



Recognising Geography As a Partial STEM Subject: The Journey So Far

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Abstract

In 2018, the National Committee for Geographical Sciences released *Geography: Shaping Australia's Future: a strategic plan for the discipline of geography*. Throughout the strategic plan, the contribution of geographical understanding and research to Australia's environmental, economic, and social wellbeing is made clear, and a series of recommendations unfold to guide future directions and planning for the discipline. The Australian Geography Teachers Association (AGTA) took leadership of actioning the recommendations from Chapter 13, "Geography in Australian Schools". The purpose of this paper is to report on the context and journey so far for the recommendation about geography as a partial STEM subject, including the outcomes from a recent national symposium.

Context and journey so far

Geography: Shaping Australia's Future includes a chapter entitled "Geography in Australian Schools". The chapter highlights the importance and contribution of geography education, an overview of geography in the Australian Curriculum, and the importance of subject knowledge in geography including within teacher education. Recommendations in the chapter include advocating for geography to become core learning up to Year 10 at a national scale, improving the provision of geography methodology units in initial teacher education programs, building awareness about the extent and implications of out-of-field teaching in geography, developing a case for geography to be recognised as a partial STEM subject, and strategies to increase collaboration between school and university geography.

To develop a case for geography to be recognised as a partial STEM subject, the authors of this paper devised and embarked upon a three- to five-year plan of dialogue-creation and awareness building with key stakeholders from within the discipline which is still underway and from which outcomes are still emerging. Once complete, the

intent is to synthesise outcomes in conjunction with the literature to present a case to Ministers for Education about the recognition of geography as a partial STEM subject in a school setting.

The three- to five-year plan includes the publication of journal articles (2018, 2019), participation in Science Meets Parliament (2019 and 2022), design and conduct of a national symposium (2020), design and conduct of a national series of conference sessions (2021–2022), provision of feedback to curriculum authorities during curriculum review processes (2020–2021), and a special issue of a journal, such as *Geographical Education*, to focus on geography and STEM (2021). Whilst each item in the plan has occurred or is currently underway, pandemic-related disruptions have delayed the conduct of a national series of workshops although one workshop was held in New South Wales during May 2021.

The national symposium was important for bringing the discipline together to discuss views and advice about the recommendation for geography to be recognised as a partial STEM subject. The national symposium was generously funded by the Institute of Australian Geographers (IAG), the Geographical Society of New South Wales (GSNSW) and the Australian Geography Teachers Association (AGTA). The National Committee for Geographical Sciences (NCGS) wrote to the authors of this paper in their support of the symposium and ensured their attendance and contribution to the debate during discussion time.

The following report from the national symposium was endorsed by the Councils of IAG, GSNSW, AGTA, and NCGS between December 2020 and May 2021. Each presenter from the symposium has verified the capture of their speech or presentation as an accurate capture.

The authors of this paper, who were also the conceptualisers and hosts of the national symposium, commend to you the following report – *Report from the national symposium: The visibility of Geography in the STEM field and*

its contribution to STEM education. To conclude the paper, there is an update about actions arising from the symposium and an outline of a way forward to continue the dialogue-creation and awareness building about geography as a partial STEM subject.

Report from the national symposium: The visibility of Geography in the STEM field and its contribution to STEM education

1. Executive summary

A national online symposium, entitled *The visibility of Geography in the STEM field and its contribution to STEM education* was envisioned and enacted as part of a planned response to a recommendation of the strategic plan *Geography: Shaping Australia's Future* (National Committee for Geographical Sciences, 2018).

The National Committee for Geographical Sciences (NCGS) and Australian Geography Teachers Association (AGTA) develop a case for submission to the Ministers of Education for geography to be recognised as partially a STEM subject (NCGS, 2018, p. 87).

The symposium was conceptualised as a repeat series for manageability in an online form; it was jointly funded by the Australian Geography Teachers Association (AGTA), the Geographical Society of NSW (GSNSW) and the Institute of Australian Geographers (IAG). There were four symposia held with a repeat program. From here-on, unless otherwise indicated, the series of symposia is referred to as the symposium.

