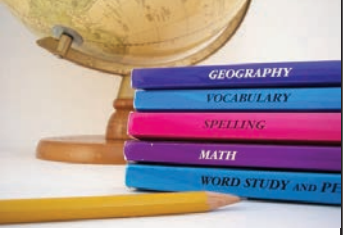

Addressing Out-of-Field Geography Teaching in Arizona, USA Through Summer Workshops to Build A Cadre of Geography Advocates

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Abstract

The Arizona Geographic Alliance has addressed out-of-field geography teaching for three decades by training organisational leaders (called Teacher Consultants or TCs) who become advocates for geographic literacy in their districts and schools. The core recruitment tool has been an annual Alliance Summer Geography Institute (ASGI). Here, we ask the research question of whether the ASGI experience provides out-of-field geography teachers with sufficient depth of understanding of the nature of geography to pass on this understanding to students via lesson creation. Our research strategy is two-fold: first, we analyse surveys taken by participants and their developed lessons in the 2018, 2019, and 2022 ASGIs; second, we analyse pathways of out-of-field retired TCs who have gone on to teach "social studies methods" courses in Arizona's colleges of education. Our results show that new TCs can mainly translate their growing understanding of geography into lessons for the grade levels they teach in that two-thirds of the lessons scored as mostly or heavily contributing to a student's deeper and more sound understanding of geography. A series of informal interviews of retired TCs teaching in Arizona's colleges of education reveals a shared passion for instructing best practices of teaching human geography, physical geography, historical geography, political geography, and environmental geography. Their social studies methods instruction focuses on lessons that task students, not with place names, but with learning core geography ideas. We conclude that the ASGI experience is somewhat analogous to a college student discovering geography as a passion. Whereas a major in college absorbs content quickly, the learning process of a new TC is much slower. ASGI mentorship and camaraderie experienced by TCs is a "geography club" promoting lifelong learning of geography through subsidised participation in national conferences and advanced geography training workshops.

Introduction

Out-of-field geography teaching in USA classrooms is the norm. Based on our survey data in Arizona over the past three decades, with more than three thousand members of the Arizona Geographic Alliance (AzGA, https://geoalliance.asu.edu/), less than one-in-a-thousand were geography minors or majors in college. Kriewaldt (2006) and Kriewaldt and Lee (2022), however, paint a different picture in Australia, with 40% of year seven through ten geography teachers studying some university geography (Weldon, 2016). Still, Caldis (2022) indicates that Australian secondary schools have a "high incidence" of geography being taught by out-of-field teachers and those specialising in geography not teaching it. Kwak (2019) indicates that out-of-field teaching is a problem in Korea but one that is being addressed. Donitsa-Schmidt et al. (2022) indicate that a third of new teachers in Israel taught out of their fields. Arendain and Limpot's analysis (2022) in the Philippines shows a very high proportion of out-of-field teachers, like in Arizona, which poses both challenges and rich opportunities.

The challenge of out-of-field geography teaching in the USA in the 1980s was met by an opportunity provided by a privately-financed National Geographic Society (NGS) initiative to develop US state-level Geographic Alliances (Salter, 1987; Salter, 1991; Dulli, 1994; Grosvenor, 1995). NGS developed a model of USA state-run Alliance Summer Geography Institutes (ASGI), where teachers spend 10–14 days gaining foundational geography knowledge. Graduates would then become enthusiasts for teaching geography and be given the title of "teacher consultant" (TC). These TCs then provide workshops in their local educational settings (school districts, schools) and become passionate

proponents for teaching geography (Salter, 1987; Salter, 1991; Dulli, 1994; Grosvenor, 1995).

The general funding model for these state-level geographic alliances was total funding by the NGS at first, and an NGS representative then helped each state alliance develop a match between NGS dollars and state-level Departments of Education support, with a typical annual budget of $100,000 in US Dollars. A key figure in starting the movement of US State alliances was Gilbert M. Grosvenor when he was NGS President and Chair. When Grosvenor stepped down from this leadership position, the NGS stopped its commitment to geography education (McClure, 2018).

Arizona is one of just a handful of geographic alliances that remain active. This is due to 30 years of support from Arizona State University's geographers and administrators, a partnership with the Arizona Department of Education, and the continued passion of AzGA members. The authors of this paper are AzGA Co-Coordinators who write grants and serve as the central hub of communication and organisation for the TC leadership and general members. AzGA is now funded through grants from various sources, but most consistently by the Arizona Department of Education.

This paper's purpose evaluates whether the ASGI experience provides out-of-field geography teachers with a deep and sound understanding of the nature of geography. This research question connects with broader theoretical concerns over the effects of out-of-field geography teachers in the classroom (e.g., Kriewaldt, 2006; Kriewaldt and Lees, 2022; Caldis, 2022), assessing teacher professional development programs (e.g., Postholm, 2012; Kennedy, 2016), and the importance of including geographic knowledge and skills in schools no matter whether it be broad in scope (e.g., Butt and Lambert, 2014; Bustin, 2019; Eui-Sun, 2019), or maintain a focus such as place-based education (e.g., Preston, 2015). Another theoretical connection to our hypothesis involves Vygotsky and Cole's (1978) theory of social constructivism, whereby we hypothesise that the shared ASGI experience leads to positive outcomes for teacher growth and teacher attitude towards the out-of-field subject to be taught. We, thus, hypothesised that a geographic perspective learned at an ASGI could lead to the teaching of deep and sound geography learned by students.

