

PHYSICAL GEOGRAPHY: CONSTRUCTS AND QUESTIONS RELATING TO CURRICULUM AND PEDAGOGY

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ABSTRACT:

A series of questions are raised to prompt examination of the role and place of physical geography in the school curriculum and its relationship with science; consequently challenging teachers to consider the implications for their pedagogy. An examination of physical geography knowledge illustrates how it is constructed with a plurality of meanings, and a framework for interpreting different meanings and approaches is offered followed by critical discussion of the dominant discourses and teaching approaches adopted in schools. Contexts have played an important role in influencing how physical geography has been taught in schools and the paper discusses the merits of recent trends towards teaching physical geography via issues-based or social contexts, where physical topics are explored for social relevance rather than understanding of the physical processes and drivers. Evidence for and against this approach is outlined and questions raised about whether integrated and applied approaches to teaching physical geography dilute the quality and emphasis of learning and understanding. It is suggested that physical geography, as taught in schools, may need to catch up by adopting a less 'fixist' view of the physical world, by which teachers develop a curriculum and pedagogies more appropriately matched to contemporary understandings of physical geography, so enabling students to develop as more informed, critical thinkers when considering the physical world.

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KEY WORDS:

Physical geography, schools, curriculum, pedagogy, knowledge, questions, debate.

RÉSUMÉ:

Une série de questions sont soulevées pour inciter examen du rôle et la place de la géographie physique dans les programmes scolaires et de sa relation avec la science ; offrant donc un défi pour les enseignants d'examiner les implications de leur enseignement. Un examen de connaissance de la géographie physique illustre comment il est construit avec une pluralité de significations, et un cadre pour l'interprétation des significations différentes et des approches est proposé suivi d'une discussion critique du discours dominant et les approches pédagogiques adoptés dans les écoles. Les contextes ont joué un rôle important en influençant la façon dont la géographie physique a été enseigné dans les écoles et le papier discute les mérites de l'évolution récente vers l'enseignement de la géographie physique via des contextes axés sur les enjeux ou sociale, où les sujets physiques sont explorées pour la pertinence sociale plutôt que la compréhension de la processus physiques et les pilotes. La preuve pour et contre cette approche est exposée et les questions soulevées si les approches intégrées et appliquées à l'enseignement de géographie physique pour diluer la qualité et l'importance d'apprentissage et compréhension.

Il est suggéré que la géographie physique, qui est enseigné dans les écoles, peut-être besoin de se rattraper en adoptant une vision moins de 'fixiste' du monde physique, par lequel les professeurs développent un programme d'études et des pédagogies plus convenablement adaptées aux accords contemporains de la géographie physique, permettre aux étudiants de se développer comme des penseurs critiques plus informés critique quand nous considérons le monde physique.

MOTS-CLÉS:

Géographie physique, écoles, programme d'études, pédagogie, connaissance, questions, débat.

RESUMEN:

Se analizan una serie de cuestiones en torno al papel y lugar de la Geografía Física en el currículum escolar y su relación con la ciencia, retando a los profesores consecuentemente a considerar estas implicaciones en su pedagogía. Un examen del conocimiento de la Geografía Física ilustra como se construye a partir de una pluralidad de significados, y se ofrece un marco de referencia para interpretar los diferentes conceptos y perspectivas, seguido por una reflexión crítica sobre los discursos y aproximaciones docentes dominantes en las escuelas. Los contextos han desarrollado un importante papel influyendo en cómo la Geografía Física ha sido enseñada en la escuela

y este artículo muestra las ventajas de recientes tendencias hacia una enseñanza de la Geografía Física mediante contextos sociales, donde se exploran los temas físicos de relevancia social más que el mero entendimiento de los procesos físicos y sus fuerzas conformantes. Se destacan evidencias a favor y en contra de dicha aproximación y se reflexiona en torno a si las perspectivas integradas o aplicadas merman la calidad y énfasis del aprendizaje y la comprensión. Se sugiere que la Geografía Física, tal como se enseña en las escuelas, necesitaría actualizarse adoptando un punto de vista menos estático del mundo físico, donde los profesores desarrollen un curriculum y pedagogía más ligadas al entendimiento actual de la Geografía Física, fomentando en los estudiantes un pensamiento mejor informado y más crítico a la hora de considerar el mundo físico.

PALABRAS CLAVE:

Geografía Física, escuelas, curriculum, pedagogía, conocimiento, cuestiones, debate.