Ninety delegates attended overall. The purpose of the symposium was to initiate a national dialogue with discipline leaders to determine areas of concern and opportunity around the Geography and STEM recommendation. The symposium discussion was framed by three overarching questions which helped inform the contributions made by a range of invited speakers. The main points arising from the symposium discussion include the need to view the discipline holistically; the need to enhance the discipline's visibility by branding and promoting it as the "science of place"; and advancing the argument that Geography makes an important contribution to STEM. There are two recommendations for further action, each accompanied by a range of possible strategies.

2. Background

Geography: Shaping Australia's Future (National Committee for Geographical Sciences [NCGS],

2018) is the strategic plan for the discipline. Chapter 13, "Geography in Australian Schools", identifies a series of recommendations to promote the subject and assist with its future positioning in the context of school education, initial teacher education programs, curriculum development, career pathways and the connection to the discipline at the university level. One of these recommendations relates to Geography and STEM.

The recommendations in Chapter 13 are being actioned by Directors of the Board from the Australian Geography Teachers Association (AGTA). In 2019, Susan Caldis and Dr Grant Kleeman, who also hold respective roles as a STEM Ambassador for geography education and Member of NCGS, co-authored an advocacy and awareness-raising paper about Geography and STEM. In 2020, Susan and Grant conceptualised and co-chaired an online symposium where discipline leaders had the opportunity to discuss areas of opportunity and concern about Geography and STEM.

The symposium operated as a three-hour, repeat-program series, offered on four separate occasions via Zoom in October and November 2020. Discipline leaders from the academy and school-based geography education were invited.

Three overarching questions provided a structure for comment, advice and reflections. The symposium program included an opening address, a panel session and a group discussion.

Three professional associations generously provided financial sponsorship of the symposium: AGTA, GSNSW and IAG.

3. Aim/Rationale

The visibility of Geography in the STEM field and its contribution to STEM education was a national online symposium, envisioned and enacted as part of a planned response to raise awareness about a recommendation in *Geography: Shaping Australia's Future* (NCGS, 2018). The recommendation called for the development of a campaign to have Geography to be recognised as a partial STEM subject (NCGS, 2018, p. 87).

In response to this recommendation, the national symposium aimed to:

- commence national dialogue with discipline leadership groups from the academy and school-based Geography education,
- discern areas of alignment and difference between discipline leadership groups and, in so doing, develop a shared view of the discipline and subject,

- propose possible next steps for future action and, in so doing, assist with:
 - actioning a second recommendation from the strategic plan. That is, to develop and increase the “collaboration between school and university geographers” (NCGS, p. 87),
 - providing advice “from-the-field” to the NCGS and AGTA for future use in a position paper targeting Ministers for Education.
- identify the distinctiveness of the discipline and subject in schools,
- know who we are as Geographers and as a discipline,
- develop internal and public clarity about the discipline of Geography including its representation in schools,
- emphasise the necessity for the in-field teaching of Geography,
- clarify the study and career pathways as an extension of Geography in schools (AGTA’s careers website project).

4. Presentation of key messages arising from the symposium series

The purpose of this section is to present the key messages arising from the 2020 Geography and STEM symposium series. An analysis in response to literature will occur in an upcoming paper. Key messages are presented in response to the three overarching questions used to frame discussion at each symposium.

Question 1: What is “my Geography” and how does “my Geography” fit into the STEM field?

Question 1 relates to the theme of visibility. Discussion at each symposium emphasised concern about the extent and implications of out-of-field teaching, particularly in response to the diminished identity of Geography as a rigorous, relevant and growing subject in schools. The diminishing identity of Geography as a discipline was also discussed in response to its dispersed and fractured representation across university faculties. Symposium delegates agreed there was a need for the discipline to be emphasised holistically and not divided into physical and human Geography. There was also agreement about the need to clarify and promote a clear identity and an accurate view of the discipline. This includes calling ourselves “Geographers” and identifying university departments, disciplines and programs as Geography, and for Geography to be badged, within the school curriculum, as both a science and a social science. To do so, would assist with the identification of a clear pathway for study, research, career identification and specialisation opportunities within initial teacher education.

