Invitation for Papers and Notes for Contributors

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- We invite your participation in producing this journal. *Geographical Education* encourages school and university teachers and all others interested in geography to share their ideas and experiences in order to promote sound practice, innovative strategies, modern developments and reflection in geographical education.

- Contributions of varying length are invited, with a maximum of 5000 words for major articles and research reports. Shorter articles of 2000 words, featuring classroom strategies, reflections on particular issues and practices in geography teaching, in-service education workshops and comments on previous articles are especially welcome.

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The aims of the journal are to:

- encourage school, college and university teachers and all others interested in Geography to share their ideas and experiences;
- promote sound practice and encourage the developments of innovative strategies for teaching Geography in the classroom and the field;
- provide a forum for discussion between teachers on issues and direction of Geographical education;
- encourage reflection on the scope and purpose of Geography and its role as a medium for the education of young people;
- promote the diffusion of developments in Geography and examples of ways they may be introduced into Geography teaching;
- examine educational issues and trends in the light of their relevance for Geography teaching; and
- disseminate news of AGTA activities and information of national interest from state affiliates.

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**Editorial**

*Rod Lane, Terri Bourke*

Co-editors, *Geographical Education*

*Geographical Education* celebrates its 50th year in 2019 and in line with that milestone we wanted to incorporate a range of elements of geographical education including technology, curriculum, pedagogy, skills and content specific knowledge. In line with the theme from the annual national conference, this volume focuses on what it means to be an innovative geography educator.

The word innovation is derived from Latin – inovatus meaning ‘to renew, change or restore’ or ‘to alter established practices’. Often, innovation is only linked to technological change but as Geography teachers, we need to be innovative in our subject knowledge, curriculum development and pedagogy, to ensure students are engaged, critical, creative and collaborative thinkers both in the classroom and beyond. In industry, we are all familiar with recent radical innovations – the taxi industry disrupted by ride sharing services such as Uber, video and cable services replaced by streaming, for example Netflix and Airbnb as the preferable choice over hotel stays. Innovation is associated with calculated risk-taking, testing horizons, experimenting, and collecting feedback to inform and refine new ways of thinking.

Ultimately, our goal as educators is to ensure holistic growth. Biesta (2015) posits a three-dimensional framework for student learning that includes achievement (qualification – knowledge, skills and dispositions), socialisation (ways of being and doing) and subjectification (student as person). As geographical educators, it is our responsibility to ensure that new practices result in such holistic growth. Our formal and informal assessment practices are an important source of evidence for evaluating educational innovations.

Three papers related to the conference theme are included in this volume. The first paper by Robertson, Maude and Kriewaldt includes an overview of the existing literature and curriculum innovations that appear to best illustrate the new wave of geographical education thought, including how best to equip students to design real-world plans. Examples of best practice and applied action specific to mapping skills in primary classrooms are outlined. The second paper by Digan outlines how meaningful and authentic GIS projects can be implemented in secondary geography classrooms based on readily available teaching resources from organisations such as ESRI. The author elaborates the use of these resources in a Year 8 unit – Landscapes and Landforms by constructing a cross-section using Google My Maps, and using Esri Collector to identify and categorise different vegetation types. The aim of the final paper by Maude and Caldis is to propose an innovative approach for the development of higher order thinking skills through the content of the Year 9 unit, Biomes and Food Security in the Australian Curriculum: Geography.

In addition, this volume of *Geographical Education* features two responses from AGTA to the Academy of Sciences report: *Geography – Shaping Australia’s Future.*

1. Out-of-field Teaching in Geography
2. Geography and STEM

We encourage all geography educators to engage with the report and familiarise themselves with AGTA’s responses written by Grant Kleeman and Susan Caldis. Many thanks also go to the writers of the articles and the book reviews. Geoffrey Paterson as proof reader and Reviews Editor has once again done a fantastic job. The book review titles reflect a range of topics in geography (coral reefs, tourism, conservation management and migration) and the teaching of geography (understanding and teaching primary geography, spatial thinking, and geography education for global understanding). AGTA looks forward to contributions to the next edition of the journal Volume 33, 2020.

**Reference**

One of the questions being asked in schools is the extent to which Geography can be considered a STEM subject. While such a question might be driven by those strategic opportunists seeking to elevate the status of the subject within the school’s curriculum, or as a means of leveraging an increase in funding, it is a question worth serious attention.

This paper argues that Geography has the potential to play an important role in advancing the objectives of STEM (Science, Technology, Engineering, and Mathematics) in the Australian educational context. In doing so, Geography’s place within the humanities is in no way diminished. The humanities remain central to our understanding of the social world in which we live. It also provides important insights into the context within which science gains its significance and from which it draws its authority. Geography, given that it straddles both the physical and human sciences, can advance both the humanities and STEM.

STEM is defined as a national strategy promoting a cross-disciplinary, multidisciplinary and integrated approach to learning. The focus on STEM aims to build Australia’s future competitiveness in a rapidly changing global economy through using the lenses of STEM to develop individual and national capacity to respond to challenges around productivity and economic wellbeing. There is an emphasis on critical and creative thinking to solve real-world challenges (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2016; Education Council, 2015; Office of the Chief Scientist, 2013, 2014; Seikmann & Korbel, 2016). In short, the focus on STEM is being driven by an economic imperative.

The status of Geography vis-à-vis STEM is ambiguous for two principal reasons.

1. There continues to be debate about what actually constitutes STEM. Does it, for example, include Geographical Information Systems (GIS) and Cartography? Does the field of Geosciences (and by definition most of physical geography) qualify as STEM?

2. Geography is a broadly interdisciplinary discipline that now embraces at least four sub disciplines – two of which (Physical or Environmental Geography) are clearly STEM. The other two, which are firmly grounded in the humanities, are Human and Cultural Geography.

In search of definitional clarity

Any discussion regarding Geography’s contribution to STEM requires some degree of contextual and definitional clarification. What is Geography and how has it been traditionally positioned within the total school curriculum?

Geography has been defined by Australia’s National Committee for Geographical Sciences (2018) as a wide-ranging and dynamic discipline where phenomena from the natural world, social world, and the humanities are integrated and studied through the perspectives of place, space, and environment. As a discipline, Geography provides us with an understanding about the world around us, for example through exploring the diversity of environments, places, peoples and cultures, the inequalities existing within and between places, dependence on the environment for survival, attachment to place, and connections between places and people throughout the world. Furthermore, Geography offers students the opportunity to develop literacy and numeracy skills in context together with an understanding about the significance of the environment, a set of personal capabilities including critical and creative thinking, and distinctive ways of thinking (Maude, 2019).

Implicit in this definition of Geography is the integrating nature of the discipline. Geography spans both the physical and human sciences. As such, it provides a unique conceptual lens.
through which to study, and better understand, a diverse range of physical and human phenomena.

In terms of its curriculum positioning, Geography is, at a national scale, typically identified as a subject within the Humanities and Social Sciences (HASS) learning area with a focus on inspiring curiosity and wonder about the diversity of the world’s places, peoples, cultures and environments, and encouraging active citizenship towards creating a socially just and sustainable future (ACARA, 2013a; Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), 2008; National Committee for Geographical Sciences, 2018).

HASS is defined in the Australian Curriculum structure as a learning area comprised of several subjects including Geography, History, Civics and Citizenship, and Economics and Business. Learning focuses on consideration of future challenges through the study of human behaviour and interaction in social, cultural, environmental, economic, historical and political contexts, from the personal to global scale (ACARA, 2013b; MCEETYA, 2008). It should be noted that across states and territories the name and inclusion of HASS-identified subjects varies slightly.

An integrated curriculum refers to the purposeful connection or links being made between what is being learnt in one subject with another – i.e. meaningful teaching, learning and assessment activities are designed across several subjects or disciplines (Dowden, 2014; Smith & Lovat, 2006). An integrated curriculum allows complex real-world problems to be solved through critical and creative thinking using a cross-disciplinary or multi-subject lens (Acedo & Hughes, 2014).

The literature suggests that Geography provides a bridge between the social sciences and biophysical sciences but is characterised by the analytical, critical and speculative methodologies of the humanities through determining the impact of place, space and environment on the human condition (ACARA, 2013b; Sorensen, 2009). As the national curriculum development process continued, and further research emerged, the *Foundation to Year 10 Australian Curriculum: Geography* was written to have specific points of connection and complementarity to the *Foundation to Year 10 Australian Curriculum: Science* and the *Foundation to Year 10 Australian Curriculum: Mathematics* (Caldis, 2019).

**Science-based content unique to the Australian Curriculum: Geography**

Alaric Maude, the Lead Writer of the *Shape Paper Australian Curriculum: Geography* (ACARA, 2011), identified, in an undated briefing paper prepared for the National Committee for Geographical Sciences, a number of science-based topics covered by the Australian Curriculum: Geography (and its HASS replacement) but not in the Australian Curriculum: Science, or not at the same depth. These topics are also identified in Geography: Shaping Australia’s Future (National Committee for Geographical Sciences, 2018).

These topics include:

- climate types (Year 3) – in Science the only mention of climate is in relation to climate change;
- vegetation types and the effects of vegetation on the environment (Year 4) – vegetation is not mentioned in Science;
- quantity and variability of Australia’s water resources compared with other continents (Year 7);
- nature of water scarcity and ways of overcoming it (Year 7);
- causes, impacts and responses to an atmospheric or hydrological hazard (Year 7);
- causes, impacts and responses to a geomorphological hazard (Year 8);
- characteristics and distribution of biomes (Year 9);
- human alteration of biomes to produce food, industrial materials and fibres (Year 9);
- environmental, economic and technological factors that influence crop yields in Australia and across the world (Year 9) – Science has this elaboration in Year 8 describing how technologies have been applied to modern farming techniques to improve yields and sustainability;
- challenges to food production, including land and water degradation, shortage of fresh water, competing land uses, and climate change for Australia and other areas of the world (Year 9);
- capacity of the world’s environments to sustainably feed the projected future global population (Year 9) – the only mention of agriculture in the Science curriculum is this elaboration in Year 8: describing the impact of plant cloning techniques (asexual production) in agriculture such as horticulture, fruit production and vineyards;
- human-induced environmental changes that challenge sustainability (Year 10) – Science has this elaboration in Year 7: considering how human activity in the community can have positive and negative effects on the sustainability of ecosystems; and
- study of environmental change in a particular type of environment (Year 10).
Note that the Geography content is from content descriptions, which are mandatory while the Science content is in elaborations, which are not.

Some scientific concepts and terms are taught in the Geography curriculum but not in Science. These include:

- climate;
- evaporation and evapotranspiration;
- water balance;
- vegetation;
- biomass;
- biome;
- net primary productivity; and
- land and water degradation.

Maude, in the same briefing paper, identifies a number of skills featured in the Geography curriculum that are mathematical or technological. These include:

- representing data in a range of appropriate forms, for example, climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies (Years 7 and 8);
- representing multi-variable data in a range of appropriate forms, for example scatter plots, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies (Years 9 and 10);
- representing spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate (Years 7 and 8);
- representing spatial distribution of geographical phenomena by constructing special purpose maps that conform to cartographic conventions, using spatial technologies as appropriate (Years 9 and 10);
- interpreting geographical data and other information, using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to identify and propose explanations for spatial distributions, patterns and trends, and infer relationships (Years 7 and 8);
- interpreting and analysing multi-variable data and other geographical information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to make generalisations and inferences, propose explanations for patterns, trends, relationships and anomalies, and predict outcomes (Years 9 and 10).

- Learning to construct, interpret and use maps helps to develop children’s spatial intelligence. It is now well established that this is a separate type of intelligence, additional to mathematical intelligence and verbal intelligence (Ness, Farenga, & Garofalo, 2017). Spatial intelligence, or the ability to think spatially, is important in everyday life, but is also used in mathematics, several fields of science, architecture, engineering, urban planning and geography. Geography has a significant role to play in developing these spatial skills. Liben (2007, p. 221), for example, argues that ‘geography education in general, and map education in particular, can have an important place in developing spatial thinkers’. Mapping is therefore much more about developing spatial thinking skills than learning how to find places and navigate from one place to another. Spatial thinking is defined as:

… the use of spatial concepts, spatial representations, and processes of reasoning to conceptualize and solve problems. Following this definition, spatial thinking involves the ability to visualize and interpret data about space that is then encoded and stored in memory. This definition emphasizes language (knowing and using spatial concepts such as location, distance, scale); being able to understand spatial representations such as maps, graphics, and diagrams; and the application of these to problem solving, both personal and academic. This is related to the development of a spatial habit of mind. This is the predilection to think spatially and to apply the skills required to engage in reasoning with concepts of space and visual representations. (Bednarz 2018, p. 3)

Also worthy of note is the inquiry-based foundations of the Australian Curriculum: Geography (and the Geography components of HASS). This methodological framework parallels that underpinning scientific inquiry, commonly referred to as the scientific method. The step-by-step approach progresses from identifying and defining a problem or issue, formulating a tentative hypothesis, gathering data to test the hypothesis, and interpreting results objectively. The skills set developed by students engaged in inquiry are generic in the sense that they can be applied in a range of contexts, including those beyond school.

Geographical inquiry is defined in the Australian Curriculum: Geography as “the process by which students learn about and deepen their holistic understanding of their world”. It is described as
involving individual or group investigations that start with geographical questions and proceed through the collection, evaluation, analysis and interpretation of information to the development of conclusions and proposals for action. The inquiries undertaken may vary in scale and geographical context.

The skills students deploy in these inquiries or investigations, both within the classroom and during fieldwork, are developed from K (Foundation) to Year 12. They include formulating questions and research plans; recording and presenting data skills; and using a variety of spatial technologies. In applying these skills, students learn to think critically about the methods used to obtain, represent, analyse and interpret information, and communicate findings.

By Years 7 and 8, students are able to present findings, arguments and ideas in a range of communication forms selected to suit a particular audience and purpose, using geographical terminology and digital technologies as appropriate. By Years 9 and 10, students progress from the presentation of ideas to the formulation of explanations. The means of communication used is selected based on its effectiveness and its suitability to the audience and purpose.

The stages of the investigations students complete are: observing, questioning and planning; collecting, recording, evaluating and representing; interpreting analysing and concluding; communicating; and reflecting and responding. As noted above, these stages mirror the inquiry sequence applied in science. In this regard Geography can be seen to make an important contribution to the development of these STEM-related competencies.

**In defence of the Geography’s status and positioning within the humanities**

Any discussion of Geography’s contribution to STEM in no way diminishes the discipline’s status within the social sciences and humanities. This is an important point to make because, as Professor lain Hay (2016) notes, the humanities are under assault from an increasingly utilitarian worldview and from conservatives preoccupied with cultural conflict. The latter argue that the humanities have been captured by the progressive left who see them as a vehicle for the transformation of society.

The trend towards a more utilitarian educational environment is reflected in the choices students make. Many students choose vocationally-focused degrees that hold the offer of financially rewarding careers. This is contrary to the flexibility of the humanities and skills set developed by those studying a related discipline. There is, as Hay argues, a degree of “vocational and economic pragmatism” in the decisions made by students, reinforced by the encouragement of the political class and parents. Governments see STEM-related subjects as central to the future economic wellbeing of nations. This, at least in part, is driven by the need to remain internationally competitive in an increasingly integrated global economy.

The focus on STEM has resulted in a decline in public and private funding of the humanities, especially in the area of research. At the same time, funding for mathematical and physical sciences, biological sciences, medical sciences and engineering has grown (Hay, 2016). This shift in funding has been cheered on by conservative commentators who fuel the devaluing of the humanities for their own ideological ends.

Maude (2019) argues that the lack of formal recognition of Geography as a STEM subject is a contributing factor to the declining student candidature in the discipline and a confused understanding about rigorous career pathways related to Geography. To counter this, the National Committee for Geographical Sciences (2018) suggests that the discipline’s profile should be extended beyond the humanities and that it be formally acknowledged that its significant science content qualifies geography as a partial STEM subject. An expanded lens of understanding about Geography will increase its visibility, integrity and profile. In so doing, geographical knowledge and understanding will be enhanced within the Australian population, together with a greater appreciation about the important university pathways and career trajectories offered by the study of geography to support the productivity and relevance of Australia in a changing world (Caldis, 2019).