1. INTRODUCTION

“One area where more content would be appreciated was Physical Geography. This was because it was felt that gaining a geographer’s understanding of, say, how Hurricane Katrina affected America, requires a clear understanding not just of the social effects but how the physical surroundings contributed to those social effects. Physical Geography was also felt to develop important scientific skills, which can be underdeveloped if an A level student focuses primarily on Human Geography.” (Higton et al 2012, p.60).

The state of physical geography within the curriculum has been a matter of some concern and flux in the over the last quarter of a century, with mixed and changing views on the nature, purpose, and approaches to teaching physical geography in schools. For example, in 2008, when revisions to the curriculum and examination specifications in England were about to be published a topic thread on a popular internet forum for geography teachers asked ‘Will students know less about physical processes?’ (SLN Geography Forum, 2008). Such concerns have also been expressed in recent reviews commissioned by government that highlight concerns issues over the content and quality of physical geography being taught (Higton et al., 2012; Ofqual, 2012). In essence, these discussions and concerns centre on the place, role and impact of physical geography in a 21st century (geography) school education.

This paper challenges teachers to consider the nature of physical geography within geography and the school geography curriculum; its relationship with other subjects with which it shares content and contexts of study. It sets out to explore what types of knowledges (ways of seeing, doing and understanding) exist within physical geography as a discipline, how these are constructed and produced and how they have influenced, and continue to dominate discourse, thinking and approaches to physical geography in

the curriculum and its teaching in schools. The ensuing analysis raises critical questions on the implications for teachers' decisions relating to curriculum and pedagogy. The challenges are examined through a series of five key questions:

1. what is physical geography and can it be defined by the subject matter?;
2. should aspects of physical geography be part of the science curriculum?;
3. what counts as 'knowledge' in physical geography?;
4. should physical geography always be taught within a social/environmental issues context?;
5. so is there less physical geography taught now taught in schools, or does it take a different form compared to former times?

The questions (and accompanying discussions) are intended to provoke debate and dialogue amongst teachers - on a personal level and in collaboration with colleagues. As such, some of the questions, ideas and evidence presented here may resonate with personal philosophies and practices, but others may well present 'uncomfortable' notions and so help teachers to clarify, justify or re-think what they teach and how they teach physical geography. Many of the issues tackled here are potentially lengthy and complex, so necessarily a paper like this can only start the debate and it is the teacher's responsibility to probe further into the ideas and evidence outlined here.

2. QUESTION ONE: WHAT IS PHYSICAL GEOGRAPHY AND CAN IT BE DEFINED BY THE SUBJECT MATTER?

The answer to the question may seem self-evident and in need of no further discussion, but to what extent are our notions of physical geography in agreement? How do we conceive physical geography? Frequently, geographers and geography teachers claim their sub-identities as 'physical' or 'human' geographers (Barratt-Hacking, 1996).

Roger Trend (1995) noted the perception of a simplistic model of school geography, which comprises discrete physical and human elements, is common and often pervasive. The issue is not new. Ron Johnston (1986) asserted that physical and human geography diverged (in the 1960s) because they deal with fundamentally different subject matter and find their inspirations from different bodies of knowledge. I mention this dichotomy not to pass any value judgment on self-identified 'types' of geographers; everyone has personal preferences and enthusiasms, but to raise questions about the implications this might have for what geography is taught in schools. Physical geography is a complex blend of various sub-disciplines, shifting emphases and methodologies that in recent years, at university level, has been increasingly positioned within larger units of environmental or Earth sciences (Matthews & Herbert, 2004; Pitman, 2004), making a comprehensive definition

difficult (Tadaki et al., 2012). However, Gregory (2000) attempts this, by exploring what and how physical geographers study, think and do and offering a synopsis of future trends in his book 'The Changing Nature of Physical Geography', to arrive at a working definition (Gregory, 2000, p. 288). Trend (2008) provides a simple and brief summary definition of physical geography, regarding it "as dealing with all the non-human processes and features which occur on or near the Earth's surface." This is a wide remit and offers a 'traditional' view of physical geography with which most geography teachers would probably agree.

However, these definitions are not unproblematic, as they overlap with other cognate disciplines and subjects taught in schools and universities. The study of ecosystems is (naturally) part of the biological sciences; studies of earthquakes, volcanoes and tectonics form fundamental aspects of study in geology, which draws on strong connecting roots in physics and chemistry; climatology and weather are allied with physics. These rooted links prompts Gregory to ask 'Is the position of physical geography within geography as a whole appropriate?' (Gregory, 2000, p. 22). Collectively, these are the Earth sciences and this content overlap provokes debate about in which school subject Earth science content should be situated.

