had to taste which salt content had the most salt in. When we made experiments with sea lettuce." This sort of perspective is encapsulated in this quote from the pupil focus group, *"I think it's a lot more fun doing something different than reading, and you also learn more from it - you have it in your hands instead of watching a video about something."* (FG-DKP1)

2b. What are participants' (pupils, teachers & aquarium educators') perspectives on the affordances and barriers of the combination of creative pedagogies and AR/VR to teach Ocean Literacy?

[Data Sources: FG-DK1, SI-DKP1]

In the focus group interview it is evident that the pupils prefer the teaching in the Ocean-project compared with the "everyday" teaching. The pupils like the hands-on activities in the laboratory, the visits at the Kattegat Center and the use of VR. They explain that they learn more when they interact with plants and animals doing "something" with the organism, instead of only reading about it, and it may be the case that this interaction is equally as engaging whether directly physical handling such as the fish dissection, and 'meeting' the fish at the Kattegatcentret, and interacting with the marine organisms within a VR space. The minimal creative pedagogy in pilot 1 makes it difficult to conclude about the affordances and barriers of this aspect either separately or in combination with the VR digital tools. The class made a biodiversity dance but it seems to be difficult for the pupils to understand the connection to the other activities in the project, stating in the focus group interview that it was a waste of time (FG-DKP1). Possible conclusions to be drawn from this for pilot 2 and the toolkit are that the creative pedagogies need to be closely woven with the learning taking place via digital tools, visits and other class work, alongside more clarity of explanation about how the learning through dance is related to the other learning within the project.

A barrier explicit mentioned by many of the students (40 %) is the text used for OL was too difficult (PreQ-DKP1-Q7): ("I think there have been very heavy texts", "there has been a lot of reading material at once", "long texts", "we read a little too much". This barrier is not directly related to the educative principles for this project in which creative pedagogies and digital technologies are combined to support ocean literacy learning, unless it can be said that drawing on these pedagogical approaches might facilitate chunking down of texts to make them more accessible.

One of the apparent barriers using technology like VR-headset is that the teacher has to rely on technology that does not always work. This was apparent in one of the 'Oceans' project lessons at the school. The pupils were supposed to experience the 360 underwater film using VR-headset. However, on the day, the class had only one VR-headset at their disposal. The planned activity with each group having a headset for 2 lessons, the groups had to share the one headset, leaving each group to have around 20 min use of VR-headset (FN-DKP1-050320). This proved to be a major obstacle for students to fully appreciate the affordances of VR. There were also some difficulties regarding the streaming of the 360-film on the VR-headset, as with the UK pilot project. It is a suggestion for Pilot 2 that alongside film, pupils are directed to engage in the VR via still 360 photographs so that they are able to engage with the VR experience, albeit not fully immersive.

(Ph-DKP1-050320-2)

Strand 3: Evaluation of the implementation of the educative principles

3b. During the projects, where and how did the features of creative and digital pedagogies within the educative principles manifest?

[Data Sources: FN-DKP1, PH-DKP1,]

Creative Pedagogies

In post-questionnaire, pupils were asked to write 3 things that they thought had been really good in the project (PostQ-Q6). Three pupils mentioned the **Biodiversity dance** and **Land art** ("when we should do a dance with biodiversity", "art in nature" and "mixture of creative and bookish work dance"). There was also one student mentioning the dance when asked to write what they think hasn't been so good about the project (PostQ-Q7), ("we were going to dance").

The biodiversity dance was an activity designed to follow after presentation and work with understanding the concept of biodiversity in the classroom. The pupils were instructed to choreograph a dance expressing biodiversity in the ocean, drawing on inter- or **trans-disciplinarity** to connect their learning in science with learning in and through the arts. It also involved engaging with the feature **risk, immersion and play**. This was a novel approach for both teacher and pupils and pupils that they could have seen as potentially risky in performing in unexpected ways. First phase was a physical brainstorm: 'what do your bodies think about ocean biodiversity?' that offers opportunities for **embodied dialogue**, in which pupils respond to each other and to their learning about the ocean physically. As soon as the first phase of the project was presented and the music turned on, everyone started moving like all sorts of underwater animals. On the photograph taken by students, we see the room filled with improvised dancing:

(Ph-DKP1-180220_1)

Unfortunately, the choreographies were never finished because of the corona. In the focus-group interview, the pupils were critical. One pupil elaborated in the focus group interview: *"I think the creative was more to get a break, I do not think I learned more from it. It was mostly for fun. If you had more time you could do it, but here it was a bit of a waste of time because you did not learn anything."* (FG-DKP1). It may be that with

more time to engage with the activity, the relevance for learning about Ocean Literacy could have been more clear for the pupils but that in pilot 1, this was not at all apparent. For pilot 2, it may be helpful if the use of creative pedagogies is seen to extend beyond simply connecting creativity with the arts (dance, in this case, or visual art in the 'land art' activity) might be useful, helping pupils to understand how thinking creatively in arts and in science is situated in, but goes beyond, disciplines, and how this can support their learning.

