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The Virtual Palaeosciences (ViPs) project: resources for online learning in or out of a pandemic

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ABSTRACT

The Virtual Palaeosciences (ViPs) project is a collaborative initiative bringing palaeoscientists together to locate, access and share online educational resources (OERs). It began as a response to the 2020 shift to online learning when the COVID-19 pandemic curtailed field and lab work. We outline the development and initial outcomes of the project and consider future directions post-pandemic. Our initial focus was to create a searchable list of OERs (now numbers 600+). The project has also promoted co-operation across institutions and created new collaborations. It became clear that even experienced and teaching-focused educators were anxious about how to incorporate virtual materials and develop alternatives to field and laboratory work and deliver their intended learning outcomes. ViPs aim to become a "hub" for palaeoscience teaching resources. While some face-to-face teaching has returned in Higher Education, the benefits of online elements have become clear to students and educators alike. Therefore, following the pandemic, an increasing shift towards a blended delivery with greater use of OERs in palaeoscience and other disciplines is likely. Longer term, the ViPs project also seeks to increase inclusive, accessible education in the palaeosciences through the digital enhancement of provision, by supporting both users and creators of virtual teaching materials.

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Environmental change; open educational resources; collaborative networks; fieldwork; laboratory work

Introduction

Many field-based disciplines, such as geography, ecology, environmental science and the palaeosciences, rely on a blend of teaching and learning environments, including fieldwork and laboratory work for the training of students (e.g. Boyle et al., 2007; Dresne et al., 2013; Elkins & Elkins, 2007). In some disciplines, a core curriculum is broadly agreed across Higher Education (HE), e.g. biology, chemistry and physics, providing a large enough market for commercial online and virtual resources to support the teaching of commonly required practical skills. However, physical geography, environmental sciences and the palaeosciences tend not to follow a core curriculum; consequently,

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any digital materials that are available are less likely to be tailored for a specific purpose and located in one place. This became acutely problematic for many academics in these disciplines in 2020 when the COVID-19 pandemic led to a dramatic shift to online learning worldwide. For many university educators, this was also the first time that they were required to teach fully online, at short notice, despite this approach's known steep learning curve (Appana, 2008). However, a wide range of online Open Educational Resources (OERs) covering many aspects of the subject area are available online, e.g. on university or stand-alone web pages and hosted on channels such as YouTube. However, they exist in isolation, making searching for disparate resources time consuming. Many digital resources also exist at a local level (i.e. within modules in a programme) that had never been shared before, either due to lack of prior interest from others or lack of network or platform to share.

The pivot to online teaching highlighted particular resource gaps in many environmental disciplines and presented immediate challenges for educators in these areas. While lectures and some practical classes were quickly reformatted, field classes and many practicals were often cancelled (Bacon & Peacock, 2021). Existing virtual field-based activities, designed to supplement and prepare for in-person trips, covered specific topics such as glacial geomorphology (virtual glaciers (https://vrglaciers.wp.worc.ac.uk/wordpress/)) and soil science (Virtual Soil Science Learning Resources (VSSLR) (https://soilweb.ca/). For many other topics, no existing online resources designed for HE teaching seemed to be available, for example, vegetation surveys.

Much of the teaching that moved online during the pandemic can be thought of as an emergency response, rather than a carefully planned shift to online teaching and learning (Hodges et al., 2020; Youmans, 2020). Whilst standard practice in palaeoscience and allied subjects in UK HE before March 2020 was almost entirely face-to-face/hands-on delivery, there are known to be many benefits to online approaches (e.g. Cooke et al., 2020; Fuller & France, 2016; Markowitz et al., 2018; Rogers, 2020), including making field and lab sciences more accessible and inclusive (e.g. Cliffe, 2017; Jeffery et al., 2021; Stokes et al., 2012; Super et al., 2021). Given the experiences of the 2020–2021 academic year, we believe that whilst many courses will return to in person and live teaching, particularly in the field, online components are likely to remain a common and important part of the curriculum for many reasons (Clay, 2020; Witze, 2020).

The Virtual Palaeosciences (ViPs) project was developed in Spring 2020 to bring together the palaeosciences community to support each other in the shift to online learning during the pandemic, but, from the start, also had longer term ambitions to support the creation of more inclusive and diverse curricula. This paper outlines the development and initial outcomes of the Virtual Palaeoscience (ViPs) project, and considers future directions of the project post-pandemic.

What is ViPs?