The study of Geography in schools and at university requires students to increasingly develop their capacity to access, use and interpret, and communicate through a range of constantly emerging technologies related to datasets and GIS. Augmented reality sandboxes provide an example of how a technology-enabled teaching tool can be used to connect learning about terrain and topography (Geography) with atmospheric processes and climate (Science, Geography), soil attributes and crop yields (Science, Agriculture, Mathematics), and infrastructure considerations for a community (Engineering, Geography, Mathematics). Geospatial technologies allow students to show connections between subjects, demonstrate their holistic interpretations about place and spatial patterns, and make predictions about future environmental events.
The Federally-established Science and Research Priorities encourage users of GIS-related technologies and data to make connections between food, soil and water, transport, energy and resources, health, and population to develop innovative solutions to the so-called *wicked problems* of a connected world. Such technologies are currently being introduced for use in schools, within Geography classrooms and across STEM education projects. Therefore, a formalised statement where Geography also becomes recognised as a STEM education subject will promote the development of the so-called 21st Century skills or general capabilities. Understanding Geography to be within the key learning area of HASS, and as part of the STEM education repertoire, will allow educators and students to grasp what is both new and important for effective participation in, and contribution to, a rapidly changing and globally connected world. (Caldis, 2019; GTANSW-ACT, 2018; Kerski, 2015; National Committee for Geographical Sciences, 2018).

Despite all this, the continued importance of the humanities cannot be understated. The role of the humanities is, as outlined by Hay (2016), “to share and build on knowledge and to participate in a (scholarly) community in which knowledge is scrutinised and challenged relentlessly, constantly taking account of empirical revelations and conceptual rethinking”. The humanities cast a light on the ideas and practices that shape the nature of the society in which we live. They allow us to better share experiences and gain an insight into the lived experience of others. They enrich lives by nurturing creativity. They make our lives more rewarding and enjoyable. They provide us with the skills that enable us to make meaning from all that is around us – skills that will hold us in good stead in an unpredictable future.

The humanities complement and nurture STEM in a variety of ways. They provide, for instance, an understanding of the context within which science gains its significance and from which it draws its authority (Hay, 2016). In a rapidly changing and technology-focused world, the humanities provide balance and perspective. They strengthen our worldview and broaden our intellectual foundations. They promote critical thinking skills and creativity, enhance our communication and problem-solving capacity, and contribute to the development of engaged citizens and thinkers (Reiter, 2017). It is within this broader educational context that Geography makes its own unique contribution.

Geography has the potential to make an important (and perhaps unique) contribution to both STEM and the humanities. It is the discipline that spans (and often integrates) the physical sciences, social sciences and the humanities. It emphasises spatial thinking and the creation of new knowledge via the study of places. It recognises the fundamental importance of the environment to human welfare and promotes an awareness of the interconnections between phenomena and processes both within places and across space. Places and people are increasingly interconnected globally, and society’s challenges require answers that integrate different fields of knowledge. In a world in which inequalities within and between places can threaten social cohesion, and where the pressure of human impacts on the environment is a growing concern, Geography has much to offer.

References


Introduction
This paper forms part of the response by the Australian Geography Teachers Association (AGTA) to two school education related recommendations put forward in Geography: Shaping Australia’s Future (National Committee for Geographical Sciences, 2018). The recommendations are:

The National Committee for Geographical Sciences and AGTA write to the federal, state and territory Ministers of Education about the urgency of addressing ‘out-of-field’ teaching in geography (p. 86); and

The National Committee for Geographical Sciences and AGTA develop a submission to university education program decision-makers about the need to improve both primary and secondary teacher training in geography (p. 85).

The purpose of this response is to alert and inform Ministers of Education, policymakers, and other key Geography education stakeholders about the implications of two important issues impacting on the quality of Geography education available to young Australians in schools.

These are the shortage of appropriately educated geography teachers in primary and secondary schools, and the nature of their pre-service preparation, with a focus on their content knowledge and pedagogical skills. In a more general sense, this response represents a call for action in policy development around improving the quality and provision of Geography education across Australia. Such actions have the potential to raise the integrity of Geography as a discipline and enhance levels of geographical knowledge and understanding within the Australian population.

The paper commences with a nationally agreed definition of Geography and then provides an overview about the nature and extent of out-of-field teaching in Australian schools with specific reference to Geography. From there, the paper uses an evidence-based approach to explore the concerns regarding out-of-field teaching in Geography and its implications for Geography education nationally. A set of proposed actions concludes the paper.

Defining Geography
Geography is defined as a wide-ranging and dynamic discipline where phenomena from the natural world, social world, and the humanities are integrated and studied through the perspectives of place, space, and environment. Geography provides an understanding about the world around us. This is achieved, for example through exploring the diversity of environments, places, peoples and cultures; the inequalities existing within and between these places; dependence on the environment for survival; attachment to place; and connections between places and people throughout the world (National Committee for Geographical Sciences, 2018). Geography contributes to public and academic understanding about the social, economic and environmental wellbeing of Australians and Australia through research, education, training, skills, expertise and engagement with industry and the community. Consequently, Geography has an important role in education at all levels because it brings particular ways of thinking based on a set of concepts to guide the choice of research topics, identify significant questions, and suggest explanations (National Committee for Geographical Sciences, 2018).

Out-of-field teaching
Out-of-field teaching occurs when teachers are required to teach subjects outside their field or fields of appropriate qualification or expertise (Du Plessis, 2016, 2019). Many teachers are asked to teach out-of-field during their career, especially during their early years of entry to the profession. In the secondary school context, this situation is often referred to as being a non-specialist teacher. Not only does teaching out-of-field impact on the integrity of a subject, it inevitably results in heightened levels of student disengagement, lower than anticipated achievement of student learning outcomes, and causes an increasing lack of confidence amongst teachers about their
ability to teach effectively (Caldis, 2017). Out-of-field teaching not only influences the quality of instruction, it also fuels public debate about declining teacher quality.

Qualifications considered suitable for the effective teaching, learning and assessment of a subject are achieved through completion of units in initial teacher education programs. They include both content knowledge (subject specialisation) and pedagogical content knowledge (subject methodology). Alternatively, subject expertise can also be achieved through completing at least three years of accredited professional learning in the designated out-of-field subject area (Caldis, 2017; Du Plessis, 2019; Weldon, 2016).

Nature and extent of out-of-field teaching in Geography

Out-of-field teaching in Geography occurs in forty percent of Year 7–10 Geography classes across Australia (Du Plessis, 2019; National Committee for Geographical Sciences, 2018; Weldon, 2016). This is the highest incidence of out-of-field teaching occurring in any subject area (Weldon, 2016). This means that forty per cent of teachers who are teaching a Geography class have neither specialised Geography content knowledge nor pedagogical content knowledge. Only thirty-five per cent of Year 7–10 Geography classes are taught by specialist Geography teachers (Weldon, 2016). The remaining twenty-five per cent of out-of-field teachers have obtained recognised qualifications in either (but not both) content knowledge or pedagogical content knowledge (Weldon, 2016). Content knowledge is understood to be the key concepts and structure of a subject whereas pedagogical content knowledge includes knowledge about how to represent and organise subject content using specific strategies and activities to develop student understanding and engagement with the subject (Lane, 2009).

By way of comparison, out-of-field teaching in Mathematics (often the source of considerable public attention) is just 19.6 per cent. For English it is 13.5 per cent, Chemistry 9.1 per cent and Biology 8.5 per cent (Weldon, 2016).

Implications of out-of-field teaching in Geography

One of the main implications of the increase in the incidence out-of-field teaching in Geography is the declining quality of instruction occurring in Geography classrooms compared with those classes taught by a specialist teacher. Subject content knowledge is vital to the effective teaching of Geography and is also a key attribute of a highly effective teacher (Lane, 2015; Weldon, 2016). Subject content knowledge (together with pedagogical content knowledge) enables specialist teachers to provide a thorough and connected learning experience in Geography as they are able to apply theoretical processes to real life examples and organise connections between geographical content and concepts in a meaningful way for students. An understanding and application of geographical concepts are fundamental to the development of geographical thinking (Shreeve, 2018). It is likely that out-of-field teachers of Geography lack conceptual understanding and often fail to recognise when students are presenting incorrect ideas. In such circumstances, the significance of geographical thinking is overlooked, and the progression of geographical knowledge does not build and consolidate in a logical and discipline-specific way (Lane, 2015, Shreeve, 2018).

The expectation that schools consistently deliver a high quality of teaching, learning and assessment is often linked to the results a school achieves in high-stakes testing. School leaders experience pressure to lead their schools toward visible progress, resulting in a greater focus on results rather than the enhancement of human capital and wellbeing (Du Plessis, 2016).

It is AGTA’s contention, supported by research, that the exceptionally high level of out-of-field teaching in Geography has had a detrimental impact on student results and affected the level of student engagement in the subject. This, in turn, results in a declining candidature in Geography across the senior secondary years of schooling and discourages the study of Geography at the tertiary level. It is also important to note that teachers teaching out-of-field often feel overwhelmed by the complexity of the content and the pedagogies required to effectively deliver it. As a result, they are often dissatisfied with their performance as a teacher (Du Plessis, 2016).

Subject knowledge is considered a key attribute of effective teaching (Weldon, 2016). Research has demonstrated that students often hold alternative (mis)conceptions – ideas that are inconsistent with scientific evidence. These ideas need to be recognised and addressed by teachers or they will persist. It is unlikely that teachers will be able to do this if they themselves have incorrect and imprecise ideas (Lane, 2015).

For secondary school teachers, the Australian Institute of Teaching and School Leadership (AITSL) specifies a minimum of six units of study in their ‘first’ teaching subject, with no more than two units at first year level. The adequacy of this requirement for teaching geography depends on what these units are, because while the school curriculum requires knowledge of both...
physical and human geography, many university geography majors do not.

Proposed actions

To address the high incidence of out-of-field teaching in Geography, relative to that of other subjects, AGTA encourages educational stakeholders to adopt the following proposed actions:

- That the requirements of Initial Teacher Education Programs be adjusted to require (i) those studying to be a secondary Geography teacher to complete a minimum of six units of study across both physical and human Geography; (ii) those studying to be a secondary History, Commerce, Economics or Business Studies teacher to complete a minimum of four units of study across physical and human Geography because typically, History teachers will also be required to teach Geography in the junior years; and (iii) those studying to be a primary teacher be required to study at least one content-based unit in Geography.

It is AGTA's belief that such an adjustment to program offerings would provide sufficient preparation in subject content knowledge for the effective teaching, learning and assessment of Geography in schools.

- That, in addition to the above, Initial Teacher Education Programs should be modified to offer a distinct Geography methodology course in Bachelor of Education and Master of Teaching degree programs. Furthermore, these courses should be delivered by specialist Geography educators and made compulsory for those studying to be specialist Geography, History, Commerce, Economics or Business Studies teachers.

It is AGTA's belief that such a requirement would provide sufficient preparation in pedagogical content knowledge for the effective teaching, learning and assessment of Geography in schools.

- That non-specialist teachers of Geography be provided with additional and conditional support to complete further education to develop their subject content and pedagogical content knowledge in Geography.

Such provisions could occur through incentivisation to complete postgraduate studies or complete Geography education-related action research projects with partnering universities (Lane & Caldis, 2018). Alternatively, the role of universities could be expanded to become active professional learning providers. Furthermore, a systematic method of distilling current knowledge in a form that teachers can readily access and use could be developed. Geography academics, educators and experienced teachers could be asked to collaboratively review contemporary knowledge on topics in the Geography curriculum and these reviews be made available via appropriate platforms, or accredited as part of professional learning hours (National Committee for Geographical Sciences, 2018).

- That the study of Geography in schools should be made nationally compulsory up to Year 10. In so doing, students will have the opportunity to study important topics not available elsewhere in the suite of core-learning subjects.

Such topics include the environmental basis of agriculture, food production and food security, people’s connections with places through communication technologies, and human wellbeing from the personal to global scale. The compulsory study of Geography up to Year 10 will develop the visibility and integrity of Geography as a discipline, increase the exposure of students to Geography throughout their years of schooling, and over time, ultimately lead to enhanced levels of geographical knowledge and understanding amongst the Australian population (National Committee for Geographical Sciences, 2018).

- Finally, that AGTA and the other professional associations represented on the National Committee for Geographical Sciences be formally recognised by Ministers of Education as salient stakeholders in geographical education, curriculum development for Geography, and the provision of teacher-centred resources that enhance the development of subject content and pedagogical content knowledge (Caldis, 2014 National Committee for Geographical Sciences, 2018).

Such recognition will acknowledge the Associations as key stakeholders in Geography education and should, therefore, ensure an invitation to roundtable discussions and similar activities with Ministers of Education about strategies with which to move forward in response to addressing the occurrence and implications of out-of-field teaching in Geography across Australia.

Conclusion

The paper outlined a nationally agreed definition about Geography and provided an overview about the nature and extent of out-of-field teaching, contextualised to Geography education in Australia. An evidence base was used to highlight ongoing concerns about the extent of out-of-field teaching occurring in Geography and its resultant implications for Geography education across
the country. A set of proposed actions for policy development around improving the quality and provision of Geography education was outlined. The purpose of this paper, and its set of proposed actions, is not only to respond directly to Geography: Shaping Australia’s Future (National Committee for Geographical Sciences, 2018) but to actively take steps in raising the quality of teaching, learning and assessment of Geography. In doing so, we hope to enhance the integrity of Geography as a discipline, which will in time, enhance the levels of geographical knowledge and understanding amongst Australia’s population.

References


Aligning Mapping Skills With Digitally Connected Childhoods to Advance the Development of Spatial Cognition and Ways of Thinking in Primary School Geography

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Abstract
New technologies are changing the ways that children navigate, find places, make and use maps, and explore the world. This is the geospatial revolution. Children live in a world of rapid technological innovation bringing new opportunities for cognitive development in school geography. Geography learning is an important component of primary school curriculum in Australia and internationally. However how young people’s mapping skills can be developed in a digitally connected realm has become an important question. These technologies require us to rethink the teaching of mapping skills in primary schools, both to take advantage of technology, and to connect with children who are growing up in a digital age. We argue that mapping in the curriculum is much more about developing spatial thinking skills by building spatial concepts. Given these purposes for learning about maps and mapping skills, teaching in primary schools can enhance students’ knowledge of geography and spatial skills through a focus on the spatial concepts and ways of thinking. This article synthesises what is known about the purposes of mapping skills, spatial cognition and geography education, and how children learn mapping. It argues that teachers can use the new technologies to do this as well as established approaches. It then applies these to proposing how established methods can be augmented by innovative approaches to building spatial thinking skills.

Introduction and the world of now
Post-millennial childhood heralds a new era in opportunities for cognitive development. The e-World package of internet linked personal devices opens the world of experience to infinite choices and decisions (Castree, 2016). Geotagging of places and spaces linked with daily activities effectively changes how children directly engage with real time space and place. The App library acts as a filter for where to go and presents options for how to get there. Added to this process, the symbols of traditional maps are no longer needed. Voice recognition provides the medium of translation between the device finder and the user. The consequence is that the ground covered may be incidental in the overall experience for the young device operator. In an attempt to grasp the significance of these societal changes in the post-millennial childhood experience we make an effort to show links between behaviours now and the more traditional signposts of mapping, map making and mapping comprehension (see Downs & Stea, 2017). Youngsters of the post-millennial age may not get too enthusiastic about venturing too far from ‘civilisation’, or being out of range for their mobile devices, but, arguably, they are ‘seeing’ the wonders of the world in other ways that are not well understood or researched (Robertson, Montouro, & Burston, 2019).