3. QUESTION TWO: SHOULD ASPECTS OF PHYSICAL GEOGRAPHY BE PART OF THE SCIENCE CURRICULUM?

The debate about what and where content relating to the physical aspects of the Earth should be taught is not new. Different nations situate the Earth sciences in different curriculum subject locations and a recent international survey shows that there is a variable and uneven distribution to approaches to the teaching of Earth science in schools (King, 2013). Some nations have interpreted the physical/human 'divide' as meaning that school geography curriculum should be placed clearly within human geography, usually within a social studies or humanities context. This raises the question of whether geography can properly exist without regard to physical geography and consideration of natural landscapes (a question too big to be tackled directly here), but if physical geography (in whatever form) is essential to geographical study, then how might any curriculum 'overlap' be resolved?

One 'solution' might be illustrated via examination of the development and revisions of the national curriculum of England. During its inception and early years of establishment, 'territorial' claims and counter-claims were made for what aspects of Earth science should be part of the science curriculum and which should be taught in geography (Wilson, 1990; Trend, 1995; Hawley, 1997). Despite a gradual 'slimming' process to the national curriculum over subsequent years, key aspects relating to physical geography remained in the geography curriculum but the study of rock types, the rock cycle and plate tectonics was also in the science programmes of study (DES/QCA 2004).

Between 2011 and 2013 a major review the national curriculum was established, with a remit that children should acquire a core of ‘essential knowledge’ in the key subject disciplines and a main aim for the curriculum was to ‘create coherence in what is taught in schools’, thus implying that any duplication in subject content would not be acceptable (DfE, 2012). The ‘dilemma’ this placed on the position of Earth science in the curriculum is evident in the generic label given to this aspect of understanding the planet. Earth is ‘naturally’ seen as the study domain of geography but a claim is also made by the some in the science education community for science being the rightful place to teach this aspect.

Concerned about possible repetition in teaching Earth science, the government Department for Education asked for a meeting to be arranged with all ‘stakeholders’ in order to collate views about the place of Earth science in a revised curriculum. Interested parties included the Geological Society, the Earth Science Teachers’ Association, the Geographical Association and the Royal Geographical Society, who all advocated different positions.

The Earth Science Teachers’ Association adopted a stance in line with an analysis by King (2011) which argues that in countries where Earth science is a significant and distinct part of the science curriculum and is taught by teachers who are Earth science specialists, the students outperform students from the U.K. and elsewhere where Earth science is not so strongly demarcated. Consequently, they considered that Earth science should predominantly be taught via the science curriculum with emphasis on training science teachers in Earth science knowledge and pedagogies to improve the quality of their teaching.

The Royal Geographical Society’ starting point was that the status and teaching of physical geography had been eroded in recent years, particularly in terms of processes (and the underpinning principles), which could be redressed by returning the main focus of Earth science to the geography curriculum.

The Geological Society’s position was to prefer an interdisciplinary approach, suggesting the need for a well designed curriculum that helps students appreciate the interconnectedness of what they learn at school with the Earth providing a unifying context rather than seeing Earth science a fixed rigidly within disciplines.

The Geographical Association developed a similar position, arguing for a complementary approach to understanding the physical aspects of the Earth. They claimed physical geography ‘naturally’ sets the study of earth processes in real world contexts that aids the capacity for interpretation and meaning, for understanding the moral and ethical implications and their application and usefulness. Their position outlined a process of using observation, location, interpretive models and a process of enquiry validation to help explain and predict the behaviour and distribution of earth’s physical features, phenomena and environments, often with a view to suggesting how these might be best managed for human use or for suggesting responses that might

reduce potentially harmful impacts on human communities. They distinguished this emphasis from a concept of ‘deep’ Earth science, which they claim focuses on the investigation and explanation of the chemical and physical properties of the earth, such as the composition and viscosity of magmas or the mechanics of seismic waves, and argued these are best developed in the context of science lessons. However, they also suggested a full understanding of the geographical perspectives of Earth science needs to draw on the concepts and principles developed in ‘deep’ Earth science. Their position concluded by stating that, if harnessed in an appropriate way, the commonalities of earth science in physical geography and ‘deep’ earth science do not duplicate learning but are complementary, and both perspectives are advantageous and essential for effective learning about the Earth, its systems and how people respond to its environments.