The Virtual Palaeosciences project is a collaborative community project for academic palaeoscientists to find, use and create online educational resources, and to network and share best (and worst) practice. The project was initially unfunded but has subsequently had support from the Quaternary Research Association (QRA) and university internship funding (University of Hull/Salford). The project's initial focus was to create a single

location holding a searchable list of existing online resources, from video clips to full virtual practical classes or field trips, with the longer-term goal of identifying gaps in OER availability and catalysing the creation and sharing of materials and practice. Whilst initial activity was stimulated by the Spring 2020 crisis, ViPs is also driven by a longer-term desire to increase inclusive, accessible education in the palaeosciences.

The project is innately a community project. The idea for ViPs came from seeing individual academics seeking OERs through Twitter and from a Yorkshire (UK) Palaeoecology Group virtual meeting during the initial pivot online. The project structure (Figure 1) is deliberately broad, with working groups as much a place for mutual support as for delivering on planned work, and regular newsletters both to keep in touch with as many people as possible and to ensure opportunities to engage with the project are readily known about and open to anyone, regardless of location or career stage. Working together greatly reduces the time and resource demands on any one educator, and also minimises duplication of effort. Cramman et al. (2021) discuss the role of Community of Practice in HE during the pandemic.

In the first stage, collating and disseminating a searchable list of resources was the top priority. An initial list was compiled from community suggestions and shared as an Excel spreadsheet both via a mailing list and through the project website. The list was greatly improved by the contributions of project interns, recent graduates gaining work experience through short-term placements via schemes at the Universities of Hull and Salford, who checked links, added details to make searching easier, and wrote short reviews of materials from a student perspective. These reviews aim to help educators choosing among several resources depending on their objective. They also contributed to the ongoing work of building a website that will include a searchable online database.

The online pivot required rapid familiarisation with a wide range of software. Sharing experiences using different software platforms has been another activity of value to the community, through workshops and less formal virtual "coffee morning" seminars.

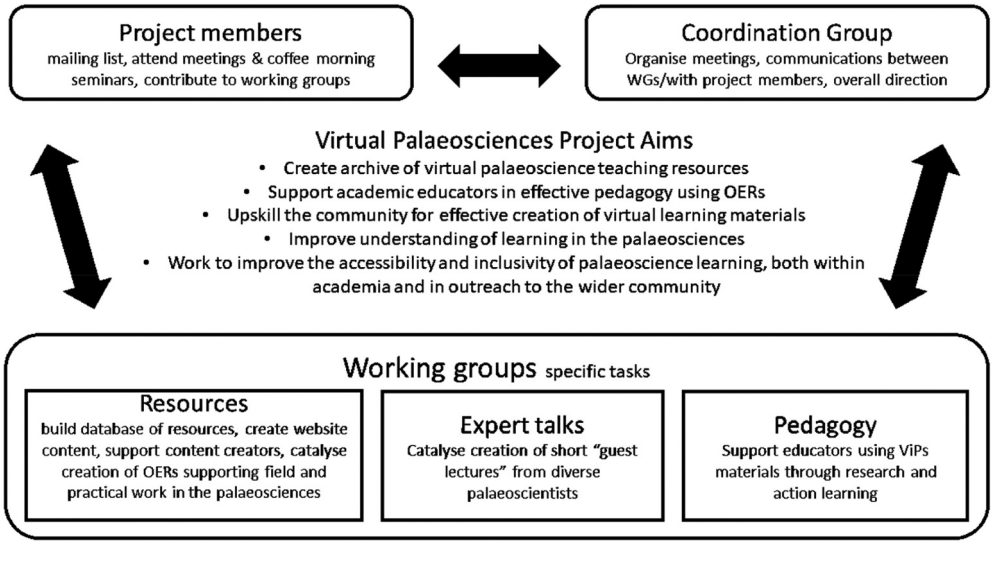

Figure 1. Virtual Palaeosciences (ViPs) project structure.

Supporting the creation of new online resources and making it easy for created resources to reach a wider audience of educators, is an increasing focus of ViPs activity through workshops and networking. The first notable product of this focus is a web-native electronic microscopy simulator, created by Steve Juggins (currently being written up) as a modernisation of CoPol (a software package developed in 2009 by Jane Bunting and Dick Middleton at the University of Hull which simulated COunting POLlen under a light microscope and prepared students for laboratory sessions and dissertation research).

Case study: existing resources

The ViPs database has over 600 resources collated to aid in tailoring teaching to desired learning outcomes. This is a suite of existing resources that are usually freely available and easily accessible and can be found here: https://virtualpalaeoscience.uk/. The collation of these resources was a first step towards the production of lesson plans that can be put together easily (example in Table 1) and the identification and filling of gaps in terms of online teaching resources for palaeosciences.