First, there was geocaching. Then there was Pokémon Go. Augmented reality captures the imagination in ways that hiking through the bush to locate caches may not. However, interestingly, the combination of reality-based mobility and virtual characters has also lost some favour from its initial popularity. Like osmosis the magic of running around the neighbourhood to catchPokémons drifted from continent to continent and now though it’s not newsworthy it is still played by millions of people. The
phenomenon is fascinating as it blends cognitive mapping skills, associated spatial navigational behaviours and fantasy (Žižek, 2008). The iPhone generation (iGen) rely on their phones for social, emotional and information needs (Twenge, 2018). The implications of these behaviours for understanding the cognitive processes of young learners is a new field for researchers and educators. New questions are the result in the world of now: How do educators capture these children's imaginations to ensure that the learning challenges are meaningful – for the child? Curriculums are interpretative statements of a nation's educational needs, and geography educators have defined core concepts that lend themselves to meaningful application in a geospatial-technology enriched world. Improving understanding of the spatial cognition of the iGen children can be the benchmark for relevance, authenticity in learning tasks, and sustainable learning.

The point is that the knowledge affordances of the world of now (Harvey 2016; Robertson 2008; Virilio, 2000), including geospatial technologies, are embedded in mainstream culture. This is well captured by Downs (2014) who summarises the likely impact on humans and the institutions that support our lifestyles as being two-fold.

The geospatial revolution has two human implications. First, as knowing actors, people make choices based on the analysis and presentation of geospatial data. Second, as known subjects, people's choices become data as their behavior is monitored through real-time tracking. . . . Both of these human implications affect the geographic sense of self: what is known about the world, how people see themselves in relation to it, and how people behave spatially in it. (Downs 2014 p. 36)

Inextricably linked with the changes afforded by the geospatial revolution is the sense of geographic self or inner space, which in turn has deep implications for geographical education and how children acquire spatial knowledge and understandings. For geographical education the possibilities of linking the digital and real worlds seem infinite. Geospatial tools align content, processes and learning outcomes in ways that ought to excite learners and endure in their cognitive and spatial development. Preparation for their worlds, including their sense of self, are part of their identity formation. Our challenges in geographical education are to herald the changes and embrace them in our pedagogical practices. For instance, as a classroom tool for modelling landscapes and altering patterns associated with real space how cool is 4D cartography? Using 3D representations with time added as a fourth dimension making possible new visualisations. (Resch, Hillen, Reimer & Spitzer, 2013). As the inherently geographic way of connecting space and place relations, how we teach mapping skills has the potential to harness the best of new and emerging technologies. There is a mapping (cultural) turn in everyday life that needs explication and interpretation for meaning making and knowledge creation.

Our goal in this article is to contribute to a better understanding of the geospatial revolution and the tools that are commonly used by geographers. The sections that follow include an overview of the existing literature and curriculum innovations that appear to best illustrate the new wave of geographical education thought including how best to equip students to design real-world plans (see for example, Harvey & Kotting, 2011). Following this we include examples of best practice and applied action specific to mapping skills and their acquisition.

The starting points: linking the geospatial revolution with primary school education

For the post-millennials innovative practice in primary schools starts with the geospatial revolution. Geospatial technologies refer to a vast array of increasingly sophisticated tools that are capable of capturing and manipulating spatial data. The growing availability of these digital databases and their interoperability makes them accessible for teachers. They 'fit' the criteria for contemporary childhood experiences. Coded by location, the technologies both capture the data, and turn them into maps and other locational information. Primary school students can access this information through software such as Google Maps, Google Earth, online mapping programs and electronic atlases, using tablets and computers. They are observing their family’s use of smart phones and other devices from an early age. The use of these technological devices by school students is widespread by early-secondary school age. For example, a 2016 Australian Roy Morgan survey found that 11% of 9 year-olds, 27% of 11 year-olds and 66% of 13 year-olds have a mobile phone (Roy Morgan Research, 2016). A 2017 Australian Child Health Poll found that 36% of 3–5 year-olds, 67% of 6–12 year-olds, and 94% of 13–17 year-olds owned a smartphone and/or tablet (Australian Child Health Poll, 2017).

Children's access to geospatial technologies means they no longer need printed maps to find places. Students can access up-to-date written and visual information about places throughout the world, and take virtual tours through many of
them. “The scale of the familiar world, the depth and accuracy of knowledge of that world, and the command and comfort within it will change [have changed] dramatically” (Downs 2016, p. 48). As a consequence:

Skills in searching for [geographic] information, part of procedural knowledge, may replace much of the base of declarative knowledge, placing a premium on knowing how and where to find geospatial information rather than memorizing that information. (Downs 2016, p. 48)

Downs also describes how the geospatial revolution provides new and more flexible ways to navigate from one place to another, with routes selected according to criteria specified by the user. These routes might be the shortest, the quickest, the most scenic and so on. He writes: “There is a potential diffusion of geographic knowledge and mapping skills to many people. There is the possibility of security and adventurousness in behaviour” (Downs 2016, p. 49). Similarly, the availability of simple online mapping programs may make teaching students to draw maps by hand an obsolete and unnecessary task.

On the other hand, there are some potential negative consequences of the geospatial revolution. One relates to people’s dependency on technology. Downs (2014, pp. 53–54) concludes:

For members of Generation M [now iGen], access to and participation in the virtual geographic world is rapidly becoming the norm. The tools and technology foster dependency. . . . Maps can contain errors from data bases that are incorrect or out-of-date. Network coverage is geographically variable in quality: . . . Tools break and malfunction. Batteries die and electrical power fails. Phones can be lost or stolen. Internet connections can be hacked. How do we establish a balance between utility and dependence, between reliance and vulnerability?

A second consequence of dependence on geospatial technology is that it results in people having limited geographical information stored in the memory. However, it is difficult to think about the world if one has no mental map of it, and of the relative location of places and countries. It is also inefficient to have to use a smartphone for every fact, so some declarative knowledge is still needed.

A third consequence relates to cognition:

There is emerging evidence that on-line software is beginning to have an effect on cognition. Sparrow, Liu, and Wegner [2011], for example, showed that access to on-line search engines affects both memory for and strategies of searching for information. . . . For example, does the use of GPS-based direction software, with its focus on point-to-point routes, diminish the likelihood of children forming coherent and integrated cognitive maps of their neighborhoods? Does route-tracking distract children from looking at the world around them? Does the sense of security offered by GPS software lead to adventurous behavior that puts children at additional and dysfunctional risk? (Downs 2014, p. 53)

A related cognitive issue is about the effects of a dependence on GPS technology on the brain. Studies suggest that people who navigate by building a cognitive map showing the relationships between landmarks have a larger hippocampus, which involves spatial thinking, than those who navigate by learning or following a path, which does not. The significance of this is that a larger hippocampus may reduce the risk of dementia and Alzheimer’s in old age (Konishi et al. 2017). This is an insufficiently researched problem, but it may need to be taken seriously. In brief, there are both advantages and disadvantages in the growing reliance on geospatial technologies.

**Purposes of mapping skills, spatial cognition and geographical education**

The bridge between the cognitive impact and learning experiences is the challenge for geographical education. Given that the geospatial revolution is now well established, and today’s students will enter a world in which more and more information is locationally coded, and more and more software and applications are available to access and use this information, raises the question of what are the purposes of teaching mapping skills? Five purposes are suggested.

1. Children should learn how to access, evaluate and use geospatial information on their phones, tablets and computers, in the same way that they learn how to evaluate and use information on the web. As Gauvain argues:

   In the unrelenting information stream which we live in today, it will be important to help children understand how and when to be circumspect about the information they obtain from geospatial technologies, how to check and evaluate the source, and how to monitor their progress in case the
information is wrong or not helpful. (Gauvain, 2014, p. 61)

Part of this process is also learning about the potential dangers of revealing their own location to others through their smartphones.

2. Maps help to develop young children’s knowledge of their own locality and its surroundings, which is important both for their safety and the development of their sense of belonging.

3. As students progress through primary school maps help them find out where their place is located in the world. They discover other places and develop the locational knowledge of the world needed to interpret and understand events. Some of this knowledge can be obtained from electronic sources but understanding will be enriched through the use of a globe to accurately understand the relative locations of places.

4. Maps are central to learning to think geographically. Maps are a way that geographers describe places, portray locations and spatial distributions, and analyse information. In particular, they develop the ability to visualise the world spatially, and to see patterns and relationships, and these are valuable skills. This means that students should learn how to use and interpret a variety of maps, including those they are likely to encounter in digital media. Added to this interpretive knowledge, learning how to construct them for themselves can add to their geographical understanding, and this construction can be done digitally by primary school children using appropriate software. Bridge writes:

Maps have the power to turn the abstract ideas, which we form in our heads, into visual reality. Only a handful of people will ever actually see the UK complete from space. Even fewer can expect to see the whole world in one go except as a map. Maps and plans have a potential for radically extending our understanding by portraying the layout and organisation of the school, revealing the network of roads in a town or region or showing the distribution of natural vegetation such as forests and grasslands. Maps contextualise information within defined spatial boundaries, allowing us to make comparisons, formulate plans and develop generalisations. The identification and analysis of patterns, processes and relationships stands at the heart of geography. (Bridge, 2010, p. 116)

5. Learning to make, interpret and use maps helps to develop children’s spatial intelligence. It is now well established that this is a separate type of intelligence, additional to mathematical intelligence and verbal intelligence (Ness, Farenga & Garofalo, 2017). Spatial intelligence, or the ability to think spatially, is important in everyday life, but is also used in mathematics, several fields of science, architecture, engineering, urban planning and geography. Skill in spatial thinking is positively correlated with competence in mathematics and some branches of science (Newcombe, 2010, 2017), although the reasons for this relationship are not yet fully understood (Mix, 2019). There is also some evidence that training to increase spatial skills, from preschool onwards, improves learning in STEM subjects (Newcombe, 2017). Geography has a significant role to play in this training, as Liben (2017, p. 221) argues that ‘geography education in general, and map education in particular, can have an important place in developing spatial thinkers’.

Mapping is therefore much more about developing spatial thinking skills than learning how to find places and navigate from one place to another. Spatial thinking is defined as:

the use of spatial concepts, spatial representations, and processes of reasoning to conceptualize and solve problems. Following this definition, spatial thinking involves the ability to visualize and interpret data about space that is then encoded and stored in memory. This definition emphasizes language (knowing and using spatial concepts such as location, distance, scale); being able to understand spatial representations such as maps, graphics, and diagrams; and the application of these to problem solving, both personal and academic. This is related to the development of a spatial habit of mind. This is the predilection to think spatially and to apply the skills required to engage in reasoning with concepts of space and visual representations. (Bednarz, 2018, p. 3)

One aspect of this spatial thinking has been described as survey knowledge — the ability to think about multiple relations among locations based on the information provided by an aerial photograph or map. Research shows that 4-year-old children can acquire survey-like information from aerial photographs and maps (Robertson & Taplin 2002). As Davies and Uttal argue (2007),
Students should learn how scale is a useful skill. Maps facilitate children’s thinking about spatial relations.

Maps can become ‘tools for thought’, allowing children to encode spatial relations in an efficient, integrated manner that is difficult, and sometimes impossible, to gain from direct experience or from linguistic descriptions. (p. 233).

On the other hand, electronic navigation programs, which provide only point to point information (and which may be verbal rather than visual), may fail to develop this ability to perceive spatial relations and think spatially. This is because when children are following a designated route, they are not observing the space through which this route passes, or the relative location of places within this space, and they are not developing cognitive maps of places.

Given these purposes for learning about maps and mapping skills, teaching in primary schools can enhance students’ knowledge of geography and spatial skills through a focus on the following spatial concepts and ways of thinking.

• **Identity and location:** Students should learn to find places, features and landmarks on maps and aerial photos, starting with familiar places and progressing to maps of unfamiliar places. The maps should be both printed and digital, and students should learn how to read them, and how to identify their limitations, such as what they don’t show.

• **Distance and direction:** Students should progress from topological concepts of distance (such as near, far, next to) to different metric measurements of distance (such as straight line kilometres, road route kilometres, travel time, travel cost), and from simple directions (such as straight, left, right) to directions by cardinal points and degrees. They should learn how to use printed and digital maps to navigate, and the limitations of different methods.

• **Relative location:** This is the location of a feature or place relative to the locations of other features or places, and includes the concepts of proximity, centrality and remoteness. Relative location often has more influence than absolute location.

• **Scale:** Students should learn how scale is used to construct and interpret maps.

• **Symbols:** Students should progress from pictorial symbols on maps to abstract icons. The use of symbols to represent things is not restricted to maps, so an understanding of symbols is a useful skill.

• **Reference frames:** Students should progress from simple alphanumeric grids to numerical grid references and latitude and longitude. The concept of using a grid to locate something in space is an important skill, and the emergency services use GPS coordinates for latitude and longitude to locate emergencies. Australia’s Triple Zero Awareness Working Group has developed a smartphone app for iOS, Android and Windows devices, which displays the GPS coordinates of a phone’s location that a caller can read out to the emergency operator. It is therefore important that students learn what these coordinates mean.

• **Hierarchies:** Students should learn the concept of a spatially nested hierarchy (such as their address) in which each place is located inside a larger place, a feature sometimes compared with a Russian doll. This can be a difficult concept for young children.

• **Spatial distributions and spatial patterns:** Students should learn to interpret maps showing the spatial distribution of a wide range of categorical and numerical information, and to perceive regularities or patterns in these distributions. They should understand how spatial distributions have environmental, social, economic or political outcomes, such as the effect of the distribution of rainfall on both the type of vegetation and the density of population. Students should also understand how spatial distributions can be used to develop ideas about causation. For example, a simple map of the location of activities in the local area could be used to stimulate thinking about why they are located where they are. Similarly, a world map of the distribution of average life expectancy by country could be used to stimulate thinking about what causes these differences in health outcomes.

• **Spatial association:** Students should learn that similarities in the spatial distribution of two variables could indicate a causal relationship between them. For example, in searching for the causes of differences in life expectancy, students might look at maps of national per capita income or educational attainment to see if they are similar.

• **Map projections:** Students should learn that different map projections portray the surface of the earth in very different ways, and influence the way that we perceive the world and the relative size of countries. The Mercator projection, which exaggerates the size of temperate and polar regions and diminishes the size of tropical regions, is gradually disappearing, but gives a highly misleading picture of the relative areal size of countries.
For example, it portrays Australia as much smaller than Greenland, when in reality it is several times larger.

The aim in all these concepts is to use the teaching of technical skills in map making and map interpretation in concert with rich geographical inquiries to develop breadth and depth in understanding of spatial concepts and spatial thinking.

**What is known about children’s map learning?**

There has been a considerable amount of research into children’s abilities to understand and use maps, and into the difficulties they may experience in interpreting them. Bednarz, Acheson, and Bednarz (2006) have reviewed much of this research and identified some important findings. The first is that children as young as three and four (see also Robertson & Taplin, 2002; Uttal, 2018) are able to interpret maps and remotely sensed images (such as aerial photographs and satellite images), especially of familiar places, and to use them to find locations and trace routes between them. They can also interpret simple maps and perceive patterns represented in them by colours or shading, without any formal instruction. This supports the argument advanced by some researchers that the mapping abilities of young children are innate, and have evolved in most cultures because of the need for children to understand their surroundings in a map-like way for their survival. There is therefore no reason to delay introducing young children to maps and vertical images.

However, this ability to understand spatial representations at early ages is limited to small spaces, those with which children are familiar, and does not automatically transfer to larger spaces, such as regions or countries, that are beyond a child’s experience (Uttal, 2018). Without formal instruction, students do not progress further in their mapping skills than this initial stage. Research has shown that students can have difficulty correctly interpreting a number of features of maps, including:

- The use of colours to show climate or vegetation zones, different states or territories, relief (height above sea level) and other characteristics of areas. For example, they may fail to understand that the colour on a map may not correspond with the colour of what is being represented.
- The use of symbols that show roads, the location of towns, the population of cities, economic activities, and other features. For example, they may fail to understand that a dot represents the location of a place and not its size.
- The relationship between two spatial distributions when high values on one distribution are associated with low values on the other.