Geography as the science of place was posed by Professor Iain Hay as a starting point for discussion about the clear, accessible and consistent messaging about the identity of Geography. Amongst delegates at the second and subsequent symposiums, the conceptualisation of Geography and the “science of place” was well received. For the visibility of Geography to be enhanced, symposium delegates agreed there is a need to:

Question 2: What are the impacts and implications of “my Geography” in the STEM field?

Question 2 relates to the theme of contribution. A majority of participants focused on the use of geospatial technologies and how the data and information generated is interpreted, with a particular focus on place, space and interconnection. The use of geospatial technologies becomes an important connector and contributor of Geography-STEM and therefore enhances the impact of Geography. Most discussions focused on agreement about committing to key points already raised and identifying potential next steps.

Question 3: How can I use my spheres of influence to enhance the visibility of Geography in the STEM field and its contribution to STEM education?

Question 3 focused on activities related to spheres of influence. At the symposium and in post-symposium reflections received via email, the following ideas were put forward from individuals about how to enhance the visibility of Geography in the STEM field and its contribution to STEM education:

- Geography teachers to explore options for the design and delivery of a Geography and STEM unit across Years 7–10 to establish or expand a Stage 6 (Year 11–12) cohort.
- GTANSW&ACT shared a specific strategy, “VisCIS” to embed a Geography and STEM focus into professional learning activities and resources. “VisCIS” stands for Visibility (where do you see Geography in STEM?), Contribution (what does Geography offer to STEM?), Impact (what could happen to geographical learning as a result of a STEM emphasis?), and Sphere of Influence (what can we do to promote Geography in STEM?).
- AGTA Board members suggested the establishment of a Geography and STEM section on the website and incorporation of

a Geography and STEM careers emphasis into the revitalised Careers in Geography project and put forward the idea of a Chief Geographer being appointed to complement the role of Chief Scientist.

- Associations/Societies to collaborate more authentically and regularly.
- Journal editors in attendance committed to a Geography and STEM-focused theme for a special issue or equivalent in 2021.
- Lecturers from initial teacher education identified possibilities for reviewing their methodology units to identify and connect learning and assessment items between Geography and STEM.

Overall key messages arising from group discussion:

For action: developing a holistic and distinctive identity as Geography and Geographers, consider the branding and perception of Geography; lobbying for the co-badging of Geography as part of Australian Curriculum review processes.

For emphasis: strategies for action regarding the impact, contribution and the transformation of Geography.

Of concern: the extent of out-of-field teaching, the extent of division occurring between physical and human geography, the lack of identification of GeoSTEM-related careers within Geography.

5. Recommendations for action

The formal recognition of Geography, in both policy and practice, as a contributor to the STEM field will be a long-term educative journey for all those within, adjacent to and beyond the discipline. While the appointment of Susan Caldis as STEM Ambassador for Geography Education remains in place for the foreseeable future, it will be necessary for consistent, connected and clear national messaging and advocacy to occur from Geography stakeholder groups, including NCGS, IAG, AGTA, GSNSW, Royal Geographical Society of South Australia (RGSSA) and Royal Geographical Society of Queensland (RGSQ), for example in developing submissions for an upcoming curriculum review.

The development and presentation of a report to Ministers for Education from NCGS and AGTA in response to the Geography and STEM recommendation of the strategic plan could potentially occur during 2022. Such a timeframe would allow for an evidence-base to develop from the 2020 symposium and follow-up events proposed for later in 2021, in addition to analysis of theoretical examinations and existing empirical studies.

In response to the key areas for action arising from the symposium, the co-chairs put forward the following recommendations (see Table 1) to the NCGS for their consideration, advice and/or endorsement.