The idea of ‘deep earth science’ playing a part in understanding physical geography has become widely practiced in higher education in recent years through interdisciplinary collaborative work that seeks to find new ways of understanding environmental issues. As Urban and Rhoades (2003) state: “Physical geography draws on knowledge of a wide range of ancillary disciplines including physics, chemistry and biology – so it is a composite science and is dependent on theoretical knowledge drawn from other natural sciences”. Earth System Science is similarly aimed at creating a (holistic) synthesis of disciplines, but which emphasizes a scientific process-oriented approach. Pitman (2003) argues that Earth System science is geography, but Kent (2009) maintains that in recent years physical geography has tended to overemphasize the importance of process and hence function and explanation at the expense of pattern, the spatial approach and characterization of place. This shift in the starting point and focus of study in physical geography promote a more distinctive perspective on the physical world that, whilst overlapping, is different from that offered by other more conventional sciences and which is less diluted in global modeling approaches such as Earth System Science (Inkpen, 2009; Gregory, 2009). Gerard (1988) considered this important, suggesting that the viability is created through distinguishing the type of questions different subject (disciplines) ask, especially so in situations where it is extremely difficult to give a rigorous definition of the subject.

The curriculum ‘stakeholder’ meeting promoted a successful collaborative venture to create a curriculum ‘map’ of key ideas outlining how Earth science concepts can be rationally divided between geography and science and identifying a progression suitable for different ages (Table 1.) Subsequent representation to the government curriculum review panel resulted in the published proposals following much of the outlined recommendations, Consequently the debate became less about ‘territory’ without, and more about the nature of physical geography within the subject curriculum, particularly in relation to what should be taught to progressively higher age groups.

<p>Fieldwork Observation and description of what is around you.</p>	<p>Fieldwork Observe and record local fossils and rock types.</p>	<p>Lab/fieldwork Observe, record and experiment to test hypotheses about past processes and environments.</p>	<p>Observation of the present and evidence about past processes and environments can be used to model future change.</p>
<p>Rocks: Sorting and grouping rocks based on physical properties.</p>	<p>Fossils are a record of past life forms and the extinction of life forms that no longer exist.</p>	<p>Life has evolved over billions of years – the fossil record informs our understanding of past environments and the development of life and the planet.</p>	<p>Life has evolved over billions of years and continuously modifies Earth systems.</p>
<p>KS1 - The world is made up of what you see around you</p>	<p>Identification and classification of sedimentary, igneous and metamorphic rock types based on key lithological characteristics of grains.</p>	<p>The Rock Cycle – formation and cycling of igneous, metamorphic and sedimentary rock by Earth processes</p>	<p>Earth and its atmosphere consist of dynamic and complex interacting systems of rock, water, ice, air and life; feedbacks operate, and energy and mass are cycled</p>
<p>Landscapes and Environments: identifying key landforms, soil, vegetation, water bodies and weather.</p>	<p>Formation of soils and their resultant properties.</p>	<p>the age of rocks at the Earth's surface can be determined by their pattern of distribution and radiometric dating.</p>	<p>Greenhouse effect - composition of the atmosphere controls the balance of incoming and outgoing energy, and hence the temperature of the planet</p>
<p>Fieldwork Observation of what is around you.</p>	<p>Solar system – Sun, Moon and Earth and their effects – light, heat and seasons, night and day.</p>	<p>Formation of the solar system and of the Earth; evolution of atmosphere, oceans and solid Earth</p>	<p>The carbon cycle – fossil fuels, limestone etc as sinks which lock away atmospheric carbon, which is rapidly released when fuels are burnt.</p>
<p>KS2 - Natural processes shape the Earth and its surface</p>	<p>World climate zones and distribution and characteristics of major ecosystems.</p>	<p>Climate has varied through Earth history and continues to do so.</p>	<p>Global distribution of mineral resources depends on past geological processes.</p>
<p>KS3 - The Earth, its environments and landscapes change and evolve over time</p>	<p>The world's major physical features – locations, patterns, characteristics and scale; continents, oceans and currents, mountain chains, river basins and hot and cold deserts.</p>	<p>KS3 - The Earth, its environments and landscapes change and evolve over time</p>	<p>Plate tectonics as a unifying theory caused by mantle convection</p>
<p>KS4 - The world is made up of what you see around you</p>	<p>KS4 - The world is made up of what you see around you</p>	<p>Weather systems, climate zones and ocean currents; their properties, processes and patterns.</p>	<p>Plate tectonics has shaped the continents, ocean circulation and climate, and the development of landforms and active geological processes at plate margins.</p>
<p>KS4 - The world is made up of what you see around you</p>	<p>The water cycle: major phases and flows; atmosphere to surface and sub-surface, surface to lakes/oceans, oceans/lakes to atmosphere.</p>	<p>People-Environment interactions</p>	<p>Plate tectonics has shaped the continents, ocean circulation and climate, and the development of landforms and active geological processes at plate margins.</p>
<p>KS4 - The world is made up of what you see around you</p>	<p>The UK: Climate and weather patterns; types of landscapes.</p>	<p>Humans depend on resources provided by the environment</p>	<p>Plate tectonics has shaped the continents, ocean circulation and climate, and the development of landforms and active geological processes at plate margins.</p>
<p>KS4 - The world is made up of what you see around you</p>	<p>Fieldwork Observe and record local landscapes and weather.</p>	<p>Humans are affected by natural hazards.</p>	<p>Plate tectonics has shaped the continents, ocean circulation and climate, and the development of landforms and active geological processes at plate margins.</p>
<p>KS4 - The world is made up of what you see around you</p>	<p>Fieldwork Observe and record local landscapes and weather.</p>	<p>Fieldwork - Observe, map, measure, analyse and interpret UK landscapes/surface processes.</p>	<p>Plate tectonics has shaped the continents, ocean circulation and climate, and the development of landforms and active geological processes at plate margins.</p>
<p>KS4 - The world is made up of what you see around you</p>	<p>Fieldwork Observe and record local landscapes and weather.</p>	<p>Fieldwork - Observe, map, measure, analyse and interpret UK landscapes/surface processes.</p>	<p>Plate tectonics has shaped the continents, ocean circulation and climate, and the development of landforms and active geological processes at plate margins.</p>