The formal teaching of mapping and map interpretation is therefore essential throughout the primary school years. As research reviewed by Weigand (2006) confirms, the learning progression for drawing maps proceeds from pictorial maps through plans to large-scale and then small-scale maps. Pictorial maps portray the features of places by pictures of buildings, roads and rivers, while plans are more abstract maps of small areas, such as the child’s school. Large-scale maps are maps of a small area, such as a neighbourhood or suburb, because the scale is a relatively large ratio. Small-scale maps show a large area, like the whole of a state or country. Large-scale maps are taught first because they are about areas that students are familiar with, and this is how they learn to relate a map to the real world it portrays. Suggestions on how to sequence map teaching and learning with preschool and primary school children can be found in Catling (2018).

The question remaining from this overview is how to marry what is known about the development of spatial cognition and mapping skills with new affordances of geospatial technologies in the day to day practices of classroom teaching.

**Building spatial cognition through known places**

Opportunities to learn about space will occur naturally though life experiences which vary from child to child (Liben & Christensen, 2010). Primary geography has an essential role to play in providing opportunities for children to interact with the environment to master interpreting graphical representations of places. Children benefit from opportunities to develop their spatial cognition by visiting places. In the early years of education, these places are likely to be their school, their school’s local area, their home, back yard (if they have one) and other places in their local area. These are places that they readily visit or can easily visit. In essence, they are known three-dimensional spaces. Places are destinations. The act of wayfinding to various places is also important to developing spatial cognition as it can build knowledge of scale and distance. School programs can offer systematic studies of places that enable all young people to develop beyond the incidental progress that they will make. As highlighted in the previous section the research shows that being in space,
and connecting with the features of places is founded on some fundamental tenets. First, constructing spatial knowledge begins with being in space, which can then be harnessed by teaching children to recognise representations of these places – most commonly through maps, and less commonly via three-dimensional models. As interactions with environments will not, by themselves, guarantee advanced levels of spatial cognition, a second tenet is that children develop mapping skills by using online and print maps or plans of known places and making or illustrating features on maps or plans of known places. Research has demonstrated that spatial cognition is more developed in children who are actively visiting and using representations of places they visited (see, for example, Wiegand, 2006). What studies show is that children who walk to school draw more accurate and more detailed maps than those who are driven, unless the adults doing the driving talk about the route they are taking. Studies also show that children who are allowed to actively explore their neighbourhood have better spatial skills, like route-finding and remembering places, than children whose mobility is constrained (Risotto & Giuliani, 2006). Four- and five-year-olds can comprehend and interpret aerial photographs as representations of the real world, and can use them to find locations in the real world (Plester, Blades, & Spencer, 2003). The same researchers also suggest that experiencing an aerial photograph of a place makes it easier for children to understand a map of the same place, leading to the conclusion that ‘young children would benefit from working with aerial photographs before they start working with maps’ (Plester, Blades, & Spencer, 2003, p. 292). Initially the images must be of familiar spaces that children use daily – such as the school, the immediate neighbourhood of their home, or the local shopping area – so that they can relate what they see in the image to what they know is there on the ground. Importantly, this tenet links to questions about how to gather, and what tools to use for the process of gathering data in the field: Digital processes versus traditional methods of recording data on spreadsheets and print maps for the task? Finally, a third tenet is that children also learn by examining maps of places they will visit and then testing their understanding of them by visiting that place. In school settings this often occurs associated with excursions, fieldtrips and school camps.

Each of these ideas sits alongside geospatial technology applications which can be alternative pathways to both enable and enhance the teaching of spatial learning. Children can take a field-walk to their local park and back in class study aerial photographs of that area using Google Earth. They ask questions: When was the image taken? Who was using the park then? Have features in the park changed? They can return to the park to map usage by drawing dots of people on a map of the area that they have printed from Google Maps. Or they might develop a questionnaire and use a georeferenced application such as ESRI's Survey123 to input data about users so they can produce a computer-generated map of users in the park. In this example, modern applications can be used as a more effective way to learn, a more motivating way to learn and sometimes they are a profoundly new way to enhance learning.

One way that spatial cognition is developed in school curricula is through projects in which students map features of their classroom, school grounds or local area. This is not new. However, the approaches being fostered for the Australian curriculum in primary education are being enhanced by the availability of digital applications for both recording of spatial data and the need to take transdisciplinary approaches. STEM curricula (cross-curriculum teaching of Science, Technology, Engineering and Mathematics) and associated state and federal government funding initiatives are providing impetus for schools to augment the professional development of teachers in ways that develop skills within real world contexts. That translates to new approaches from established teaching methods to consider and implement innovative practices more likely to mirror real life. Technological advances now provide what was once astonishing information about places through GIS, satellite imagery, aerial photos and animations. Teachers have bountiful opportunities to draw on programs including Google Earth and virtual realities that simulate three-dimensional space, and to use these in concert with the child's environment. The use of GIS to solve problems can also be introduced in upper primary school, and has been shown to stimulate student interest. (Jadallah et al., 2017). Children enjoy using GPS to undertake treasure hunts in geocaching in their local area and it can advance their spatial cognition (Conlan, 2017). Children develop their skills over time and experience to improve spatial competencies. They become more capable spatial thinkers through curricula that incorporate activities in places that use maps of these places, and by making and using representations of known and unknown places.

Promoting spatial learning in this cross-curricula manner requires teacher confidence to ‘see’ the possibilities. In forward-looking primary classrooms, the teachers’ role in this process depends on their personal skill capabilities with the new technologies as well as their discipline knowledge. Considering an example of practice can enable both an evaluation of existing practice and identifying ways for improvement to better match the future worlds of learners. What follows
Case study: Designing a learning landscape at The Patch Primary School

At The Patch Primary School, 45 Kilometres east of the Australian city of Melbourne, school students worked with the school community to design a use for a disused area adjacent to the school. Called a learning landscape, this project had outcomes in a range of curriculum areas including geography, mathematics, science and art. The design process included phases of investigating, consulting, collaborating, designing and communicating (Rayner, 2017).
Specifically this project developed spatial cognition when students estimated and calculated distance and area, located specific features and developed scale drawings and models (see Figures 1 and 2). Mapping skills are implicit as the detail indicates. There are symbols, a key, spatial representation distinguished by colour, patterns and arrangement. Three dimensional, the representation indicates the learners' efforts to model real space and the impact of vertical structures on shade options.

The process has much to commend it in the context of contemporary curriculum thinking. In this project comparing representations on plans and Google Earth aerial views can provide a link to the power of digital representation. Distance can be measured in Google Maps as well as at the site to discuss which is more accurate, and why. There are interesting applications to considering their local site to ground truth with other digital and paper representations so that students understand that Google Maps relies on images taken in the past, and that it may not show exactly what they see.

This project is then a platform on which, in the following years, geography lessons can develop using new technologies. For instance, field data are gathered and logged via digital waypoints using mobile phones, and new aerial footage is collected using drones. The options are becoming increasingly affordable and available for schools. Once the waypoints are collected, mapping applications can be used to convert the data to digitised maps using readily available applications from ESRI sources (see for example, ArcGIS). Once in digital format the mapping options can create new possibilities for discussion, planning and implementing change (see Appendix 1 for lists commonly used mapping tools). With additional access to a 3D printer these landscape features could be constructed as a three-dimensional terrain model.

The point of this development in learning options is to bring the real world of geospatial technologies to the forefront of educational thinking. Twenty-first century classrooms for the post-millennials need to match the lived experience of what is now everyday practices in the community. Learners need to go through the process of recognising and implementing their own meaning making using the steps of established pedagogical approaches to geographical education, as well as embracing the affordances of new technologies. The skills developed in the The Patch example remain fundamental for learners to grasp the meaning of maps and map making. Digital technologies can enhance geographical understanding and spatial cognition, but we need to be cautious that learning progression will be be developed when children recognise and implement their own meaning making using models, local fieldwork and by examining aerial photos (Plester, Blades, & Spencer, 2003). Then, embracing geospatial technologies in the world of now can enrich their spatial cognition, develop industry-valued skills and engage learners.

Conclusion

There is an old adage “once a learner, always a learner”. For adult professionals who have the responsibility of teaching the post-millennials this seems an apt mantra. The constancy of change with the globalised world of knowledge, and its availability via personal digital devices is revolutionary for human endeavour. Preparing children to succeed within the parameters of this new world paradigm places a significant burden on teachers, parents and teacher educators to support and guide their development (Kriewaldt & Hutchinson, 2010). Knowing how to map and how to use maps is part of everyday life. Spatial cognition of the real world comes with child development. The real challenges are twofold. The first is how to harness this inherent knowing in ways that help the knower to make the most of the geospatial tools available now to better understand mapping and maps. The second is how to help the knower develop an understanding of spatial concepts and their ability to think spatially. Though this will not necessarily happen through reliance on digital tools, it is an exciting time to be teaching geography with the breadth of contemporary accessible and user-friendly applications that can be integrated into programs. One thing is clear. Children entering formal schooling retain their imaginative curiosity and excitement regarding movement, colour and imaging. New directions for learning need to better understand the digital spaces which young people inhabit and create (Downs, 2016; Pawson, 2015), and ensure that these are used to help them develop the spatial skills needed in the post-millennial world. The logical pathway forward for geographical education is collaborating with them as co-learners.

Appendix 1: Spatial technology tools that are suitable for primary schools

Google Maps
https://maps.google.com/help/maps/education/
A guide to using Google Maps in schools.

Google Earth
https://www.google.com/earth/education/
A guide to using Google Earth in schools.
Scribble Maps
http://www.scribblemaps.com/
Students can add text, lines, images and colours to a base map at all scales from local to global. This can be saved, or converted to a file for adding to a document. May require a small monthly payment, but initial use is free.

National Geographic MapMaker Interactive
https://mapmaker.nationalgeographic.org
A very valuable resource produced by National Geographic Education that displays maps of a variety of environmental and human characteristics, some of which are suitable for Years 3–6 and possibly earlier. The maps can be examined at a wide range of scales, from the whole world to a small area, depending on the country, and one map can be overlaid on another to assist comparison. Students can make a map with MapMaker Interactive by drawing on it and adding symbols. They can then save their map as a file that can be inserted into a report or printed.

National Map
Generates maps for a wide range of information about Australia.

StatWorld – Interactive Maps of Open Data
https://www.statsilk.com/maps/world-stats-open-data
Students can generate maps for a very large range of indicators of development relevant to Year 6.

GIS for Schools
Esri has mapping software suitable for primary schools, for those who are more ambitious.

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References


Endnotes

1 Adapted and developed from Jo & Bednarz, 2009; Liben & Christensen, 2010; Golledge, Marsh, & Battersby, 2008; Mohan & Mohan, 2013; National Research Council, 2006
Abstract

Digital technologies such as Geographic Information Systems (GIS) can be innovative tools for learning when used in purposeful ways and embedded in sound pedagogical frameworks. The predominant skills stimulated through the use of GIS are querying, collecting, analysing and manipulating spatial data. In recent years, the financial, technological and curricular hurdles for using GIS in schools have been reduced through free campus licences (e.g. Esri Australia), online apps and cloud-based mapping solutions (e.g. ArcGIS Online). Additionally, with the inclusion of GIS in the Australian Curriculum there is a need for specialised teacher training and in-service professional development to make GIS integral in the secondary school environment. In this paper, teaching units for Year 8 Geography using GIS in experiential fieldwork will be presented and evaluated in regard to their learning outcomes as examples of how to incorporate GIS into teaching episodes.

Introduction

In Australia, the implementation and use of Geographic Information Systems (GIS), or Geographic Information Science, in education has been emphasised through the integration of spatial technologies in the Australian Curriculum: Geography. In recent years, GIS has been promoted through freely available web-based or online resources (Abbay, 2017). In Years 7 and 8, the content descriptors of the Australian Curriculum: Geography broadly encourage the use of ‘spatial technologies’ to interpret and analyse geographical data under the strand of Geographic Inquiry Skills. In Years 9 and 10, the curriculum makes specific reference to GIS.

The benefits of using spatial technologies in the classroom have been widely studied (Demirci, Karaburun, & Ünlü, 2013; Jo, Hong, & Verma, 2016; Lee & Bednarz, 2009; Mzuza & Van Der Westhuizen, 2019) and include the enhancement of spatial thinking and reasoning skills and the use of GIS as a geographic inquiry tool. Considering the growing need for (spatial) data scientists (Delporte, 2018; Granville, 2014), another benefit of using GIS in teaching is to assist young Australians to develop skills needed for these roles.

There have been various efforts to implement GIS in the classroom, however, its use in some places still remains marginal (Höhnle, Fögele, Mehren, & Schubert, 2016). Some teachers lag behind in their knowledge, skills and experience with GIS (Collins & Mitchell, 2019; Höhnle et al., 2016; Mitchell & Lambert, 2015). This limits the implementation of meaningful and authentic GIS projects in schools and questions the achievability of meeting the Australian Curriculum standards for Geography in regard to spatial technologies. This may be a result of limited pre-service teacher training at university or a lack of professional development for in-service teachers. Short courses as part of professional development for in-service teachers should explore GIS software in adequate depth to enhance confidence. It is vital for teachers to have access to units and resources that introduce beginners to GIS. Readily-available teaching units can be an important incentive to engage in learning. Lesson plans using GIS have been published online and are free for download. Esri Australia, for example, offers a number of short online lesson plans using the web-based ArcGIS Online (esriaustralia.com.au, 2019). These lesson plans target teachers at the beginner level and provide units linked to the Australian Curriculum: Geography. Training in GIS is also available online and free of cost.

The following outlines and discusses two Year 8 inquiry-based teaching activities using GIS.

Year 8 Geography teaching unit – Landscapes and Landforms

In Year 8 Geography, there are two units of study, Landscapes and Landforms and Changing Nations, targeting topics of physical and human geography, respectively. The first example presented below involves an in-depth study of mountains. GIS is introduced and embedded into practical field activities in Kosciuszko National Park. Students use their own digital devices to collect data through the ViewRanger app and Esri Collector app.
Learning objectives
The general learning objectives of this teaching unit, in combination with GIS, are:

- to produce a cross-section from elevation and location data, which can be viewed and then used to calculate distance in Google My Maps.
- to identify different vegetation types with increasing altitude, which can be viewed and analysed in ArcGIS Online;
- to understand the impact of fire on the subalpine/alpine environment of the Australian Alps.

Prior to taking students on the excursion to Kosciusko National Park, students are introduced to the concept of landscapes and landforms, their value, and processes such as weathering and erosion. Furthermore, mapping skills as part of geographic inquiry are practised. The following learning activity is designed to teach the construction of cross-sections using digital data. Students explore topographic maps and construct cross-sections manually from contour lines before applying the affordances of GIS.

Learning Activity 1 – constructing a cross-section using Google My Maps
Students require access to a portable device, either a phone or a tablet, and the ViewRanger and Esri Collector applications. Depending on students’ prior ICT skills, it may be beneficial to have screenshots of step-by-step guidelines on how to use these apps as well as how to view the data later in Google My Maps and ArcGIS Online.

This activity is easy to prepare and teaches students how data can be collected, imported and manipulated. Before students collect location and elevation data on the fieldtrip, they practise on the school campus. Guided instructions are useful for students to work on their own while the teacher attends to students experiencing difficulties. Before commencing the field trip students should be familiar with the calculation of geographic coordinates and elevation data. This activity can be conducted in any type of environment. Note that ViewRanger requires a data connection to operate so a remote location without phone reception is not suitable. The Esri Collector app, however, works offline. Examples of a map and the corresponding cross-section from this activity are provided in Figures 1 and 2 respectively.

Learning Activity 2: Identifying and categorising different vegetation types, using Esri Collector
The second activity is based on the free web course ‘Teaching with GIS: Field Data Collection Using ArcGIS’ (esri.com, 2019) and can only be accessed once the teacher has an Esri account as well as installed ArcGIS Pro or ArcMap software (which is part of the free campus license). The web course takes about five hours to complete and guides the teacher to set up a vegetation field survey map that can then be shared with students. To access this map, students require an ArcGIS online account (individual student accounts need to be set up by the administrator of the school campus) and the Esri Collector app installed on their phone.