Table 1: Areas for action and proposed strategies arising in response to the 2020 Geography and STEM symposium

Area for action	Proposed strategies
1. To address the identity, branding and perception of Geography.	<p>1.1 Following the success of the 2020 symposium, co-chairs are to design, organise and implement a follow-up event to connect stakeholders and progress discussion about the Geography and STEM recommendation. Representatives from the NCGS could attend and present an opening address in a known capacity and/or offer a series of provocations for discussion. For example, for the suggestion from Professor Iain Hay at the 2020 symposium, <i>Geography as the science of place</i>, becoming a starting point for discussion about the identity and branding of Geography.</p> <p>1.2 For representatives from NCGS, AGTA, IAG and other interested associations/societies to jointly author papers for journals and media such as <i>The Conversation</i>, in response to the IAG Conference theme <i>Remembering, Reimagining Geography</i>. The focus of papers could explore the identity of Geography, the impact of Geography and its contribution to the STEM field, the importance of Geography being a co-badged subject in curriculum development, schools and initial teacher training, together with possibilities for a potential appointment of a Chief Geographer.</p>

Area for action	Proposed strategies
	<p>1.3 For the NCGS to provide a short statement of support as appropriate, for the establishment of a Geography Education focused IAG study group and IAG/NZGS conference stream; for the NCGS to nominate a representative to be a panel-session discussant should the conference session be approved. For example, Susan Caldis intends to approach IAG about establishing and convening a study group for Geography Education to cover research, action, policy and decisions which are important to the future directions of geographical education in schools, higher education, and initial teacher education because identity of the discipline, awareness about Geography and STEM, implications arising from out-of-field teaching are important areas of focus. Susan and Professor Jennifer Carter have already submitted a session proposal for a Geography Education conference stream to occur at the upcoming IAG/NZGS Conference to include focus on Geography and STEM.</p> <p>1.4 The editorial team from <i>Geographical Education</i>, journal of AGTA, are suggesting the theme for the 2021 volume be <i>How can STEM be enhanced by Geography?</i> The editorial team plans to invite papers from the 2020 symposium panellists and other interested Geographers and/or researchers. The 2020 symposium co-chairs suggest they approach the editorial team requesting an invitation be extended to the NCGS to contribute an article and compose a foreword to the special issue in advocacy of the Geography and STEM recommendation.</p>
<p>2. To lobby for the cobadging of Geography as a subject of both the Sciences and Humanities during the 2021 Australian Curriculum review process. The review is led by the Australian Curriculum, Assessment and Reporting Authority (ACARA).</p>	<p>2.1 Selected AGTA Directors are already liaising with ACARA Curriculum representatives about proposed revisions to the <i>Australian Curriculum: Geography</i>. Once public consultation occurs during April and May 2021, a round-table discussion between representatives from NCGS, AGTA, IAG, GSNSW, RGSSA and RGSQ is proposed. The purpose and outcome are to develop a combined report and ensure alignment occurs between separate reports from each representative group, that puts forward an evidence base to demonstrate the contribution and impact of Geography and argue for the positioning of Geography as a co-badged subject within the Sciences and Humanities. Reports can be made available on relevant websites. The strategy will also assist to address Area for Action #1.</p>

Appendices

Appendix 1: Attendees

The symposium series was invitation-only for reasons of expertise, spheres of influence and manageability of symposium size. Invitations were extended to:

- Committee, National Committee for Geographical Sciences
- Council, Geographical Society of NSW
- Council, Institute of Australian Geographers
- Board, Australian Geography Teachers Association
- Council, each AGTA affiliate (up to 5 representatives)
- Head of School/Department/Discipline of Geography at universities across Australia
- Geography Methodology lecturers in initial teacher education programs
- Editors for *Australian Geographer*, *Geographical Education*, and *Geographical Research*
- President and a representative, Royal Geographical Society of Queensland
- President and a representative, Royal Geographical Society of South Australia
- Eminent academic geographers who may not be included in already issued invitations
- Geography educators are known to be enacting Geography-STEM initiatives in a school that may not be included in already issued invitations.

An invitation was offered to international colleagues who expressed interest in the symposium in response to social media posts. The following international colleagues attended:

- President, Geographical Association, United Kingdom
- Editor-in-chief, RIGEO journal, Turkey
- A North American based wetlands ecologist, Homeward Bound delegate, and curator of *StoryTellers of STEMM* podcast.