Key Stage 1 = 5-7 year old students, Key Stage 2 = 7-11 year old students, Key Stage 4 = 11-14 year old students, Key Stage 4 = 14-16 year old students).

TABLE 1. A curriculum map of earth science and physical geography, based a document produced jointly by The Geographical Association, The Geological Society, The Earth Science Teachers' Association, The Royal Geographical Society and The Royal Meteorological Society submitted to assist with the review of the National Curriculum for England (December 2011).

4. QUESTION THREE: WHAT COUNTS AS 'KNOWLEDGE' IN PHYSICAL GEOGRAPHY?

As a classroom teacher in the 1980s I can relate to John Morgan's (2006) account of his experience of physical geography as a student at school, telling how there was a lot of teaching about hydrology, drainage basins and catchments which involved quantification, measuring correlations between stream order and other variables and this was symptomatic of physical geography thereby studying glaciers as a 'system' and coasts as 'process studies'. He (rightly) suggests this approach was aimed at students learning to experience how geographers practiced the subject, but critiques it as an inculcation into one particular type of knowledge that breaks the world down into discrete parts studied in their own right. The processes were small-scale, the focus was on the data and number crunching rather than seeing how the river formed part of the wider landscape. What was portrayed as a neutral and objective scientific approach is only one way of constructing meaning about the river, which is built on assumptions. Newson (1997) illustrates this construction of different meanings with an anecdote based on a conversation with a Lake District farmer in which the farmer decried the river specialists who came to offer him advice on how to prevent flooding: "I wish the bloody boffins (experts) would come here in a spate and watch how this beck (stream) eats my land; they'd not waste money making it deeper then - it's deep water what drowns sheep."

Morgan suggests that if teachers are aware of types of knowledge (and how these are produced) they are more likely to be able to give a considered answer to what it is they want students to learn. It raises questions about the process of how we teach physical geography and what meaning students likely to derive from what they are being taught. Morgan is not alone, debate about the meaning of 'scientific' knowledge and method in physical geography is alive in academic physical geography (Trudgill & Roy, 2003). How is physical geography portrayed through teaching, is it taught as 'the truth' or explored as different forms of 'truth' (Inkpen, 2005) and different layers in constructs of meaning? (Trudgill, 2003).

A useful framework for this discussion can be drawn from a set of stories to be told about landscapes (Huggett & Perkins, 2004; Bloomer & Atherton, 2006), adapted to physical geography and how it can be 'read' in ways that produce different knowledges, each occupying a different place in constructs of meaning. These knowledges create physical worlds that are (i) machine and system driven by processes, (ii) text - constructed through heuristic and swayed by paradigm (see Kennedy 2006), (iii) palimpsest - where understanding the current 'layer' is contingent, e.g. river landforms in the British landscape can only be fully understood by reference to the last glacial period, (iv) providers for taste and value - aesthetic value and/or spiritual/recreational nourishment e.g. the picturesque or special designation as a conservation area, (v) drivers of social and political process e.g. hazard geography.