After the corona-break the pupils reengaged with the pilot with a session with staff from Kattegatcentret among others dissection of herring. Later the students were given the task of going out and translating their impression of the fish into "Land art". The task was open-ended, enabling the pupils **empowerment and agency**, and many creative land-art-fish were produced, which were carefully placed in the landscape - the forest floor. Interacting with the forest in this way can also be interpreted as a means of pupils engaging in **embodied dialogue** as part of their learning. The photograph shows two girls immersed themselves with great seriousness in the work of recreating a herring as lifelike as possible, connecting this activity to some extent to the concept of **modelling**. On the mobile, the fish was studied carefully once more, creating a link to the dissection activity.

(Ph-DKP1-090620_1)

(Ph-DKP1-090620_2)

VR/AR and digital pedagogies

In the post-questionnaire, pupils were asked to write 3 things that they thought had been really good in the project (PostQ-Q6). Several pupils highlighted filming with 360-camera and using the VR-headset ("When we were in the kattegatcenter to record those movies.", "When we had to try VR and investigate in the biology room").

Observation of biodiversity using 360 video, and use of the Ocean Connection VR-platform was supposed to be an important part of pilot 1. Due to the time of year (March), it was difficult to record video in the ocean due to poor visibility. The observation was therefore relocated to one of the large fish tanks at the aquarium. Pupils focus group comments show that from the visit it was clear that … (FN-DKP1-030320).

(Ph-DKP1-030320-1)

Glow-moment: The wow-factor...

(Ph-DK1-050320-1)

This view is also addressed in the focus group interview. Pupil 3 answering why he had chosen a specific picture*: "I have chosen that image from the day we worked with VR. Where we saw the films, we had made ourselves at the Kattegat Center a few weeks before. I think it was really cool because we could just look into the aquariums before, but with the movie we could just move around the aquarium. I think that was really cool and a little different teaching."* (FG-DKP1). This was also noted in the field notes (FN-DKP1-050320) ….

Conclusions and Implications for Ocean Connections Pilot 2

OL Learning

It is clear from these responses that the pupils had a more nuanced perspective on the relationship between humans and the Ocean that before the pilot project took place, and that they had indeed learned about the Ocean with respect to two of the Ocean Literacy principles: that humans and the ocean are inextricably linked, and that the ocean contains a great diversity of life and ecosystems. Pupils' care for the Ocean and the environment was also apparent.

Creative Pedagogies

It was clearly a challenge for the teacher and pupils in this project to draw on the features of creative pedagogies and embed them in the practice. Efforts were clearly made, via the dance choreography that was disrupted by the COVID-19 pandemic, and the 'Land Art' activity completed in June 2020 following the pupils return to school. In both cases, use of an interdisciplinary, rather than transdisciplinary pedagogy were made, linking science and arts whilst maintaining disciplinary boundaries and perspectives. **In pilot 2, it may be interesting to draw out a more transdisciplinary approach, in which pupils ask and respond to questions inspired by and in the context of both art and science depending on the knowledge(s) they are interested in exploring. Similarly considering how the features of creative pedagogy are found beyond simply the Arts to explicitly plan to weave creativity through the use of digital tools, visits, and class work during the Oceans**

project without confining these to an artistic activity or objective, and exploring the impact of this approach on learning about the Ocean may be of interest. Making this explicit in the planning phase might then enable more clarity of explanation about how the learning through dance, for example, is related to the other learning within the project.

Digital Technology

There were some key barriers to pupils' engagement with the digital technology in pilot 2, since their access to the VR headsets was limited due to the number of sets available, and there were also some difficulties regarding the streaming of the 360-film on the VR-headset. **It is a suggestion for Pilot 2 that alongside film, pupils are directed to engage in the VR via still 360 photographs so that they are able to engage with the VR experience, albeit not fully immersive.** However, pupils reported strong engagement with the VR tools when given the opportunity. **This suggests that in Pilot 2, building in more opportunity for pupils to engage with the digital tools would be beneficial.** However, it is not yet clear whether the creative and digital pedagogies are simply a means of increased engagement with the Ocean, or whether learning in this way has an additional impact on pupils' learning of OL principles and attitudes towards the Ocean beyond that provided by any project to learn about the Ocean.

Data-key reference list

Data-Key	Dataset	Subset-comments
PreQ-DKP1	Pre-questionnaire	-Q1, -Q2, … Qn reference the specific question no. n in the questionnaire
PostQ-DKP1	Post-questionnaire	-Q1, -Q2, … Qn reference the specific question no. n in the questionnaire
FN-DKP1	Field notes	Reference to a specific field note. -"date" specify the data of observation.
FG-DKP1	Focus group Interview	Only one FG was conducted (the last one was skipped due to covid-restrictions)
EI-DKP1	Educator Individual Interviews of collaborating teachers and aquarium educators	Individual, semi-structured interviews conducted by the University of Exeter research team at the end of the three pilot projects have been completed.
Ph-DKP1	Photograph	Reference to a specific Photograph use _"date"_NO.
GM-DKP1	Glow-moments	Reference to a specific glow-moment use _"date"_NO.