

Teacher Knowledge and Geospatial Technologies

Bianca Bowman

University of Tasmania

<bianca.coleman@utas.edu.au>

The use of geospatial technologies, particularly GPS enabled devices and simple Geographic Information Systems, has the potential to increase student engagement and achievement in Geography. Despite this, it is currently unclear whether teachers possess the knowledge required to effectively use the technology in their classroom practice. This paper outlines some of the key issues surrounding teachers' knowledge for teaching with geospatial technologies and offers some questions to guide further conversations on what teachers need to know for teaching with geospatial technologies and how they can be supported in developing that knowledge.

Geospatial technologies, such as the Global Positioning System (GPS), GPS enabled devices and Geographic Information Systems (GIS), are a set of tools that allow geographical and spatial data to be collected, stored, manipulated and evaluated for a range of analytical purposes. As professional tools, geospatial technologies have a wide range of applications in industries such as forestry, construction, urban planning, mining and transportation. Increasingly, the use of geospatial technologies is expanding beyond the professional sphere due largely to the introduction of free downloadable software, such as Google Earth and ArcGIS Explorer, and the increased availability of low cost GPS enabled devices. Over the past decade, these tools have slowly infiltrated the education sector. The release of the Australian Curriculum in Geography in 2013 has cemented the place of geospatial technologies as an integral tool for teaching the skills and concepts of secondary Geography.

The use of geospatial technologies in education has been widely endorsed by educational researchers and relevant professional organisations for the ability of the technology to enhance teaching and learning in Geography. These skills include the ability to visualise, evaluate and draw conclusions about geographical and spatial data (Australian Geography Teachers' Association, n.d.; Bednarz, 2004; Bednarz & Ludwig, 1997; Demirci, 2013; Demirci, Karaburun, & Kilar, 2013; Houtsonen, Kankaanrinta, & Rehunen, 2004). In addition, the use of these technologies can enhance students' critical thinking, literacy and numeracy skills (McClurg & Buss, 2007; McInerney, 2002; Wheeler, Gordon-Brown, Peterson, & Ward, 2010).

Despite the positive educational outcomes associated with the use of geospatial technologies, research has shown that there has been minimal uptake of the technology in schools both in Australia and overseas (Bednarz & Ludwig, 1997; Lam, Lai, & Wong, 2009; Meaney, 2006; Wheeler et al., 2010; Wiegand, 2001). The existing literature on geospatial technology diffusion in education identifies a number of factors that have contributed to the slow uptake of these technologies. These factors include poor teacher knowledge for teaching with the technology. Indeed, poor personal knowledge and inadequate professional development opportunities for learning about the technology have contributed to an observable resistance from teachers and schools administrators to embrace teaching with these tools (Lam et al., 2009; Wheeler et al., 2010).

This paper is divided into three sections: first, the existing literature will be briefly reviewed in order to highlight some of the challenges and issues experienced by teachers in

developing their knowledge of the tools; second, a series of discussion questions will be posed to generate further discussion about teachers' knowledge for using geospatial technologies; and, finally, an appendix provides a brief description of a current PhD project that aims to evaluate teachers' knowledge for teaching Secondary Geography with geospatial technologies.

Brief Literature Review

Poor personal technological knowledge is identified within the existing literature as a significant inhibitor to teachers utilising geospatial technologies in their teaching practice: teachers are not able to use the technology for teaching if they lack the knowledge of how to operate it. A survey of 193 Victorian Geography teachers conducted by the Australian Geography Teachers' Association of Victoria and presented in Wheeler et al. (2010) determined that 50.3% of participating Geography teachers indicated poor personal knowledge of Geographic Information Systems (GIS). This finding is consistent with that of Meaney (2006) and McInerney (2002) who argued that using geospatial technologies, particularly GIS technology, is challenging for teachers as many lack confidence in their ability to respond to students' questions about the technology or are unable address the operational requirements for using it in the classroom (for example, uncertainty as to how to download the software or access school computers). Dascombe (2006) further indicated that many teachers with poor knowledge of geospatial technologies have simply "given up" (p. 265) on using the technology in their classroom as a result of these challenges.

Geospatial technologies, particularly Geographic Information Systems, have been developed largely for use in professional and industrial spheres. Although freely available software, such as Google Earth, are becoming more widely available, many of the technology packages commercially available are overly sophisticated and complex for teachers without specialised training with the tools. A number of practitioners and researchers have argued for the development of simpler, classroom friendly programs that can be customised in their level of complexity (Artvinli, 2010; Brodie, 2006; Höhnle, Schubert, & Uphues, 2013; McInerney, 2002). As Bednarz (2004) has suggested, until these programs are developed, there may be limited diffusion of the technology in school classrooms due to teachers' lack of knowledge of how to operate often-complex geospatial technologies.