The dominant type of knowledge experienced in school physical geography tends to be that of machine and system driven by process (Lambert & Morgan, 2010, p.138), portraying physical geography as determining the way nature works in geography through a set of stable, 'fixed' processes where facts fit together in a given way according to 'laws' i.e. a positivist perspective. It is manifest through pre-determined models presented in the classroom through descriptions, diagrams and definitions and/or in the classic hypothesis-testing approach. At one level, this knowledge as a system can convince of rational explanation and is intellectually seductive (Harrison, 2009). However, it can also lead to belief in an outdated machine that doesn't match with a dynamic understanding of nature, leading teachers passively to depict a machine that doesn't exist. It can encourage students to learn the model and slot the components in even if they don't fit, the so-called 'tyranny of models' (Trudgill, 2003).

Academic understanding of physical geography has shifted from this empirical and 'rigid' world to acknowledge 'simplicity' doesn't exist and the real world is more 'naughty', complex, approximate and our perceptions of it are socially constructed (Kennedy, 1979; Tadiki et al., 2012). There is no objective 'truth' but there are better approximations to the truth (Inkpen, 2005). This philosophy has more in common with the pluralities of knowledges outlined above. In 'knowledge as text', the information isn't just 'out there' but is constructed or created in specific contexts for particular purposes. In this sense, physical geography should be exploratory as well as explanatory as it can be created in different ways through prior experience or constructs (interpretative frameworks) offered by teachers that help to stimulate seeing the world in new ways (Trudgill, 2003).

So are paradigms useful in teaching physical geography or can learning be swayed by paradigms? When a construct is over-simplified, out-dated, offered as the sole explanatory model, as though no understanding about the physical world existed previously and without critical evaluation, it can obfuscate rather than clarify. For example, according to popular textbooks the 'recipe' to create a waterfall is simple. Take bands of 'hard' and 'soft' rock, erode the soft rock carefully for a period of time until the hard rock is undercut, the hard rock collapses, a plunge pool is created and the waterfall will retreat to form a gorge. While such happy endings make us feel comfortable, they are not always the most helpful outcome as they do not encourage examination of the range and complexity of processes that could have produced the same outcome. In this case: glacial action to produce a hanging valley, isostatic uplift and faulting are all other processes which might create a waterfall; and, in focussing on the seductive detail of one story, it misses the more significant meaning, beyond description - that waterfalls tell us something about changes in base level and the volatility of the Earth's past.

Accounts of the 'one size fits all' model can be temptingly found in many aspects of physical geography, especially in textbooks. However, when teachers only consider

a limited number of the facts in order to fit the theory we teach (and tell the story), it results in a lesser rather than a better approximation of the 'truth'; and, usually, the lesser approximation does a disservice to students, as they make sense of the world in a less powerful way and the understanding they develop has less power to explain and make sense of novel situations. If the paradigms taught in school are not explored, it can make it difficult for students to distinguish 'trend' (nearer the truth) from the 'noise' (exceptions that don't fit) in the real world. This can be dangerous as it can lead people to believe things that are not helpful (as recent and on-going debates on climate change indicate). Atherton (2009) suggests students develop skills of acceptance rather than enquiry, but in reality the world is riddled with uncertainty so students should be taught to deal with ambiguities, and a constructivist approach is more appropriate to physical geography teaching. Trend (2009) and Morgan, A. (2006) advocate the use of argumentation as a pedagogic approach to empower students with a more critical understanding of the world's natural systems and there is a role for introducing the history of ideas into teaching (such as the development of glacial theory and the interpretation of associated landforms) using 'original' evidence), thus creating opportunities for students to argue, debate and re-create the intellectual struggles that brought about our current constructs and frameworks of understanding of the physical world.

5. QUESTION FOUR: SHOULD PHYSICAL GEOGRAPHY ALWAYS BE TAUGHT WITHIN A SOCIAL/ENVIRONMENTAL ISSUES CONTEXT?

Curriculum-making has become a prominent professional development focus for geography teachers in recent years as it is realized that potentially different geographies and the learning derived in lessons stem from how a teacher selects geographical content. The debate revolves around how teachers can be enabled to become (critically) active in formulating lesson content (Morgan, 2006). Questions about the curriculum-making of (school) physical geography have existed for some time. In England, David Pepper was, perhaps, the first to resonate with his article 'Why teach physical geography?' (Pepper, 1985), in which he railed against what he saw as the predominant mode of school physical geography at that time (driven by public examination syllabus content), arguing it didn't allow students (and teachers) to set knowledge within the context of human society and problems. He thus claimed the physical environment was seen as a system entirely separated from society.