What have we learnt so far?

The need for community, especially for academics from smaller departments where there are only one or two palaeoscientists, is substantial. Like so many social challenges, this has been brought to light by the current crisis but was not created by it. ViPs have provided a valuable opportunity to work together across institutions and created new and unexpected collaborations and relationships. The palaeosciences community is itself a resource, and sharing experiences, ideas and local solutions to widely experienced problems with other practitioners has been an important component of developing effective online learning, supporting isolated home-working academics and building confidence in the materials and experiences that we have been able to offer to students.

Taking a "maker space" approach, where a variety of materials, tools and conversations are easily available yet each academic build their own teaching reflecting the needs and limits of their students, programmes and institutions, has proved highly effective. Whilst commercial packages of virtual material are unlikely to ever be appropriate for subjects like the palaeosciences, which are taught as part of a variety of different degree programmes and do not have a common statement of coverage expectation or widely used core textbooks, the maker space approach has been empowering. The ongoing cataloguing of virtual resources shows that there is a great deal of material out there in the palaeosciences and that ViPs still have plenty of work to do in terms of both listing existing materials and identifying and filling gaps in the coverage.

As the ViPs community worked together, it became clear that even experienced and teaching-focused educators were anxious about how to incorporate virtual materials and to develop alternatives to field and laboratory work which could deliver the same learning outcomes. The pedagogy working group has begun to address this by developing and sharing example "pedagogic journeys" (see Table 1). The example in Table 1 lays out a typical "environmental change" module sequences and mapped this to materials and approaches that could be used to deliver the same learning outcomes. Drawing on the community experience by facilitating peer support and discussion, through the

Table 1. Example set of existing resources for teaching the flow of taking a core to producing and analysing a pollen diagram. In this case, the activities can be split into three steps (Step 1: Taking a core; Step 2: Sediment dating; and Step 3: Pollen analysis) allowing student time to utilise the various resources. The resources highlighted below are all freely available online and can be used in synchronous or asynchronous online, blended, or in-person sessions.

Step	Objective	Learning outcomes	"In-person" format	Online alternative	Comment
1. Taking a core	To understand how evidence for past environmental change is retrieved during fieldwork	1. To describe why coring is used in palaeoscience 2. To compare coring methods appropriate to different environmental conditions 3. To explain how to process cores 4. To explain how to record cores	This would usually be done via live discussion often in the field with students either taking their own cores or observing the teaching staff taking cores.	A series of freely available online resources linked here can be used to replicate the process within an online lecture/ tutorial or practical. Taking a core: https://www.youtube.com/watch?v=GZ3NIESSk40 (short video) https://www.geomorphology.org.uk/sites/default/files/geom_tech_chapters/4.1.1_Coring.pdf (online book chapter) https://www.youtube.com/watch?v=xZRmdr6-9tw This video is a step-by-step guide to splitting and recording a lake sediment core.	There are many other options that include examples of specific equipment (e.g. using a Russian-corer) or looking at specific environments (e.g. ice coring in Antarctica or in a saltmarsh). Resources linked via ViPs collated resources.

(*Continued*)

Table 1. (Continued).

Step	Objective	Learning outcomes	"In-person" format	Online alternative	Comment
2. Sediment dating	To demonstrate understanding of the principles of radioactive decay and its application to dating materials	1. To measure the radioactive decay of Barium-137 and calculate its half-life 2. To examine the half-life of ^{14}C and ^{238}U 3. To estimate the date of materials 4. To summarise the methodology for radiocarbon analyses	This material would usually be delivered via lecture and possibly computer practical sessions	Series of online materials include: https://www.youtube.com/user/JeffersonLab/search?query=half+life A series of YouTube videos to enable students to perform a half-life experiment. https://phet.colorado.edu/sims/cheerpj/nuclear-physics/latest/nuclear-physics.html?simulation=radioactive-dating-game Video showing the half-life of ^{14}C and ^{238}U https://phet.colorado.edu/sims/cheerpj/nuclear-physics/latest/nuclear-physics.html?simulation=radioactive-dating-game Game that shows how to estimate the date of materials. https://www.youtube.com/watch?v=-xKvq6VLe4s Video summarising the methodology of radiocarbon analysis.	There are many different resources available on this general topic area, many more are linked on the ViPs resources page.

(*Continued*)

Table 1. (Continued).