The created Collector Map on vegetation data allows students to identify different types of vegetation (tree, shrub, herb, other) and categorise their findings, for example, in regard to a tree’s condition as poor, healthy, etc. These categories can be pre-defined, either by the teacher or by the class. They become available as a drop-down menu once students have logged in to the app. As with the previous activity, it is recommended that students practise collecting and viewing data prior to the excursion. Exploring the school campus is an easy way to achieve this. There are three main steps for students to complete: a) logging into their ArcGIS online account and creating a password, b) collecting data on a portable device which automatically
synchs the data to ArcGIS Online, and c) accessing and viewing their data on a shared map displayed in a web browser, using the web-based ArcGIS Online. Examples of vegetation data that students collected on a walk from Perisher Ski Resort to Porcupine Rocks are provided in Figures 3 and 4.

Figure 3: GIS data inquiry – Vegetation Types

Source: Author with Year 8 Geography class, using ArcGIS Online, 2017

Figure 4: GIS data inquiry – Vegetation Condition

Source: AUTHOR with Year 8 Geography class, using ArcGIS Online, 2017

Evaluation

The difference between these two Year 8 Geography activities can be considered in terms of user-friendliness, teacher’s time-investment and data analysis. The ViewRanger/Google My Maps is easy to set up, but requires more teacher-guided instructions. Esri Collector/ArcGIS Online, on the other hand, requires teacher investment time to acquire the skills necessary to create a map query and set up individual accounts (there is also an option to have one account for all students that is then shared between the whole class). When viewed only in regard to the wealth of data, using Esri Collector/ArcGIS Online will create a richer learning experience. This is especially true as ArcGIS Online has several built-in functions, for example, a buffer function, that allows the analysis of data, whilst in Google My Maps data can only be viewed. Students can analyse where certain types of vegetation are more common, grouping them and using this data for further analysis. For example, some trees along the Porcupine Rock walk had died due a fire. On ArcGIS Online, students were able to single out these ‘poor’ conditioned trees to identify how far the fire had reached.

The first activity teaches students valuable numeracy and ICT skills, for example multiplying the geographic decimal degrees by minus one to express southern latitudes or having to import a GIS-compatible file (e.g. ‘.csv’). It also provides opportunities to distinguish between different coordinate systems as different phones have different settings, thus the location data collected may vary from geographic coordinates of degrees, minutes, seconds to decimal degrees and UTM coordinates. It should be noted that the .csv files described in the first activity can also be imported into ArcGIS Online, which also allows for the measurement of distance. Google My Maps, however, has a simpler-looking interface, with less distractions for students. During a field experience, it is advisable to limit data collection to certain sections or specific points of the route. Students should have opportunities to experience the environment without the distraction of frequently looking at their device. Therefore, it is the teacher’s responsibility to provide locations where GIS can be used purposefully.

These two field-based GIS activities facilitate students’ spatial thinking, for example when constructing a two-dimensional cross-section from their own digital data. By allowing students to determine their own data queries students gain autonomy and a sense of ownership. This also allows them to problem-solve and work as a team.

Conclusion

In summary, GIS allows students to visualise, query and analyse data within field activities enabling them to physically interact with the environment. Constructing cross-sections is positively correlated with spatial visualisation abilities (Cohen & Hegarty, 2012). Using spatial data for analysis as presented in the second teaching activity can equally enhance students’ spatial thinking skills, helping them to organise and structure data (Lee & Bednarz, 2009). Whilst the second teaching activity may be more time consuming for teachers to set up, it allows for inquiry-based learning and greater manipulation and analysis of the collected data. But training is necessary so teachers have the skills to provide such lessons. Collins and Mitchell (2019) recommend that to achieve long-term success with GIS implementation in the classroom, pre-service teacher training in Geography should improve and include adequate training in GIS, beyond the mere awareness of the technology. These writers also call for improvements in professional development in GIS for teachers. Teachers often limit the use of GIS to displaying spatial data (Walshe, 2017) instead of using the more complex functions of spatial analysis.
References


Abstract
The article outlines ways that teachers could use the content in Biomes and Food Security unit in the Australian curriculum, and its state and territory versions, to encourage their students to engage with higher order thinking. It first briefly discusses how to describe and classify higher-order thinking and argues that concepts are central to this thinking. It also argues that powerful knowledge, an idea associated with Michael Young, develops the same ways of thinking. The article then discusses the higher order actions of explaining (in the sense of explaining causation), analysing, synthesising (or generalising) and evaluating, and how they can be applied to the content of the unit. The contribution of geography’s major concepts (such as place and interconnection) to higher order thinking, and therefore to making the unit geographical, is also discussed. The article concludes with a description of a way of teaching the unit as an extended inquiry, organised as a series of questions. This strategy provides many opportunities to use higher order thinking, because to answer the questions students will have to explain, analyse, synthesise, generalise and evaluate, while the whole unit becomes an exercise in problem solving.

Introduction
It is hard to imagine a teacher or school leader who is not aware of the importance of teaching higher-order thinking skills to prepare young men and women to live in the 21st Century. However, the extent to which higher-order thinking skills are taught and assessed continues to be an area of debate, with many teachers and employers expressing concern that young people ‘cannot think’. (Collins, 2014).

In addition, we want to highlight the use of geography’s major concepts in higher order thinking, because conceptual application and analysis are essential to higher levels
of geographical thinking. As Young (2010, p. 25) writes, “intellectual development is a concept-based not a content-based or skill-based process”. For example, concepts enable students to think about the abstract attributes of the phenomena they study. Young (2010) describes this as making the world ‘an object of thought’ rather than ‘a place of experience’, and he illustrates this with the example of the city. As an object of thought, students learn that cities have functions, such as retailing and manufacturing, not just shops and factories, and that understanding these functions and patterns enables them to compare cities. Another role of concepts is to form generalisations, which have been described as “a synthesis of factual information that states a relationship between two or more concepts” (McKinney & Edgington 1997, pp. 78–79). Marschall & French (2018, p. 18) add that ‘Generalizations transfer across contexts and situations. They are written as truths, and therefore may require qualifiers such as often, can, or may’. A generalisation can be used by students to apply their knowledge to situations they have not experienced, and so create new understandings.

Table 1: Three taxonomies of cognitive demand

<table>
<thead>
<tr>
<th>Revised Bloom taxonomy of the cognitive process</th>
<th>Marzano’s taxonomy</th>
<th>Biggs’ SOLO taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Remember</strong></td>
<td><strong>Retrieval</strong></td>
<td><strong>Unistructural</strong></td>
</tr>
<tr>
<td>Recognise</td>
<td>Recognise</td>
<td>(student includes one relevant aspect)</td>
</tr>
<tr>
<td>Recall</td>
<td>Recall</td>
<td>Identify</td>
</tr>
<tr>
<td></td>
<td>Execute</td>
<td>Name</td>
</tr>
<tr>
<td><strong>Understand</strong></td>
<td><strong>Comprehension</strong></td>
<td><strong>Multistructural</strong></td>
</tr>
<tr>
<td>Interpret</td>
<td>Infer</td>
<td>(student includes several relevant independent aspects)</td>
</tr>
<tr>
<td>Exemplify</td>
<td>Compare</td>
<td>Combine</td>
</tr>
<tr>
<td>Classify</td>
<td>Explain</td>
<td>Describe</td>
</tr>
<tr>
<td>Summarise</td>
<td></td>
<td>Enumerate</td>
</tr>
<tr>
<td><strong>Apply</strong></td>
<td></td>
<td><strong>Perform serial skills</strong></td>
</tr>
<tr>
<td>Execute</td>
<td></td>
<td><strong>List</strong></td>
</tr>
<tr>
<td>Implement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Analyse</strong></td>
<td><strong>Analysis</strong></td>
<td><strong>Relational</strong></td>
</tr>
<tr>
<td>Differentiate</td>
<td>Match</td>
<td>(student integrates information into a structure)</td>
</tr>
<tr>
<td>Organise</td>
<td>Classify</td>
<td>Analyse</td>
</tr>
<tr>
<td>Attribute</td>
<td>Analyse errors</td>
<td>Apply</td>
</tr>
<tr>
<td></td>
<td>Specify</td>
<td>Argue</td>
</tr>
<tr>
<td></td>
<td>Generalise</td>
<td>Compare/contrast</td>
</tr>
<tr>
<td><strong>Evaluate</strong></td>
<td><strong>Knowledge utilisation</strong></td>
<td><strong>Extended abstract</strong></td>
</tr>
<tr>
<td>Check</td>
<td>Make decisions</td>
<td>(student generalises the structure to a new domain)</td>
</tr>
<tr>
<td>Critique</td>
<td>Solve problems</td>
<td>Create</td>
</tr>
<tr>
<td>Create</td>
<td>Experiment</td>
<td>Hypothesise</td>
</tr>
<tr>
<td>Generate</td>
<td>Investigate</td>
<td>Reflect</td>
</tr>
<tr>
<td>Plan</td>
<td></td>
<td>Theorise</td>
</tr>
<tr>
<td>Produce</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Krathwohl, 2002; Dubas & Toledo, 2016; Biggs, 2019.
A focus on geography’s major concepts, such as place, space, environment and interconnection, underpins the content of the Australian Curriculum: Geography. These concepts should be explicitly incorporated into teaching, learning and assessment programs, because they describe geography’s ways of thinking and deepen students’ understanding of the subject. For example, they guide the questions that geographers ask, the methods they use to organise and analyse information, the explanations they might test, the structures and patterns they look for, the ways they think about problems and search for answers, and the criteria they use to evaluate these answers. They are what makes geography geographical, and students should finish the unit with a better understanding of how the underpinning concepts can be applied at a range of scales, in response to a variety of questions and from different perspectives. The importance of these concepts is also highlighted in the Professional standards for accomplished teaching of school Geography (AGTA, n.d.). Standard 1: Knowing geography and the geography curriculum, Element 1.1 is “know the breadth and depth of the academic discipline including its concepts, skills, values and understandings”, while Standard 3: Developing geographical thinking and communication, Element 3.4 is “provide students with varied contexts through which to construct a deep understanding of geographical concepts and use case studies to give support to the subject’s breadth and depth”.

**Powerful knowledge**

We also want to show teachers how focussing on higher order thinking will help them to teach powerful geographical knowledge. The concept of powerful knowledge was introduced into school educational debates over a decade ago by Michael Young, a British sociologist of education (Young, 2008). He contends that the main purpose of schools is to teach knowledge that enables students to understand and explain phenomena, or events, particularly those that are beyond their personal experience, is powerful knowledge.

Powerful knowledge refers to what the knowledge can do or what intellectual power it gives to those who have access to it. Powerful knowledge provides more reliable explanations and new ways of thinking about the world and . . . can provide learners with a language for engaging in political, moral, and other kinds of debates. (Young, 2008, p. 14)

“Powerful knowledge” is powerful because it provides the best understanding of the natural and social worlds that we have and helps us go beyond our individual experiences (Young 2013, p. 196)

Knowledge is ‘powerful’ if it predicts, if it explains, if it enables you to envisage alternatives. (Young 2014, p. 74)

Powerful knowledge, therefore, provides students with ways of analysing, explaining, predicting, evaluating, and thinking about the world. These powers are very similar to those in the list of higher order thinking skills in Table 1, which shows that the two can be developed together. They are discussed below, along with an explanation of how they can be illustrated and taught through the content in the Biomes and Food Security unit, and how they contribute to higher order thinking.

The discussion also includes some comments on the way the unit is presented in the textbooks produced by the four major Australian publishers for the Australian Curriculum (Oxford University Press, Cambridge University Press, Pearson and Jacaranda). This is designed to draw attention to ways that the content in these textbooks could be extended by teachers.

**Explaining and analysing**

The Biomes and Food Security unit has many examples of ways of explaining, and here we focus only on those that apply geographical concepts. Below are some examples of the ways that concepts can be used in the Biomes unit to understand, explain and analyse, and therefore to use higher order thinking skills. Michael Young would argue that the knowledge that enables students to understand and explain phenomena or events, particularly those that are beyond their personal experience, is powerful knowledge.

**Place**

In the unit the application of the concept of place is imperative to being able to understand the link between where a biome is located and what it is able to produce. For example, although the concept of place underpins key understandings from the content descriptions across the whole unit, particular emphasis on place can be illustrated in the following content description: Environmental, economic and technological factors that influence crop yields in Australia and across the world. When explaining regions with particularly high crop yields, or evaluating the food production potential of northern Australia, we must examine the distinctive characteristics of particular regions, or places. For influences on crop yields, students could look for the common factors in regions with high yields that might explain their productivity, and the curriculum has suggestions on what these might be. In contextualising crop yields to Australia, students could use their knowledge...
of agriculture in other regions of Australia to evaluate the potential of northern Australia, and the likely problems that might be encountered. Investigating the differences between places is a very geographical way of thinking, but as in none of the textbooks is this use of the concept of place mentioned there is an opportunity for teachers to extend their content.

**Scale**

The method of testing relationships by analysing them at different spatial scales comes from the concept of scale, and it is important because different explanatory factors can be involved at different scales. In the Biomes unit, the analysis of scale can be emphasised in the following content description: *Distribution and characteristics of biomes as regions with distinctive climate, soils, vegetation and productivity, where the production of plant matter as the basis of agriculture, is first analysed at the scale of major biomes, where temperature and precipitation are the important variables. Agricultural yields are then analysed at a larger scale, where soils and water resources modify the effects of temperature and precipitation. Students should understand that this is an analytical use of scale.*

**Interconnection**

The concept of interconnection is fundamental to explanation in geography, because causal relationships are about the connections between causes and effects. These connections involve processes or mechanisms that seek ‘to show how – by what means, through which networks – particular outcomes materialize’ (Gregory et al., 2009, p. 586). Systems are phenomena linked through flows of energy, matter and information, and the second content description in the Biomes unit: *Human alteration of biomes to produce food, industrial materials and fibres, and the use of systems-thinking to analyse the environmental effects of these alterations,* suggests systems thinking can be used to analyse the effects of the changes to the environment made by humans to produce food and other products. Some textbooks explain how ecosystems are structured, but only one (by Cambridge University Press) explains that ecosystems are an example of a system, and then only briefly. None of the texts lists systems in their index. There is an opportunity here to introduce students to systems thinking as a way to understand the relationships between phenomena, and the processes of environmental change.

An example of the application of systems thinking that is very relevant to the Biomes unit is salinisation in Australia. Such an application is appropriate to use when covering the following content description: *Challenges to food production, including land and water degradation, shortage of fresh water, competing land uses and climate change, for Australia and other areas of the world.* Figure 1 shows the changes that can occur when native vegetation is cleared in places where the groundwater is naturally saline. The situation can be described as a system because of the interconnections between vegetation, evapotranspiration, the volume of water penetrating into the soil, and the level of the water table. When the native vegetation, with its deep roots, is removed all the other variables in the system change, as explained in the figure.

**Figure 1:** The causes of dryland salinity

Trees, deep-rooted perennials and native vegetation use most of the water that enters the soil, and the large blue arrow pointing upwards represents their evapotranspiration into the atmosphere. The result is limited water flow below the plant root zone, represented by the small blue arrow pointing downwards.

Removing native vegetation and growing shallow-rooted annuals reduces evapotranspiration into the atmosphere (the small blue arrow pointing upwards), and increases the flow of water to the groundwater system (the large blue arrow pointing downwards). The result is that the water table rises and brings salt to the root zone and the soil surface.

Source: Podmore 2009.
Generalising

Generalisations, as noted earlier, synthesise concepts into statements of relationships. They can be powerful because they help students make sense of a lot of information, and so increase their understanding. More importantly, they are powerful because they enable students to apply what they have learned from the study of one set of factual relationships to new situations that they have not encountered before. This enables them to ask appropriate questions, make sense of contexts beyond their experience, and increases their ability to solve problems. Generalisations can be especially powerful if they include explanation or can be used to predict. For example, from their study of the Biomes unit students might be able to appreciate the power of a generalisation such as this:

Because of the interconnections between the components of the biophysical environment, change in one component may produce change in others. The subsequent changes may be experienced in the same place as the initial change, and/or in different places.

This generalisation could be developed from a study of the causes of salinisation described above, and then used as a framework to analyse the likely outcomes of continued land clearing for agriculture in northern Australia. Note that the generalisation adds the concept of place to that of interconnection, which makes it distinctly geographical.