Appendix 2: Program of speakers

Co-chairs: Susan Caldis and Dr Grant Kleeman

Opening address: Mr Trent Zimmerman MP, Federal Member for North Sydney electorate

Panellists (alphabetical order):

- Dr Karen Joyce: Education Director, She Maps; Geospatial scientist and Senior Lecturer, James Cook University

- Dr Emma Lee: Trawlwulwuy Woman, Aboriginal and Torres Strait Islander Research Fellow, Indigenous Affairs for land and sea management, Swinburne University of Technology
- Ms Kimberley Parnis: Geography teacher, Teaching and Learning Advisor, Parramatta Marist High School
- Professor Ian Rutherford: Fluvial geomorphologist, School of Geography, University of Melbourne; Immediate Past President, Institute of Australian Geographers
- Dr Kate Selway: Superstar of STEM; Earth scientist and Senior Lecturer, ARC Future Research Fellow, Department of Earth and Environmental Sciences, Macquarie University
- Professor Michael Solem (Co-Director, National Centre for Research in Geographical Education, Texas State University; Senior Education Advisor, American Association of Geographers).

Appendix 3: Summary of presentations

The opening address

Mr Trent Zimmerman MP is aligned with Susan Caldis in her STEM Ambassador role; he agreed to provide an opening address. In so doing, Mr Zimmerman MP spoke about his surprise that Geography is not already formally part of STEM-related discussions in policy and practice. He then provided some advice about how to proceed with actioning the recommendation from *Geography: Shaping Australia's Future*. Mr Zimmerman MP complimented the quality of the strategic plan and drew on it to speak about what he saw as the strength of Geography – its multidisciplinary nature; he also spoke about the importance of science, technology and innovation to government priorities.

Key points of advice focused on being able to articulate the contribution of Geography to the STEM field and develop a national approach and message. Such advice was framed in the following way:

- being clear and succinct about what Geography is and where the Geography is evident in STEM-related Government priorities – remember you will be needing to share this information and persuade policymakers and stakeholders who are not from your field,
- having an evidence base to demonstrate where geographical understanding and research will make a contribution and have an impact on STEM-related Government priorities,
- keeping the end-user in mind – whether the end-user be a teacher, a school student,

a researcher, or a practitioner in the field, how will they benefit compared to now by Geography being represented as a STEM subject; how will the discipline overall and Geography as a subject in schools benefit compared to now through being recognised as a partial STEM subject,

- remaining connected with organisations and people of influence such as Science & Technology Australia, local MPs, and Susan as STEM Ambassador for geographical education.

Speakers in the panel session (in speaker order)

Professor Michael Solem presented the Geography-STEM related experience from the United States of America. The focus was given to strategies of success in response to the following areas:

- connecting Geography, Environmental Science and Social Science through integrative concepts, scientific inquiry, problem-solving skills, GIS,
- developing an American Association of Geographers GeoMentoring program to better connect Geography academics, Geography teachers and industry representatives from Geography-STEM related careers,
- the enactment and outcomes of ongoing National Centre for Research in Geography Education-led research around Geo-progressions focused on maps, use of geospatial technologies, and spatial thinking,
- the importance of naming and identifying Geography in courses, departments, careers.

Dr Karen Joyce presented the dichotomy between the perception and reality of Geography. As a result, the presentation leaned heavily into the theme of visibility – what and where is the Geography in STEM. Dr Joyce used a “pub-quiz” activity to demonstrate the public perception of Geography as being only about capital cities, flags and identification of places on a map, and therefore not being a science, technology, engineering or mathematically oriented subject. Dr Joyce used her work in drone education and the use of other geospatial technologies to demonstrate Geography as a science due to its inquiry focus, spatial reasoning, place-based analysis, and human-environment interactions.

Professor Ian Rutherford presented the mutual benefits of Geography and STEM – Geography good for STEM and STEM good for Geography. To do so Professor Rutherford covered curriculum topics in school-based Geography, targeting demography, landcover and land use, climate,

topography – and articulating the need to be clear about science and numeracy. Geography requires a scientific skillset to ask the right questions and to interpret, understand and apply data and information across the discipline, not just in so-called physical geography. Therefore, Geography is a science as it uses the scientific method and capabilities of inquiry, gathering and analysis of data and information. Spatial science capability is a key contributor to employment and careers from a Geography angle which enhances its contribution to the STEM field.