Step	Objective	Learning outcomes	"In-person" format	Online alternative	Comment
3. Pollen analysis	To demonstrate understanding of the importance of pollen to palaeo-environmental sciences	1. To describe the importance of pollen in reconstructing past environments 2. To examine how to make pollen slides 3. To examine how to identify and count pollen 4. To convert pollen data into a pollen diagram	This would often be done via a practical session or sessions where students are introduced to the topic and then either make their own slides or work through existing pollen slides to make counts. They then would usually be required to make a pollen diagram (sometimes via a separate computer session)	Online resources include the following: https://www.youtube.com/watch?v=XcRn7ATJD2M An introductory talk on fossil pollen analysis that is clearly linked to a research paper https://www.youtube.com/watch?v=kv228XD8nYk A video showing the journey from field sampling to microscope analysis https://www.staff.ncl.ac.uk/stephen.juggins/eSlide/GEO2136/eSlide.html CoPol provides an open access and interactive pollen identification and counting environment. https://www.benjaminbell.co.uk/2018/02/pollen-diagrams-in-r-using-rioja-part-1.html How to use R to create pollen diagrams	There are many resources available online to aid in the construction of a pollen-identification or pollen counting practical session.

workshops and the more frequent coffee seminar meetings, also supported confidence building.

ViPs seek to both be inclusive for palaeoscience practitioners and improve inclusivity for students encountering the palaeosciences within their HE studies. Technical staff, researchers who interact with students only occasionally, and palaeoscientists working outside of academia all have valuable contributions to make, and have been important contributors to ViPs. For example, one gap identified early on was the absence of a good video about standard pollen sample preparation, and a technical colleague who had access to laboratories in order to do some urgent sample preparation during the crisis was able to make a video that was then shared across the community.

The future of ViPs post pandemic

ViPs were initially set up to support the teaching of palaeosciences during the pandemic; however, the project also has medium to long-term goals that go beyond crisis teaching. ViPs aim to become a "hub" for palaeoscience teaching resources, development and support. Therefore, the development of the ViPs website is a current goal and includes adding community pages to enhance interaction with users, creating a better search interface for accessing the resources (currently collected in a spreadsheet) and compiling topic narrative pages that link existing materials in ways that make them accessible to independent learners. Having compiled an initial collection of existing resources, we have identified gaps in provision, and the "Creation" and "Expert Talk" working groups are focussed on catalysing the creation of OERs in those areas. As the list of existing resources grows, the project is beginning to identify gaps in what is available and creating resources to fill those gaps.

While some face-to-face teaching has returned in the academic year 2021–2022 (in the UK at least), the benefits of online elements have become clear to students and educators alike. It is anticipated that following the pandemic, HE will increasingly shift towards a blended delivery (Witze, 2020). Even in strongly hands-on subjects, greater use of OERs to help students get the most out of practical activities and expand the range of content students can access beyond what is possible or accessible in their institutional setting will enhance the quality and inclusivity of palaeoscience education. By making it easier to find and select from palaeosciences OERs, ViPs will (1) provide a range of digital resources that can be used as supplementary material within a blended learning environment and enable the flexible, inclusive and accessible consumption of previous field- and lab-based activities (e.g. Bean et al., 2011; Rogers et al., 2021; Sancho et al., 2006) (2) support educators in working to overcome existing barriers to field and laboratory work (Giles et al., 2020); (3) offer viable alternatives where traditional modes of delivery are not accessible (Green et al., 2020); (4) increase opportunities for students to explore the breadth of the subject regardless of institution; and (5) offer students and educators more choice in how they engage in the teaching and learning of their subjects (Harris et al., 2020).

Following the success of bringing the palaeosciences community together to discuss and support teaching and learning, a key aim of ViPs is to continue this community-minded approach to teaching development. Sharing of resources in UK HE is complex with fears over copyright (Yuan et al., 2008) and possible concerns over job security and

negative peer-review. Interestingly, this contrasts with the resource sharing common across primary and secondary education sectors (e.g. TES, 2021). ViPs hope to overcome existing challenges through careful attribution of the materials being developed in addition to working together to build resources and confidence. Having a platform and mechanism to share resources is perhaps the first step in overcoming some of these barriers. This cultural change will enable the community to support one another in the long term as well as train palaeoscience educators of the future.

Beyond website development and community support, future priorities for ViPs will be set and driven by the community. Individual projects, like the eSlide virtual microscopy practical, will develop under the banner of ViPs out of the interests, needs and abilities of the community members, and the scale of projects will vary with availability of person-hours and of contributions from the wider community. With ViPs providing a platform for pedagogic palaeosciences discussions, it is hoped that the sharing of ideas, resources and skills will enable exciting and innovative projects to emerge that expand on the resources already identified and available.

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Disclosure statement

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