Evaluating

This higher order thinking skill is, first, about the ability of students to evaluate claims about knowledge, by assessing the accuracy and soundness of information, arguments and opinions, including their own. This is a high order intellectual task, and to do it students need to know something about the ways knowledge is created, tested and assessed. The Biomes unit provides some very good opportunities to explore these ways by asking the question: how do we know? For example:

- How do we know what the future population of the world might be?
- What is the evidence for the harmful effects of genetically modified, or GM, foods?
- How do we know that vegetation clearance can cause salinisation?
- How do we know what the effects of future climate change on food production might be?

Questions such as these make students examine the methods used to find answers to some important and difficult problems, and to think about why different people produce different answers. For example, a recent book argues that the projections of the future population of the world by the United Nations are much too high, and explains why (Bricker & Ibbitson, 2019). Which projection is chosen makes a big difference to the assessment of future food security.

A second aspect of evaluation is thinking about the implications of what one is learning about a topic. For example, the Biomes unit asks students to think about the sustainability of food production methods, and about future threats to sustainability, yet the textbooks have little explanation of how to evaluate this. There is an opportunity here to give students a much deeper understanding of sustainability, and of how to make the concept operational. Some suggestions can be found in Maude (2014) which proposed this test of sustainability for renewable resources:

To be sustainable, renewable resources should be extracted at or below their rates of renewal, and in ways that do not reduce the productive capacity of the environment.

This tells students to assess the sustainability of timber production, for example, by whether timber is being extracted above the rate at which it is being renewed through growth or new planting, and of agricultural production, by whether the methods used are degrading the productive capacity of the land. The curriculum draws the attention of students to several examples of land degradation.

Ways of thinking

The actions described by the verbs in Table 1 all involve individual ways of thinking. Young’s idea of powerful knowledge as providing “new ways of thinking about the world” offers a much broader view of higher order thinking, because these ways of thinking influence a number of these actions. Geography’s ways of thinking are embedded in its major concepts of place, space, environment and interconnection. These concepts influence the questions geographers ask, the methods they use to answer them, the explanations they explore, and the ways they evaluate their findings. However, in the textbooks we examined, while the major concepts specified in the curriculum are explained in the introductory pages, with the limited exception of two texts (both by Oxford University Press) they are scarcely referred to in the rest of each book. Here is another opportunity for teachers to extend the texts to teach geographical ways of thinking.

There are many opportunities in the unit to show how the topic being discussed illustrates
a concept, or could be further explored by applying a concept. For example, the concept of interconnection can be illustrated by ecosystems, by the environmental changes caused by agriculture, by the links between the various causes of food insecurity, and by trade in agricultural products.

The unit also provides opportunities to develop student understanding of the concept of environment. One of the dimensions of the concept could be described in this way:

Humans are dependent on the biophysical environment for their survival. It supports and enriches human life by providing raw materials and food, recycling and absorbing wastes, maintaining a safe habitat and being a source of enjoyment, inspiration and identity.

This statement emphasizes our dependence on the environment, and therefore the fundamental importance of preserving its ability to support human life and human welfare. The Biomes unit explores human dependence on the environment for raw materials and food in some detail, particularly as it starts with the productivity of different environments, the ways that humans have modified them to increase yields, and the threats to their productive role from land degradation, water scarcity, competing land uses and climate change. The whole unit is an extended illustration of the above statement, and could be taught as such.

Structuring the unit as an inquiry

One way to design the Biomes unit to teach higher order thinking is to structure it as an inquiry, because this will emphasize questioning, analysis, explanation, generalization and prediction, and issues that do not have simple answers. This is not difficult, as the unit has a theme running through it that links the sections of the curriculum, and these have been arranged in a logical order. The theme is described in the title: Biomes and Food Security. This is not a unit about biomes on their own, but about biomes as the source of food and fibre. Here is a possible structure.

The overall question to be answered at the conclusion of the unit is:

Can the projected future population of the world be adequately and sustainably fed?

An answer to this question can be developed in steps, each of them starting with a question, the answer to which leads to the next step and question. The major geographical concepts that can be illustrated and applied at each step are noted in brackets in the description below. The structure also includes possible generalizations that sum up each stage in the inquiry. They are included as examples, not as definitive statements, and some of them are suitable for class debate, as they can be contested.

**Question 1. What is the ultimate source of our food?**

Our food comes from the environment, either directly from plants or indirectly when we eat animal products. At a global scale, the production of plant matter, or biomass, depends on precipitation and temperature. It varies between biomes and is measured by net primary productivity. We need, therefore, to know what biomes are, where they are, and the effects of climate on biomass production in each major biome.

Note that the content description for this section of the Biomes curriculum, and one of its elaborations, include the terms productivity and net primary productivity. These were added to get students to think of productivity as one of the attributes of a biome or ecosystem, and of net primary productivity as a numerical way to measure it and compare biomes. Only one textbook adopted this approach.

**Possible generalizations:**

- The biophysical environment supports human life through the production of plant matter that supplies food, fibre and industrial materials. (one dimension of the concept of environment);
- The production of plant matter is determined by temperature and precipitation and varies between biomes. (concepts of environment and place);
- The production of food, fibre and industrial plant materials requires the alteration of environments, and the appropriation of biomass by humans. (concept of environment).

**Question 2. What factors determine food crop yields?**

Food crops are a specialized form of biomass, grown by human intervention in the environment. The next step is to examine the environmental, economic and technological factors that influence food crop yields. This is where soils and water resources modify the influence of climate, and factors such as irrigation, accessibility (concept of space), labour supply, landforms and agricultural technologies (for example, high-yielding varieties) become important. Australia is an excellent example of environmental constraints on
agricultural production (for example, limitations in soil moisture, water resources and soils), as well as of innovations (such as crop breeding and conservation farming) that have overcome some of them. Note that the analysis of crop yields is at a different scale to biomes and can be used to illustrate the concept of scale.

While the curriculum specifies food crop yields, most textbooks only discuss the quantity of production of specific crops in various countries. This is a missed opportunity, because understanding yields is a step towards understanding the potential for increasing them to feed future populations (by intensification), instead of simply bringing more land under cultivation (by extensification).

Possible generalisations:

- Food crop yields are influenced at a local or regional scale by landforms, soil quality, irrigation infrastructure, labour supply, accessibility and agricultural technology, as well as at a global scale by temperature and precipitation. (concepts of environment, space and scale)
- The constraints on food production produced by environmental conditions can be reduced but not eliminated by technology and human organisation. (one dimension of the concept of environment)

Question 3. Are the methods used to produce food environmentally sustainable?

The changes to the environment required for food production have had positive effects, as they enable us to feed ourselves, and produce fibre and timber. Furthermore, some highly altered environments have been quite sustainable agricultural systems, such as in China or Bali. On the other hand, some changes have had negative effects, and some of these may be a threat to the sustainability of food production (concept of sustainability). The curriculum mentions the following changes: vegetation clearance, introduction of exotic species, drainage, terracing and irrigation, and there are others such as fertilisers, pesticides and genetically modified plants. To understand their effects on the environment it can be useful to compare the differences between natural and agricultural ecosystems in flows of nutrients and water, and in biodiversity, and the consequences of these differences. This is where ecosystems become relevant to the argument (concept of interconnection). As mentioned earlier, students also need to understand what sustainability means when applied to food production, including fishing.

Australia should be a case study of the effects of human alteration of the environment for food production, and of ways to manage any negative consequences and improve sustainability.

Possible generalisations:

- To be sustainable, renewable resources should be extracted at or below their rates of renewal, and in ways that do not reduce the productive capacity of the environment. (concept of sustainability);
- Because of the interconnections between the components of the biophysical environment, change in one component may produce change in others. The subsequent changes may be experienced in the same place as the initial change, and/or in different places. (concepts of interconnection and place);
- Agricultural methods have degraded large areas of the world’s soils though erosion, acidification, contamination, salinisation, compaction and loss of organic matter. (concept of environment);
- The production of food and raw materials has increased the appropriation of biomass by humans, and reduced that available for animal life. (concept of environment);

Question 4. Can the world’s biomes produce enough food to sustainably feed the projected future global population?

The answer to this question builds on material examined in questions 2 and 3, but we must first estimate the size of the projected human population, and the implications of trends in food consumption, such as the growing preference for animal products. The next step is to evaluate ways of increasing food production to the level needed to feed that population, including the differences between intensification and extensification, and the environmental sustainability of alternative methods. The curriculum also reminds us that future food production will be reduced by land degradation (soil erosion, salinity, desertification), industrial pollution, water scarcity, competing land uses (such as urbanisation), and climate change, if these challenges cannot be managed.

An appropriate case study is Australia's potential to increase its contribution to future world food production. Can production be increased, both through technological innovations and agricultural production in northern Australia? Will this increase outweigh the effects of population growth in Australia on local food consumption, and therefore on food exports? What is the environmental sustainability of the different methods of increasing agricultural production in Australia?
None of these topics and questions has obvious answers, and they provide opportunities for students to discuss, evaluate evidence and validity of alternative opinions, debate, and reach conclusions that they can defend. Predicting the future population of the world, and of individual world regions, is one such topic.

Generalisation:

- Intensification may be a more environmentally sustainable way to increase world food production than extensification, but the capacity of either to produce food in the future faces challenges from land degradation, water scarcity, competing land uses and climate change. (concepts of sustainability and environment).

**Question 5. Will increased food production provide food security for all people?**

An elaboration in the curriculum suggests examining how poverty, food wastage, government policies or trade barriers could also affect future food security. This part of the unit provides great opportunities for students to discuss, debate and argue over alternative answers, building on what they have studied so far. There is no one simple answer to the question.

Generalisation

- Future world food security is threatened more by poverty, conflict, water scarcity, climate change and unsustainable agricultural methods than by the growth of population. (concept of environment)

The structure outlined above provides a framework that will help teachers decide what needs to be taught, and what doesn’t, because some textbooks have material that is not specified in the curriculum. For example, the focus in the biomes sections of the curriculum is very much on their productivity, because the biomass they produce is the source of food and fibre. This should be the theme of these sections, but some texts have material on ecosystems that does not fit the theme, such as on threats to biomes. This content would be appropriate in a purely physical geography text, but in the Biomes unit it results in an overload of information. The structure will also help teachers to decide when to illustrate and develop an understanding of a concept, what sorts of generalisations might be discovered, how the content of the unit can be organised around questions and inquiry, ways to encourage debate, and how to integrate the teaching of skills with the content being studied. All of this will contribute to higher order thinking. The structure is shown diagrammatically in Figure 2, using generalisations (syntheses) to describe each step.

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**Figure 2: A possible structure for the Biomes unit**

The biophysical environment supports human life through the production of plant matter that supplies food, fibre and industrial materials.

The production of plant matter is determined by temperature and precipitation, and at a global scale varies between biomes.

Food crop yields are influenced at a local or regional scale by landforms, soil quality, irrigation infrastructure, labour supply, accessibility and agricultural technology, as well as at a global scale by temperature and precipitation.

The changes to environments caused by current methods of agriculture have both positive and negative effects on the sustainability of food production.

Intensification is likely to be a more sustainable way to increase world food production than extensification, but the capacity of either to produce food in the future faces challenges from land degradation, water scarcity, competing land uses and climate change.

Future world food security is threatened more by poverty, conflict, water scarcity, climate change and unsustainable agricultural methods than by the growth of population.
Conclusion

In this article, we have explained why higher order thinking is important, and how it can be integrated with the teaching of powerful knowledge and geography's major concepts. We then proposed ways that teachers could use the content of the Biomes and Food Security unit to develop the higher order thinking of their students, and to teach some powerful geographical knowledge. We set out a way of structuring the unit as an extended inquiry, guided by a sequence of questions, in order to emphasise questioning, analysis, explanation, synthesis, generalisation, and prediction. Structuring the unit in this way should make teaching easier, because the questions provide a guide to what is relevant and what is not, and a focus for each step in the inquiry. Students, on the other hand, should find the unit easier to comprehend because of its clear structure, while the generalisations they develop will enable them to synthesise factual information into powerful statements of relationships and understandings. If geography's major concepts have been fully applied to the content of the unit, students should also understand what is geographical about it, and why these concepts are the foundation of geographical thinking and the distinctiveness of the subject. At the same time they will have learned some important information about the environmental basis of food production, and agricultural methods and their sustainability, particularly in Australia. These are topics that, in the Australian curriculum, are only taught in geography.

References


**Endnotes**

1. For explanations and critiques of powerful knowledge see Maude (2016 and 2017), Huckle (2019), and White (2018).

2. For a cautionary history of resistance to knowledge about the causes of salinisation in Western Australia, see Beresford (2001).

3. For other ideas on teaching this unit see Birch (2014), Carey and Sheridan (2017), Chaffer (2019), and Rostolis (2014).
This volume consolidates reports from a number of research projects across North Australia, which were funded in 2013 by the Melbourne-based Bushfire and Natural Hazards Cooperative Research Centre in partnership with Charles Darwin University and the North Australian Indigenous Land & Sea Management Alliance (NAILSMA).

The editors deserve our gratitude and congratulations on assembling an invaluable guide to what needs to change in the way North Australia is responded to. While this is an expensive volume, it will be an invaluable resource for anyone seeking to understand and engage with the debates about land, water, culture and resources across the region.

Chapter 1 offers an important contextual introduction to the issues – and to NAILSMA and the role of Indigenous peoples and organisations in any policy proposals for North Australian development. It concludes with an appeal for a national commitment for inclusive and sustainable development (p. 7) in the north of Australia, but recognises the need for structural reform to achieve this, acknowledging that this will require a patchwork of local and regional settlements that negotiate both inclusion and sustainability.

The depth of that challenge is clarified in Chapter 2, which recognises that business-as-usual scenarios preoccupied “with large infrastructure development, ‘food bowls’, and unfettered exploitation of mineral and pastoral resources” (p. 9) have produced social and environmental catastrophe across the North.

The translation of legal land title and recognition into effective Indigenous influence over policy and practice has failed because of the developmentalist (and, one must acknowledge, fundamentally racist) mindset that has long dominated policy settings in North Australia.

Chapter 1 offers a framework for addressing the challenge. This framework emphasises the necessity of maintaining law, culture, and country, and the aspirations of Indigenous people across the North’ (p. 11). Djungan man Ricky Archer offers a powerful visual representation of the challenge of balancing the business-as-usual of top-down corporate-government-science approaches to management with the ground-up connected relationality of cultural governance of Country (Figure 2.3, p. 14).

The urgency of shifting dominant, business-as-usual approaches to national stewardship of this continent, and of integrating the best of Indigenous, cultural and scientific knowledges into considered decision-making, is difficult to overstate.

Next generation thinking is being shaped in contemporary geography classrooms around Australia. It needs to be informed by balanced understanding – and this impressive volume offers the creative teacher huge opportunities and significant resources to shift Australian thinking from the short-term, get-rich-quick thinking that has dominated development policy and practice in Northern Australia for little more than a century in most areas, towards a deeper understanding of place, process and connection stretching across 65,000 years or more of human experience.

There are terrific illustrations, really powerful, short and articulate boxed texts, excellent references and accessible presentation of data throughout the book.

The volume brings together rigorous research from the humanities in Chapter 3 on the history of dispossession, colonisation and legislation across the North, and from the social sciences in Chapter 4 on economic development policies and programs. Chapter 5 on rethinking sustainable economic foundations across the North, Chapters 6 and 7 on community scale resilience and Chapter 8 on governance are deeply informed by, and engaged with, scientific research in collaboration with diverse Indigenous scientists, communities and values.

For geographers, this volume is a terrific supplement to the emerging literature presenting new cultural geographies of the region. In those works, we are beginning to see geography marshalled not as a means of colonising places, but as a partner in treasuring, protecting and celebrating places and their connections across space and time.