Dr Kate Selway presented the nature of her work in earth science through the lens of how she understands Geography to contribute and have impact on the development, communication of, and action upon findings. Dr Selway also presented a challenge to geographers to understand and agree upon what it is that the discipline contributes to the STEM field, and to determine whether or not Geography wishes to include more STEM in curriculum development processes.

Kimberley Parnis presented a GeoSTEM project-based learning initiative focused on Changing Places for Year 9. Conceptualised as the *Urban Mess*, Kimberley wanted to encourage her students to engage in real-world problem solving through the lens of geographical thinking. Emphasis was on place, space, sustainability and interconnections. Technology became a tool of learning to facilitate inquiry and communication. Through building awareness of Geography as a driver of/contributor to STEM education, through the collaborative design of the *Urban Mess* between the Social Science and STEM departments, it is hoped such a project will transform understanding about and appreciation of Geography amongst students, parents/caregivers and colleagues so that a Stage 6 Geography class will become viable by the time these students are considering study/career pathways and choosing subjects for Years 11/12.

Dr Emma Lee presented the impact of Indigenous knowledges and ways of being from Country – land and waterways – related to Geography and STEM. Dr Lee emphasised the need for a holistic approach to knowledges (western and Indigenous) and knowledge transformations through its impact on Country and assistance to communities. Indigenous strategies of learning, by doing and keeping Country at the centre of knowing and being, will enable knowledge to bring communities together and to keep the discipline of Geography together as we look towards and have responsibility for the future. To weave STEM, Geography and Indigenous knowledges together to create a big net, an umbrella for cultural safety and respectful knowledge will show how each

knowledge becomes important and has an impact that is strategically aligned to transform the political, social and scientific world. Geography can be a leader in the STEM field by using connections between Indigenous and Western knowledges, not separating such knowledges. A connected approach between knowledges (Indigenous, Western, geographically-related, STEM-related) will create change and encourage belonging by drawing together all knowledge and not distinguishing or diminishing the cultures we belong to. Exclusions and barriers to knowledges are not helpful to future world order, the future in which Geography and STEM together will have a great impact.

This is the end of the report from the national symposium: *The visibility of Geography in the STEM field and its contribution to STEM education.*

Conclusion

Progress has occurred, with several of the proposed actions from the national symposium now being realised. For example: this paper appears in a geography and STEM themed edition of *Geographical Education* (1.4); a proposal was accepted for a conference session on geographical education at the 2021 IAG/NZGS Conference with papers presented by scholars from Australia, Japan, Turkey, Germany and

the United Kingdom (1.3); liaison has occurred with curriculum authorities prior to, and during, national consultation on a review of the Australian Curriculum: Geography (2.1); and instead of a round-table discussion, GSNSW, IAG, NCGS and each AGTA affiliate provided a written submission to outline concerns with the way geography is represented in the curriculum and suggest appropriate amendments (2.1).

Unfortunately, pandemic-related disruptions have slowed progress on other initiatives. The nationwide conference sessions were designed to repeat the focus and questions of the 2020 national symposium with geography teachers around Australia during 2021, culminating in a plenary session at the AGTA Conference. Due to ongoing travel restrictions this part of the program has been put on hold until 2022. Despite this setback, real progress has been made in the repositioning of geography as a partial STEM subject. There is certainly a growing awareness of the contribution geography can make to STEM among key curriculum decision makers.

References

National Committee for Geographical Sciences. (2018). *Geography: Shaping Australia's Future*. Australian Academy of Sciences. <https://www.science.org.au/files/userfiles/support/reports-and-plans/2018/geography-decadal-plan.pdf>

List of abbreviations

AAG	American Association of Geographers
ACARA	Australian Curriculum, Assessment and Reporting Authority
AGTA	Australian Geography Teachers Association
GIS	Geographical Information Systems
GTANSW&ACT	Geography Teachers Association of New South Wales and Australian Capital Territory
GSNSW	Geographical Society of New South Wales
IAG	Institute of Australian Geographers
IAG/NZGS	Institute of Australian Geographers and New Zealand Geographical Society
NCGS	National Committee for Geographical Sciences
NCRGE	National Centre for Research in Geography Education
RGSQ	Royal Geographical Society of Queensland
RGSSA	Royal Geographical Society of South Australia
STEM	Science Technology Engineering Mathematics