Twenty years on, Clare Brooks (2006) questioned the types of geographical knowledge represented in the classroom, illustrated by reference to three lessons. One of these related to 'solving acid rain', in which the main aim was 'to identify the causes and effects of acid rain' by looking at the environmental impacts (in Europe and Canada) and identifying some of the ways they can be managed. From this, it might be assumed this

lesson goes some way to satisfying Pepper's need for 'relevance' in placing the acid rain problem in a social context. However, Brooks comments that whilst the lesson tasks and activities allowed students to gain knowledge about the physical processes and impacts of acid rain, the teacher didn't draw attention to the borderless nature of acid rain and how this could result in different 'solutions' dependent which side of a geo-political border you happen to live. Her question is over the knowledge made by the teacher, which presented as a simple understanding of cause, effect and symptoms based on the physical process would likely leave students thinking the solution to acid rain is a simple issue rather than one that cannot be easily resolved. The argument Brooks advances is that knowledge and understanding of physical processes is not sufficient without these being referenced in the wider geographical (social) context, even if they appear to be set within the frame of an 'environmental issue'.

What lies at issue here is the previously noted prevailing divide between human and physical geography in schools, even though the intention is for the context to create integration. Over the last two decades there has been a substantial debate amongst academic geographers about the nature and this gap and how there are productive ways to narrow it and unify geography (Matthews & Herbert, 2004) but at school level this issue has been dealt with simplistically, often by creating 'applied problem-solving' tasks rather than teasing out the complexities of a holistic approach that involves people's perspectives on the physical environment (Newson, 1992; Tadiki et al., 2012). David Pepper would probably still be dissatisfied.

6. QUESTION FIVE: SO IS THERE LESS PHYSICAL GEOGRAPHY TAUGHT NOW TAUGHT IN SCHOOLS, OR DOES IT TAKE A DIFFERENT FORM COMPARED TO FORMER TIMES?

Rachel Atherton (2009) suggests that new ideas in physical geography only trickle through to schools and into the curriculum when it appears that they pass through a test for 'how does this apply to humans?' which aims to ensure relevancy of the content to young people. Atherton gives the example of tackling sea level rise from the point of view of its impacts rather than studying the underlying scientific processes. In this approach, the processes are supplementary and only introduced to further the understanding of the component of human impact. However, Gregory contests this approach stating "the greater tendency at pre-university level to focus on the impact of human activity and upon management of the environment, with much less, if any, emphasis on the mechanics and principles of landscape development, is rather like putting the cart before the horse. It is very difficult later to take up the study of the horse when all the emphasis has been placed upon the cart!" (2000, p.109). Gray (2009) agrees, stating that despite

our dominantly ego-centric view of the world physical form is largely untouched and remains essentially natural over large parts of the world. The physical layer (land forms materials and processes) provides the foundation for super-posed biological and cultural layers that make up the landscape, so landforms and their character need to be studied in their own right before being able to make sense of and develop a full appreciation of the other layers in understanding the character of landscapes their management and restoration.

Atherton further suggests that the teaching and delivery of many physical geography topics in school tends to rely on extreme simplification of complex topics, especially at Key stage 3 due to students' level of intellectual capacity and lack of time to explore the concepts in any depth (Atherton, 2009). This raises a question about the extent to which placing the teaching of physical geography in a 'social context' teaching leads to superficial approaches in understanding of way the natural world works and/or develops misconceptions, which somehow diminishes a key aim of the social context approach of enabling and empowering individuals to participate in decisions and actions affecting the physical world in an informed way.

An underlying assumption of Atherton's 'applicability test' is that relevance is recognized by students as being something worthwhile and so becomes of interest. Decisions about the context of teaching are usually made by teachers, with little regard for students' views, which begs the question of whether students prefer physical geography being taught within a social (issues-based/integrated) context or as a branch of geography in its own place? Referring to Earth science in mass popular culture, Iain Stewart asserts that social contexts are interesting but it is the awe and wonder that captivates and inspires, stating "that modern Earth science is ripe for public consumption but ironically, this ripeness stems less from 'pressing social relevance' than from an inherent sense of narrative" (Stewart, 2012).