The work of the Bawaka Collective based at Yirrkala in northeast Arnhem Land (Bawaka Country, Suchet-Pearson, Wright, Lloyd, & Burarrwanga, 2013; Bawaka Country et al., 2014; Burrawanga et al., 2008, 2016; Lloyd, Wright, Suchet-Pearson, Burarrwanga, & Hodge, 2012) has recently culminated in an extraordinary

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**Sustainable land sector development in Northern Australia: indigenous rights, aspirations, and cultural responsibilities.**

**By Jeremy Russell-Smith, Glenn James, Howard Pedersen, & Kamlajit K Sangha. Boca Raton, Fl.: CRC Press, 2019,**

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http://www.crcpress.com

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Reviews Editor: Geoffrey Paterson

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new book that sees leading Yolngu thinkers present the cultural geography of their region for a wider audience with exceptional eloquence and elegance (Gay’wu Group of Women et al., 2019). Further west, the stories of the creation, history and people of Dambeemangaddee Country in the northwest Kimberley between Derby and Kalumburu have been shared in an exceptionally beautiful and compelling cultural geography of people, place and knowledge (Dambeemangaddee People et al., 2017). In that work, Australian geography is genuinely addressing and transforming its colonial roots.

In Sustainable land sector development, that hard work of transforming the way knowledges, connections and relationships are negotiated, created, communicated and applied is extended impressively and powerfully. This is a very contemporary view of the challenges and opportunities of North Australia. There is none of the boosterism, racism and ignorance that has characterised so many discussions of the region. Instead, this deeply collaborative work presents the thoughtful and well-informed understanding and assessments of people who are deeply connected to the region.

It is not just the Indigenous contributors, but also the scientists and social scientists themselves, who have forged and been transformed by connection to and understanding of place, that bring their passion for the North into play here. These are people who have developed respect for the place-based knowledges, the deep connections they reflect, and have critically contextualised the data generated by new science.

The principal audience for the book is probably more advanced than most classroom groups, but that should not deter teachers who will find the material offers an exciting integration of human and physical geographical perspectives and resources, and makes them accessible through good referencing with a lot of the material referred to being easily accessible online.

The work presented in Sustainable land sector development in Northern Australia brings diverse and important resources into easy reach for classroom use, and offers a stark contrast to earlier generations of knowledge that demeaned, diminished and discredited the discipline of geography with huge consequences for North Australia and its wonderful places and diverse peoples.

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City life: the new urban Australia


240 pages, paperback, ISBN 9781742235615
http://www.newsouthpublishing.com

This book challenges ideas about Australians, how they see and perceive themselves and, more particularly, the urban centres and large cities in which they live. Australia is one of the world’s most urbanised countries and has among the highest life expectancy. These salient facts mean in the future most Australians will live in globalised cities for most, if not all of their lives and that there has to be a fresh understanding of the nature of twenty-first century urban Australia.

This book contributes to the understanding of our cities and their suburban characteristics, particularly in Melbourne and Sydney. City life also presents a major emphasis on the urban transformations and manifestations that have come as globalisation – the “opening up of Australia” – has washed over and through Australian cities since the 1970s. The book drills into the research, documents and writings that chart many of these changes.

The particular focus of the book on the two biggest cities, Sydney and Melbourne, is a problem for geography teachers in the smaller population states who need some analysis of the “change through time” that has taken place in their urban
centres. However, the smaller Australian state capitals and regional centres are not completely ignored.

There is no doubt that O’Hanlon brings a keen historian’s eye to the local scene and circumstance, as well as the big Australian picture. It is at times a view most geography teachers would recognise as that of a historical geographer. The seminal work of internationally known city geographer, David Harvey, is also mentioned.

Throughout the book, the author introduces many terms, phrases, concepts, quotations and descriptions to which a geography teacher can immediately relate. These include tyranny of distance, “... Australia born urban and quickly grew suburban”, the data on the number of houses and apartments that have been built, urban densities, national migration patterns, inequality, “... by 2007 the world was more urban than rural”, hyper diverse cities, night-time economy, sights, smells and sounds of manufacturing and industrial suburbs before and after globalisation, manufacturing suburbs of the inner city and the outer suburbs and the changing nature of work.

The book’s chapter headings clearly summarise the author’s thesis: Introduction: Globalising the Australian city; Opening up and closing down; The twilight of the Fordist city: Working and not working in the post-industrial city; Cosmopolis: urban multiculturalism; Global migrations, local impacts; Studentification: From trends to PBSAs [Purpose Built Student Accommodation]; Lifestyle destinations: building the new inner city; Business, leisure and pleasure: reinventing the inner city; On the town: popular culture and the new Australian city; Conclusion: globalisation and the Australian city – an opportunity wasted?

Each chapter ends with a two- to three-page conclusion that summarises the sub-thesis of the chapter.

O’Hanlon shows he has been an industrious researcher over many years and marshals his material and breaks his subject fields into well-defined themes. He nourishes the ability to create word pictures, this being particularly so when tackling descriptions of an individual street, e.g., Victoria Street, Fitzroy, Victoria; an individual suburb, Elizabeth, South Australia; or the changes to the make-up of an individual industry, e.g., Moran and Cato the local and national grocery company.

O’Hanlon’s prose is sturdy and generally appropriate, with the drier statistics and trend data that are sometimes importantly introduced being coloured by the contour of his word pictures.

The central section of the book contains some important colour and black-and-white historical images of Melbourne and Sydney. Examples are ‘Melbourne, the Yarra and Southbank looking east from the Rialto Tower, 1983’ and ‘Darling Harbour, Sydney 1984’. These will allow a well-resourced geography teacher to make present day comparisons. Unfortunately, these images are not given figure numbers.

If there is a criticism of this book it is because there are two themes that are not covered and which are vital to any understanding of a “New Urban Australia”. They can be summarised by the two words solastalgia and meteoranxiety.1

Australia’s urban population is already suffering from these two anxieties and many existing, and future, urban initiatives are already aimed at, or will be attempting to alleviate, the economic, social, health and infrastructure consequences of these critical environmental hazards. The impact of the urban hazards, associated with these mega trends, is already occurring and future weather and climate scenarios suggest they will be of increasing severity.

The coastal suburbs of Australian cities will be subjected to sea level rise and storm surges while inland suburbs will suffer from the widespread and sometimes localised nodal effects of bushfires, floods, droughts, extreme temperatures, tropical diseases and vectors, and severe storms that will take a variety of forms – cyclonic, hail, frontal, dust and micro-bursts.

When considering the needs of Australian secondary schools, it is apparent that a teacher of years 11 or 12 urban geography, who is using the Australian Curriculum: Geography (ACG), or its state derivations, as their guide, could use this book as a background source. For example, chosen extracts could be read to students or investigated by them.

ACG Global Transformations unit provides this opportunity because under this general heading students engage “... with an understanding of the economic and cultural transformations taking place in the world today, the spatial outcomes of these processes, and their political and social consequences”, and undertake a depth study that can range from local to global, as appropriate (ACARA, n.d.).

Similarly, ACG unit Sustainable Places provides considerable opportunities for the book’s use because it concerns the study of “the interconnected challenges faced in places, including population growth and decline, employment, economic restructuring, transport infrastructure needs, housing, demands for improved health and education services, and other matters related to liveability” (ACARA, n.d.).

This book is not suitable for use by students in those years below and including year 10.

Fortunately, the book does have an index, so any search for topics and themes is made easier, and this is supplemented by a sources section of nine pages where the author lists the many other writers, books and articles that contributed to his text.

Chapter 2 includes two maps that show, presumably, the Melbourne and Sydney metropolitan areas, highlighting several localities and suburbs that are central to the content of the chapter. Even though they include several cartographic design principles, the clarity of their intent is limited by symbols that are hard to read, and a legend that doesn’t fully explain all details of the maps. The maps are not given figure numbers. A Figures list of these maps, and the images in the central section of the book, would be a welcome addition and make the book more user-friendly, if placed after the Contents page.
Although this book is primarily a teacher resource, senior school geography students would benefit from an introduction to the many stand-out examples that illustrate the urban-human environment relationships in the contemporary and historical setting of Australian cities. This is why it is possible to recommend the book, and why it would be an excellent addition to any school library and the background literature of a geography teacher who wants to really engage students when learning about their own cities.

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Reference

Endnotes
1. Solastalgia is the emotional distress specifically relating to climate change. Meteoranxiety is the anxiety that is felt in the face of the threat of the increasing frequency and severity of extreme weather events.

Coral reefs: tourism, conservation and management.

Coral reefs around the world are currently facing multiple pressures. From fishing through to tourism, pollution and climate change, humans are causing both direct and indirect threats to coral reefs and, in turn, the tourism industry.

Corals reefs: tourism, conservation and management provides a wonderful multidisciplinary and global review of the world’s major coral reef tourist destinations and their future prognosis. Over twenty international experts have been brought together from a diverse range of backgrounds and areas of expertise to compile a four-part assessment of the status of coral reef tourism.

Part One outlines in four chapters coral reef ecology, including how they are currently governed and managed. These early chapters provide a thorough overview of many of the major threats to reefs and their value to local peoples and economies, particularly the benefits that tourism brings and the challenges that a lack of legislation and regulations can have on an area’s long-term sustainability. Part One provides the reader with a strong understanding of the size and scale of the issues facing coral reefs as well as introducing the complex nature of any assessment of risk, impact and mitigation strategies that should possibly be considered by tourist operators, governments and other stakeholders.

Part Two extrapolates on the sustainability issues raised in Part One and addresses the impact and flow-on effects of rising sea temperatures on biodiversity. The section outlines how reef-dependent tourist destinations in many parts of the world will increasingly be affected by bleaching events. It also suggests that reef-based tourist operators that are a one trick pony will potentially suffer economic loss. With the reef as their only drawcard, and reef health in decline in many locations, the authors promote the idea of diversification within a business model for the future.

In addition to this, however, a contrasting proposal is made in the subsequent chapters with respect to the status of coral reefs in Belize and the benefits of good management. The final chapters in this section discuss Florida Keys and Western Australia’s Ningaloo Reef, where there appears to be a balance between development, growth and environmental protection which appears to be shoring-up their long-term survival.

The third section provides six case studies related to ecotourism. From the Maldives to Bali and Brazil, these chapters outline how tourism is being sustainably managed including the introduction of effective reef restoration strategies. The flip side is also discussed in this section as the text expands on some of the more challenging or threatening factors that will affect not only the reef’s survival, but also that of the tourist industries that rely on them. Political instability, funding shortages and ineffective law enforcement are some of the main issues discussed.

The final section addresses traditional and indigenous use of coral reefs, and the involvement of the media in shifting public awareness and debate on coral reefs and reef tourism. It concludes with a possible future roadmap for reef use and management. With almost a billion people living within 150 kilometres of the world’s coasts and reefs, traditional ownership, values and customs are considered within a Pacific context. In this sphere, positive flow-on economic effects are identified as being available and promoted to indigenous communities despite the long-term social costs not having been extensively explored to date by governments or other organisations. I found the section on the role that the media plays in its promotion and manipulation of public opinion towards coral reef tourism and reef destinations as particularly interesting. It would appear that this element may play an increasingly future pivotal role.

The authors conclude the section with a glass half full approach. Despite the negative aspects of climate change, poor water management, overdevelopment and overfishing, Prideaux and Pabel focus on the need for action in manageable ways. While they acknowledge the complex interconnected web of factors that affect coral reefs, they maintain the line that, with a clear policy framework that is adapted to local circumstances and then enforced, ongoing tourism use of coral reefs is possible, with the caveat that any legislative changes recognise that further damage must be minimised to achieve sustainability.

Coral reefs: tourism, conservation and management.

288 pages, hardback, ISBN 9781138689831
https://www.routledge.com/
In summary, the book highlights that effectively managed coral reef tourism provides an opportunity for well-informed public discourse related to the urgent need for government and community action. The text’s strength lies in its comprehensive analysis of coral reef tourism from different global case studies and perspectives. The diversity of thematic examples keeps the reader absorbed in the topic and motivated to dive deeper into the subject matter. Overall, I found it provided fascinating insights into the topic that I was not always expecting and subsequently wanted to inquire further about, and for me that what makes a good read. I would therefore happily recommend the text to teachers, students, academics and NGOs.

At the end of the day regardless of my review, it is whether or not the text is accessible, meaningful, appeals and stimulates debate. So, I will leave you with a quote from my 16-year-old daughter who picked it up, started reading it, couldn’t put it down and then peppered me with questions about some of the things she had read. I think she hit the nail on the head with this quote, but you decide – ‘It’s like those stories they have in National Geographic only with lots more detail and without the glossy pictures! Are there more in the series?’.

Clearly, it ticks all the boxes!

Anne-Marie Gerlach
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Extreme conservation: life at the edges of the world.
https://www.press.uchicago.edu

Written by a scientist and conservationist, this unique book takes you on a journey to three of the planet’s most extreme environments, where punishing conditions, increasingly influenced by human activities, pose a threat to some of the planet’s most hardy creatures.

Joel Berger has extensive experience researching animal behaviours in these environments and writes passionately about his encounters, both rewarding and challenging. Divided into four parts, the book provides a fascinating insight into the adaptations of three species in particular: musk oxen in Alaska, yaks on the Tibetan Plateau and saiga in the Mongolian steppe. The final part is dedicated to considering the complex factors affecting the future of such creatures.

Joel’s stories draw you into environments that are hostile but surprisingly diverse. Whilst the book is focused on three distinct species and their strong interconnections with the landscape, climate and other animals, the influence of humans is never too far away. Whether the legacy effects of hunting on animal behaviours and numbers, the impacts of cashmere goatherds, or our changing climate, the book calls into question the ability of these unique animals to adapt to the fast pace of environmental change they are currently experiencing.

Despite our perceptions of the beauty of nature, the book also highlights its brutality. In such extreme environments Darwin’s theory of natural selection plays out in a myriad of ways, be it through lone female muskox trapped in a snowhole or the existence of mysterious death assemblages, many of which go undetected in such hostile environments.

Joel provides both comical and nail-biting accounts of the field techniques used to monitor the animals. I was drawn to Joel’s account of dressing up as a caribou to observe the reactions of muskoxen. Later in the book, he recalls the excitement and nerves associated with capturing and collaring an energetic saiga with the risk of imprisonment should the animal die in the process.

This book is a suitable tool for teachers interested in broadening their knowledge of environmental change, animal adaptations and extreme environments. Extracts from the book could be used with students Year 10 or above to give them a sense of the fragility of the world’s extreme environments and the animals that have populated these regions for millennia, animals that traditionally do not receive much attention.

Anna Haigh
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Finding resilience: change and uncertainty in nature and society.
https://www.publish.csiro.au/

This was a fun book to read, full of a life of great endeavours, humour and friendship, but also importantly, a constant striving for new knowledge and its application for better futures.

At times as I was reading, I wondered who would use a book like this. The work isn’t a textbook or a book structured for guiding teaching; nor is it a pretty book with lots of pictures and figures; nor again is it a strongly theoretical book with particular comprehensive insights into resilience theory – other books by Walker and others provide more academic guidance. Nevertheless, while it doesn’t fit into those categories it does fit into another – a book to engage perceptive students with the ecological challenges that humanity faces. The aim of the book states (p.17) that “this book is an unfolding story around these
questions” of resilience and how it applies within natural and social ecosystems.

There is enormous challenge ahead for humanity to transform environmental systems for resilience – the core theme of this book. As the book outlines, many solutions will be associated with new knowledge, better policies and new governance arrangements, but we will also need another element – human bravery.

Students will need to understand the personal costs associated with making real change, and yet still make the choice to join the struggle for a sustainable future. Young people are making those decisions, recognising that within a struggle for socio-ecological justice is an important quest that is not just vital for the planet, but also provides a life-path which is fruitful and fulfilling.

What Walker has shown in this book, by drawing from engaging and humorous anecdotes and lessons from his own research path through southern Africa, North America, Europe and Australia, is that by engaging with ecological principles such as predation, disturbance, migration, niche and resilience theory, and using that knowledge to promote better places, the application of rational socio-ecology is also a personal adventure.

I particularly enjoyed the middle chapters that examined the roles human culture plays in framing the key social principles that enable societal resilience, such as social cohesion, decision-making and cooperation, diversity, languages and belief, which together assist people to negotiate their interactions with each other and the environment.

Ethical investment, ecotourism and education are introduced, but instead of offering comprehensive solutions, the book leaves me with a feeling that scientists have largely been working on the sidelines, documenting the process of ecological destruction as it plays out before them.