Previous studies have also suggested that many teachers lack knowledge regarding the relevancy of geospatial technologies to the teaching of Geography content and skills. Lay, Chi, Hsieh and Chen's (2013) survey of 719 Taiwanese Geography teachers found a direct correlation between teachers' perceived usefulness of Geographic Information Systems and their willingness to attend training opportunities to learn about the technology and ultimately use it in the classroom. Similarly, McClurg and Buss (2007) found that teachers' were reluctant to learn about geospatial technologies unless they explicitly understood the how the technology enhanced student outcomes. Smerdon (2006) additionally determined that teachers' beliefs regarding the relevancy of the technology directly affected the uptake of the technology in the classroom. Teachers' perceived relevancy of the technology for teaching Geography is, therefore, likely to be a significant factor in the diffusion of the technology in school classrooms.

Additionally, teachers' lack of familiarity with the application of geospatial technologies to Geography has resulted in a tendency for teachers to teach *about* the technology rather than *with* the technology. Meyer, Butterick, Olkin and Zack's (1999)

analysis of two case studies of teachers and students using Geographic Information Systems in K-12 education determined that, although students were taught and were able to replicate basic GIS functions, teachers were unable to utilize the technology to improve students' skills of spatial analysis. Demiciri, Karaburun and Kilar (2013) ascertained that students are only able to achieve deep spatial learning when careful planning and consideration is given to ensuring that learning activities move beyond simply learning about how to operate the technology to incorporating analysis and problem-solving using the technology.

Discussion Questions

As the brief review of the literature has illustrated, teachers face a myriad of challenges and issues when using geospatial technologies in their classroom practice. Most significantly, the literature reveals that many teachers may lack the knowledge to use geospatial technologies both from an operational perspective and in pedagogically appropriate ways. A series of discussion questions are posed here to generate discussion about teacher knowledge for teaching with geospatial technologies:

Types of Teacher Knowledge

- What kinds of knowledge do teachers need to possess to in order to teach effectively with geospatial technologies?
- What technological, pedagogical and content knowledge do teachers require?
- Is one 'type' of knowledge more important than another?
- How can novice teachers who are still developing their pedagogical and content knowledge effectively use the technology in their teaching?

Inhibiting and Enabling Factors

- What factors might be inhibiting the development of teacher knowledge about teaching with geospatial technologies?
- What factors might be enabling the development of teacher knowledge about teaching with geospatial technologies?
- How can teachers be supported or encouraged to increase their knowledge of teaching with geospatial technologies?

The Influence of the Curriculum

- What impact will the inclusion of geospatial technologies in the Australian Curriculum have on teachers' knowledge levels?
- Will the inclusion of geospatial technologies in the Australian Curriculum lead to an increased uptake in the classroom?
- What is the role of the curriculum in technology diffusion in education?

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Appendix

PhD Project (2014-2017)

A PhD project being undertaken at the University of Tasmania by the author and under the supervision of Associate Professor Rosemary Callingham and Dr Andrew Fluck, seeks to examine and evaluate teacher knowledge for teaching Secondary Geography with geospatial technologies. The project, entitled *Teachers' Use of Geospatial Technologies in the Teaching of Secondary Geography (Years 7-12)*, has been approved to begin data collection in a number of schools in Tasmania from May 2015. Utilising mixed research methods, the study will invite practicing Year 7-12 teachers to first participate in a survey to examine their knowledge for using geospatial technologies to teach the concepts and skills outlined in the Australian Curriculum in Geography. The survey will consist of a self-assessment of teachers' technological, pedagogical and content knowledge for teaching Secondary Geography with geospatial technologies.

The results of the survey will help to inform the second phase of the PhD project: classroom observations of teacher practice and semi-structured interviews with teacher-participants. The observations will be an opportunity to gain a deeper appreciation of teachers' knowledge for using geospatial technologies as evidenced by their classroom practice. Additionally, semi-structured interviews with participants will give teachers the opportunity to outline the factors that have influenced, constrained or enabled the development of their knowledge of geospatial technologies for teaching.

The primary objective of the study is to improve teachers' knowledge and use of the technology in school classrooms by evaluating the current knowledge levels of practicing teachers and helping schools to define their professional learning needs. It is hoped that the project will go some way towards informing good teaching in Tasmanian schools that engages, motivates and fosters students' achievement and interest in Geography.

Currently practicing Secondary Geography teachers interested in participating in the research project can contact the author by email (Bianca.Coleman@utas.edu.au) to register their interest.