There are few studies that have looked into physical geography as a focus of students' interest (Trend, 2009) but in researching interest in geosciences Trend (2005, p.271) found "Girls have a preference for phenomena perceived as aesthetically pleasing and boys have a preference for the extreme and catastrophic". Hopwood (2006) researched the responses of students to their experiences of physical geography and their conceptions of the people-environment theme. He discovered different understandings and not all were persuaded by the 'social context' despite being acknowledged as part of geography. He reports "evidence suggests equally if not more strongly that physical phenomena *per se* interest Matt, and his desire to study them reflects a fascination with the physical world and how it works rather than an ultimately social concern" (p. 5). Perhaps physical geography always passed through the 'applicability test' risks negating the spiritual and intellectual stimulation (the awe and wonder) to find

out about the natural world. As Hopwood asks, “Are we in danger of losing sight of education about the environment?” (p. 5).

Concerns about the ‘weakening’ of physical geography in the school curriculum have surfaced periodically. These began to appear in the 1980s following the rise of humanistic geography and as the environment emerged as an important focus of political concern leading to a drift toward “concentrating attention on human geography in the school curriculum”, which was perceived as a potentially damaging neglect of the physical environment (Mottershead, 1987). For a number of geographers the people-environment framework did not provide the rigour required to give proper attention to physical process (Adamczyk et al., 1994) giving some academic physical geographers some concerns over whether appropriate and up-to-date knowledge and ideas are being taught in schools (Keylock, 2006; Knight, 2007).

Inman (2006) suggests that physical geography in higher education has enjoyed significant development and attention in recent years. However, these have not been matched by innovations in physical geography pedagogies in schools, which Inman considers have been neglected in the development of the ‘thinking skills’ curriculum. He suggests that, despite physical geography continuing to feature in GCSE and A level specifications, there is evidence of poor understanding and lack of confidence and motivation with regard to physical geography, resulting in students not having the foundation needed to move to higher education. This a concern voiced also voiced by academics in physical geography as Keylock comments: “The lack of sufficient scientific grounding at A-level means that we may serve the interests of our students better by telling them that if they wish to succeed in a physical geography degree, they should pursue maths, physics, chemistry or biology instead of geography, at least in their A2 year” (Keylock, 2006, p. 272).

So, a key debate is centered on the extent to which physical geography set within a social context or a people-environment issues-based approach weakens or strengthens engagement with and understanding of the natural world, together with its attendant effect on potential participation in appropriate environmental decision-making. This diverts us back to the opening question raised by the internet forum contributors mentioned in the introduction, ‘Will students know less about physical processes?’, and we are impelled into considering the pedagogical implications.

7. CONCLUSION

This exploration of the role and place of physical geography has clearly identified that school geography could not exist without due consideration of the physical world; the interdependence between the physical and cultural and social worlds, in a range of

direct and indirect ways, is too strong to be dismissed. However, the physical world is wide-ranging, complex and dynamic. The content matter of physical geography lies within a collective of scientific disciplines called Earth sciences, but our current understanding shows that there is value in a geographical dimension brought to a 'hard science'-driven systems approach (Pitman, 2003). Teachers need to consider questions over what to emphasize in choosing to teach in physical geography and how to develop students' thinking to enable a fresh, distinctive perspective to be gained in understanding the physical world. The idea of physical geography as emphasizing the surface, spatial and social, as opposed to 'deep' Earth science, is attractively simple, but this throws up debates about the balance of studying processes, for it is in understanding processes and principles that the power of prediction and applicability lie. Applicability seems to be a current filter for much physical geography taught in school that gives a social justification to the place of physical geography. However, the dilemma of 'cart before horse' (Gregory, 2000) can lead to insufficient knowledge and understanding in how the physical world works, and so the application becomes detached from reality. Applicability could also limit the development of a 'richer', more spiritual, appreciation of the physical world. The challenge for teachers is in deciding appropriate starting points and routes for study. Recent shifts in constructing our understanding has shifted from a fixed positivist view of the physical world as a stable place to exploring multiple knowledges which interpret and aim to reveal 'approximate truths'. There is much merit in teachers critically recognizing the type of knowledge(s) being produced from their teaching and working out its impact on the meaning students construct in their understanding of the physical world. The challenge for geography teachers is to critically engage with their curriculum and pedagogies of teaching physical geography so as to evaluate decisions over how best to portray and develop students' critical understanding of the 'naughty world'.

8. REFERENCES

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