I reviewed this while also reading articles about the amnesty given to farmers illegally clearing land in New South Wales, the potential collapse of the Murray-Darling Basin Agreement due to questionable governance arrangements, and the arrest of protestors (and journalists!) at the Adani mine site in Queensland. I couldn’t help thinking that the solutions offered also needed to be more deeply political to challenge the corporate conservatism that is preventing positive change.

While the final chapters didn’t engage with the key constraints of hegemonic power, I found it to be a beautiful and thoughtful book, which would be useful for students searching for rational answers to complex socio-ecological questions. There are rewards for the reader all the way through, but given the minimal use of structural sign-posting, it requires the reader to be seeking the wisdom generously outlined within stories from a life well-lived. As Walker states (p. 118), humanity is “trapped in a way of living from which it is very hard to escape. Change won’t be easy but as more and more people become aware of and concerned about the need for it, hopeful developments are underway”.

Dr Douglas Bardsley
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Geography education for global understanding.
https://www.springer.com/gp

The theme of the book is building global understanding through Geography Education and its stated aim is to promote a conversation between colleagues across the globe. It is, therefore, principally a book for an academic audience but would be of interest to secondary Geography teachers with a passion for Global Education and the potential of Geography Education in a contemporary geopolitical context.

The book forms part of the series of academic works produced under the editorial supervision of the International Geographical Union’s Commission on Geographical Education and is edited by noted geographers from Turkey, Spain and the United States.

The collection of articles is predicated on the view that globalisation is transforming the geographical conditions of everyday life and that Geography Education has a key role to play when it comes to reassessing currently held geographical worldviews, especially those that have guided our actions and served us well in the past but are no longer consistent with our lived experience.

The book showcases the core concepts of geographical education as a means of understanding global issues from a spatial perspective. It promotes the idea that Geography Education is essential in exploring the interactions of the world’s human and environmental systems at a range of scales. It covers topics such as climate change, sustainable development goals, geopolitics in an uncertain world, global crises and population flows, all of which are of interest to geography researchers and educators keen to explore the complexity of contemporary societies.

Part I features four articles that provide a ‘framework for global understanding’. In the first of the four articles, the book’s editors advance a rationale supporting the claim that Geography Education has an important role to play in developing our understanding of globalisation and its impacts. In her contribution, La Trobe-based academic, Margaret E. Robertson, addresses the two-pronged question: What do we mean by global understanding and how can global education contribute to the process? In doing so, she explores the geopolitical complexity of the world in which we live, outlines what needs to be understood, discusses the role of geography in enhancing our understanding of processes involved, and investigates the role of Geography Education in promoting global understanding.
understanding. Chew-Hung Chang and Andy Wi of Singapore's National Institute of Education contribute an interesting article looking at geography's contribution to global understanding through a climate change perspective. In the final thematic contribution, Inga Gryle and Thomas Jenkel examine how a spatially informed education can make a contribution to global understanding.

Part II focuses more explicitly on Geography Education for global understanding. The five articles presented here cover the role of Geography Education in promoting global understanding, an exploration of ideas and trends in Geography Education as it relates to global understanding, the ways in which Geography curricula tackle global issues, the transition from classroom practice to global action, transculturalism, and global understanding.

Part III provides a number of snapshots of education for global understanding in a number of countries, specifically those of Ibero-America, China, Finland, Japan, South Africa, Spain, the United Kingdom, the United States, India, Russia and Canada.

In Part IV, the book’s editors include what they call a Road Map for global understanding.

The strength of this book is the manner in which it focuses on the way geography can be used to promote global understanding in what is an increasingly fractious and fraught geopolitical context.

This is an expensive publication. It is also available in a marginally less expensive eBook version. Given its cost, one would only recommend this book to those keenly interested in the role of Geography Education in promoting global understanding. One principally for the academics?

Dr Grant Kleeman
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Globalography: our connected world revealed in 50 maps.

By Chris Fitch. London: White Lion Publishing, 2018,
224 pages, hardback, ISBN 9781781317914
https://www.quartoknows.com/

The 21st Century has brought unprecedented change in the way people, ideas and resources move across time and space. Author Chris Fitch suggests that it is necessary, therefore, to update the way we view the world and to understand the “radical way globalization is transforming our world” (p. 7). Indeed, Rosling (2018, p. 249) argues that “we [teachers] should be teaching them [students] that the world will keep changing and they will have to update their knowledge and worldview throughout their lives.”

It is quite timely, therefore, that Chris Fitch has created a book that can help teachers and students update their knowledge of how the world works. With maps by Sam Vickars, Fitch has carefully curated a set of 50 maps which helps to explain and illustrate how the “new globalized world really operates”. Some
stories were familiar to me, such as tea consumption, whereas others caught me by surprise (I did not know that Madagascar was the leading producer of vanilla beans!).

Each of the A3-sized maps is stunningly presented, diverse and engaging. Accompanying each data-rich map are two to four pages of text and additional geographic media that provide the context for the stories displayed. For example, following a map showing the number of skyscrapers over 150 metres per country, Fitch describes how the distribution of the world's tallest buildings has shifted from the west to the east (China has twice as many skyscrapers as the United States) and explains how the homogenisation of city skylines is due to the "globalization of urban architecture" (p. 109).

The stories in the book cover a wide range of geographic concepts. For example, the distribution of bananas and gold; the movement of sneakers, copper and flowers; the change in use of Messenger apps; and the spatial association between food security and humanitarian assistance. The maps, and accompanying text, could be used to support the teaching of Geography across many year levels. In Year 7, for example, students could explore the bottled water map to learn why Mexico is the world's largest consumer of bottled water. In Year 9, the map showing the leading producers of cocoa beans could be used as part of a topic on biomes and food security.

If there is any limitation to the book, it is only that upon the moment of its publication some of its data will already be outdated. This is, of course, unavoidable as it is the very nature of the world in which we live. It is also one of the most challenging – and rewarding – aspects of teaching and learning Geography. Maps are an important way that geographers understand the world and they are a fundamental component of every Geography classroom. This is a book for all those who like maps and who are curious about the ways in which we connect with one another in the increasingly globalised world.

Micah Wilkins
The Mac.Robertson Girls' High School, Victoria

Endnotes

Migration: incredible animal journeys.

By Mike Unwin and Illustrator Jenni Desmond.
London: Bloomsbury Children's Books, 2018,
47 pages, hardback, ISBN 9781408889916
https://www.bloomsbury.com/au/

Migration is a beautifully illustrated children’s book describing the migration of 20 different animals from across the world. The incredible journeys told throughout this book, from whales to insects, are a delight to read and provide a rich launching pad for numerous geographical and scientific inquiries.

Unwin uses a third-person narrative to convey each journey and stunning, full-page, coloured illustrations by Jenni Desmond tie each migration story together. Desmond has captured the essence and movement of each animal and clever use of scale helps readers to understand the sheer size of some mass migrations. To complement the narrative, a two to three sentence factual description on each double page describes the movements of the animals through the seasons.

This book provides endless opportunities for students to wonder and investigate. The Monarch Butterfly's migration story offers a glimpse into the seemingly magical world of instincts in that “no individual butterfly completes the two-way migration; it takes four generations which complete their life cycle along the way”.

Many stories in Migration focus on the needs of animals to migrate based on food supply, highlighting the interconnectedness of Earth’s creatures and their dependence on one another as a food source. The 10,000 kilometre migration of the gold skimmer dragonfly (the longest of any insect) provides a vital food for falcons, bee-eaters and many other birds that migrate alongside them.

The final pages of this fascinating book include a map with a migration key, which may help some readers understand how animals use the world as one place, rather than individual countries or regions. Migration is an amazing book that is essential reading for any primary school classroom. Migration creates a sense of wonder about the natural world and provides teachers with an opportunity to discuss location, scale, distance, human impact and the importance of conservation and sustainability. It also leaves the door wide open for exploration into human migration and change.

Shae Nechwatal
Preston High School, Victoria

Spatial citizenship education: citizenship education through geography.

By Euikyung E. Shin and Sarah Wilham Bednarz.
https://www.routledge.com/

In August 2018, a fifteen-year-old, Greta Thunberg, began missing school to protest outside the Swedish parliament holding up a sign asking for action on climate change. Her School Strike 4 Climate gathered media attention and the ripples of her nonviolent resistance spread over the following year. Groups of young people engaged in similar protests in their own communities under the name Fridays for Future. Greta Thunberg asked “why should I study for a future that soon may
be no more, when no one is doing anything to save that future”. Greta’s actions are situated in Sweden, but the consequences have interacted globally. The effects of the climate crisis, and call for actions each happen in place.

Given young people are mobilising to respond to critical issues, this edited collection of 11 chapters is a timely exploration of the significant intersection between geography and citizenship education. This valuable book, edited by two education academics, provides a comprehensive range of viewpoints of ways that citizenship can be promoted through providing spatial and geographic perspectives. It includes an historical overview of geography’s contribution to citizenship education, and reports on the current situation. It outlines some of the challenges in implementing approaches to geography that can contribute to citizenship of young people who are better able to understand the world and influence preferred futures.

The authors identify key concepts of space, place, scale, power, and interrelationships as theoretical tools needed for citizenry. It is also a realistic account as it also identifies obstacles and opportunities for action. It is beyond the scope of this review to outline all chapters so I will highlight two that I found especially valuable.

Firstly, chapter 4 by Sandra Schmidt was illuminating as she explored vulnerable citizens and how space is implicated in their lifeworld. Using fictionalised cases that draw on genuine situations, the chapter considered migrants as citizens, the raced arrangement of spaces, and how space acts on citizens. Drawing on the concepts of belonging and unbelonging, and also the actions of Women’s March and Occupy Wall Street, enabled me to draw parallels with the Sorry March.

Secondly, Todd Kenreich’s chapter 6 on rediscovering the local provides a rich account of Mrs Washington’s grade four fieldwork-based mapping project in Baltimore that begins by formulating a spatial question, collecting data and presenting the findings to the community using Esri’s StoryMap application. The rich detail of this case provides a road map for other teachers who would like to explore spatial justice issues with their class. The project activated students’ spatial citizenship and strengthened their sense of belonging and their ability to improve their area.

Spatial citizenship education is an innovative exploration that is well theorised and draws together inspiring real-world, classroom-based teaching approaches. This volume will be worthwhile for geography education researchers. This book is designed towards academic reading and it would be an asset for any teacher desiring professional reading in space and citizenry and how this might strengthen engagement with issues such as social justice. The perspectives are United States-centric, with almost all contributions from US scholars. Nevertheless, the issues posed are of interest to teachers and researchers worldwide as the book provides new ways of thinking about citizenship and geography.

Dr Jeana Kriewaldt
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Adelaide, South Australia

**Sunburnt country: the history and future of climate change in Australia.**  
http://mup.com.au

Authoritative, comprehensive and lucid, climate scientist Joëlle Gergis’ *Sunburnt country* is an exceptional book. A critically important landmark in the burgeoning literature on climate change, as well as the historiography of Australian climate history, it convincingly explains how human activities have fundamentally altered the nature of the Australian climate especially, but not exclusively, since the Anthropocene (from the 1950s). Gergis also details the monumental challenges posed by the resultant environmental changes, and suggests some fruitful responses.

During the past decade, Dr Gergis has played a significant role in international academic climatological debate with her research focusing on conditions in Australia, and more generally in the southern hemisphere. This gives great insight into the contribution of other climatologists here and abroad, particularly in interdisciplinary fields that combine systematic investigation of historical climatic records with conventional palaeo-climatic proxy indicators to form long-term climatic time series data, e.g., used in climate modelling. This baseline information is crucial to understanding the timing of change, the nature of variability, and the contribution of anthropogenic forces to otherwise natural climatic forces.

*Sunburnt country* is a fine synthesis of diverse information gleaned from both the humanities and natural sciences along with a rich explanation of how the data are gathered, integrated and interpreted. The book easily communicates technically complex and empirically precise detail such as the magnitude, rate and geography of various causes and effects.

It also provides excellent introductory level descriptions of such fundamentals as: the major factors influencing Australia’s climate and its variability (chapter 4); the nature and use of the various methods used to reconstruct and extrapolate from it (chapters 17–21); and the literature on global climate change (chapter 22).

The comprehensive bibliography is exceptionally valuable, as is the way that the literature is incorporated into the text. The largely chronological narrative and its underlying argument flows well, thanks in part to the use of simple questions linking to each following chapter.

Such an ambitious book has very few limitations: the beginnings of a systematic record of Australian colonial climate history is changed to a more selective overview of climatic extremes after the 1830s, and the understandable Sydney-centric focus gives a geographic bias; the easily-accessible popular writing style occasionally grates with *tabloid* chapter headings and a few clichés; and the political context and necessary calls for fundamental and urgent action, in the final of the book’s three sections, is sometimes handled less confidently than the science.

But *Sunburnt country* is essential reading for all involved in Australian environmental management, and education including those teaching senior school Geography.

Dr Stephen Legg  
GTAV Committee Member, Victoria

**Understanding and teaching primary geography. 2nd edition.**  
https://au.sagepub.com

As the title suggests, *understanding* is an important feature of the text, which begins with a comprehensive overview of the key knowledge that underpins Geography in Part 1.

The balance between information about geographical concepts such as *place* and *sustainability* and the curriculum demands are carefully considered and situated within a practical approach to teaching Geography in primary contexts.

However, it is the acknowledgement of student perspectives that is a real strength of this text. The section focusing on children’s geographies values and establishes the prior knowledge, understanding and experiences that students bring to the classroom. The authors continue to respectfully acknowledge student perspectives in all sections of the text and link this to curriculum design that optimises and builds on this knowledge. The emphasis placed on *noticing* the geography of local areas and the school relates these concepts back to familiar places for students.

Part 2 addresses teaching geography and provides level-appropriate content, strategies and advice for teachers. The text not only identifies the essential content and geographical skills that are required, but there are numerous ideas and practical applications that have the potential to stimulate rich inquiries in primary classrooms.

The understanding that learning in geography is developmental is supported by learning progressions and pedagogies that teachers will find very useful. Although the
text is published in the United Kingdom, the authors have cited international research, resulting in a text that is applicable to our schooling system.

The writers’ passion for geography and experience in teaching and research results in an essential resource that has the potential to inspire pre-service, graduate or experienced teachers in expanding their geographical knowledge, skills and pedagogical approaches. I highly recommend this text to primary generalist teachers who are keen to take on a developmental, research-informed approach to teaching Geography.

Dr Natasha Ziebell
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You are here has the subtitle of A brief guide to the world. Nicholas Crane does an amazing job to do just that in 136 pages. This book is organised in six chapters: The view from L1; Water world; Neuropolis; Yū, or How I found my inner geographer; One to one; and Age of geography.

The book promotes the value and utility of Geography. It cites research that confirms that a child develops geographical concepts from the age of four years, and outlines the historical developments of maps from over 3,000 years ago in the Euphrates to the Geographical Information Systems (GIS). Indeed, GIS “is so vast and versatile that there is scarcely a facet of modern existence that is untouched by it (pp. 95, 97)” . Yet GIS has the capacity to widen the gap between Less Economically Developed Countries and More Economically Developed Countries He raises the questions “Will GIS merely consolidate existing power relationships? Or can it be harnessed more positively to empower marginalised communities?” (p. 98)

In his chapter Neuropolis, Crane outlines not only world population growth over time but the recent radical movement from rural to urban areas. In doing this, he advocates that “cities have the capacity to innovate and become models of sustainability (p. 57)” and points out that the United Nations Sustainable Development Goals are all geographical goals.

He reaffirms the value of geography and geographical education but highlights that significant numbers of Indians and Chinese do not have access to a teacher with a geographical background.

This book is very much a teacher resource. It underlines the essential value of geographical teaching. He reminds us of Lucy Sprague Mitchell in the early twentieth century promoting “school field trips and mapmaking and thought of the neighbourhood around a school as an extension of the classroom (p. 102)”.

You are here is an inspirational addition to a geographer’s book collection.

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Geography is the subject which holds the key to our future.

— Michael Palin