We start here by briefly reviewing how the Arizona ASGI works. We then explain our methods of analysing both recent participants in ASGIs (new TCs) and TCs no longer in K-12 classrooms who teach social studies methods courses in Arizona's colleges of education. After presenting results, our discussion section turns to broader implications for training out-of-field geography teachers.

How Arizona's Alliance Summer Geography Institute Works

Each ASGI has the same five goals: (a) learn geography content from professors and graduate students in geography; (b) learn the model of lesson plan and presentation format developed by James Binko (1989); (c) learn how to incorporate geography into the participant's classroom; (d) have fun while receiving a small stipend for attending ASGI; and (e) as an ASGI graduate, become a TC and be part of a network of statewide colleagues that mentor new TCs and experience ongoing professional development supported by AzGA via being sent to national conferences and experiencing advanced summer training in geography.

An essential ASGI requirement is that participants create an original lesson. This lesson is an integral part of our research methodology because it serves as the tool by which we assess how well an ASGI participant translates their training in geography into a classroom lesson of their design and implementation. Each lesson is written in the Binko (1989) lesson plan format, which is the lesson template given to ASGI participants.

The Binko (1989) format of lesson writing and presenting allows time for peer-to-peer brainstorming on lesson ideas, mentoring from current TCs, and guided learning through example presentations. Once the ASGI is finished, teacher participants have about three weeks to complete their lessons. During this time, they can access TCs (either ones they just met or their assigned mentors), ASGI staff, fellow participants, and connections to professors and graduate students. Then, at the end of the three weeks, everyone, including active TCs, are invited to return for a round of lesson presentations. After feedback, teacher participants will have time to make final edits and submit their lesson to AzGA for publication on the website. These lessons are then presented by the teacher participants at AzGA's GeoConference held near the start of the K-12 school year in September as a final requirement of becoming a TC.

Methods

In trying to answer the research question of whether the Arizona ASGI experience provides out-of-field geography teachers with a deep and sound enough understanding of the nature of geography to pass on through lessons, we studied newer TCs and TCs no longer teaching

in K-12 classrooms who have obtained positions teaching social studies methods courses in Arizona's education colleges.

Our research strategy focuses on the newest and the oldest ASGI participants. First, we examined TCs participating in the last three ASGIs in 2018, 2019 and 2022. Second, we studied those TCs without any geography degrees (or even a geography minor) but who have retired from K-12 teaching and have been hired in Arizona's colleges of education to teach aspiring pre-service teachers social studies methods courses.

The pre-COVID ASGIs had 20 participants in 2018, 13 in 2019, and the 2022 ASGI had 10 participants. To measure participant growth and experiences during ASGI, we employ four types of surveys: (a) geographical knowledge of ASGI participants before the summer ASGI (pre-knowledge survey); (b) geographical knowledge of ASGI participants after the summer ASGI (post-knowledge survey); (c) ASGI experience survey given after the ASGI; and (d) daily feedback surveys called "exit ticket." A re-examination of surveys from these ASGIs aimed to understand linkages between the ASGI experience and the success of a TC in developing a geography lesson that tries to instill a deep and sound understanding of geography in their students.

We evaluated the lessons developed by 2018, 2019, and 2022 new TCs, regardless of grade level. We used one metric as to whether the lesson contributes to a student's deep and sound understanding of geography. We used a Likert scale of 1 (not at all), 2 (in a shallow way), 3 (somewhat), 4 (mostly), and 5 (heavily). We explain our ranking in an analysis that includes insight learned from survey data from the 2018, 2019, and 2022 ASGI participants. Moll and Dorn completed our rankings and analysis separately. They then agreed on any slight discrepancies, such that, what we present as results reflects a common perspective of two individuals with multiple geography degrees: Moll with BA, MS, and being a PhD candidate in Geography; Dorn with AB, MA, and PhD degrees in Geography.

We employed an approach of informal or semi-structured interviews (Brown and Danaher, 2019; Ruslin et al., 2022; Swain and King, 2022) of experienced TCs no longer in K-12 classrooms but who then taught courses for colleges of education in Arizona. The informal interview focused on determining whether their ASGI experience influenced their pathway to teaching for a college of education, whether their experience of being a TC influenced this pathway, and whether the methods course covers in a substantive way effective lessons on geographic thinking.

Results

Table 1 provides the reader with a broad look into perceived knowledge gains by the ASGI participants based on surveys. Compiled results of ASGI surveys of the new TCs from 2018, 2019, and 2022 are explained in the methods. There are several limitations to the summary data presented in Table 1. First, the "percent gain" of knowledge

Table 1: ASGI participants are asked to assess their knowledge about specific subjects both before and then after an ASGI. Most of the questions were the same in the 2018 and 2019 surveys. However, every ASGI is a bit different, and the pre-post surveys also included questions unique to each of these years. This is why the lower portion of the table flips back and forth. The survey tasks ASGI participants to rank on a Likert scale (1 to 4) "I am knowledgeable about . . . and then the various rows seen here. Even though the Likert scale (1 strongly disagree, 2 disagree, 3 agree, 4 strongly agree) involves an ordinal scale, the "percent gain" for the entire ASGI group of participants involved averaging all answers, requiring the assumption that the Likert scale was interval in nature.

2018 I am knowledgeable about	2019 I am knowledgeable about	2018 Average Percent Gain	2019 Average Percent Gain
Teaching of Geography	Teaching of Geography	22	20
Geography resources and classroom lessons available	Geography resources and classroom lessons available	28	22
The teaching of STEM and Social Studies (STEMSS)	The teaching of STEM and Social Studies (STEMSS)	24	20
STEMSS resources and classroom lessons available	STEMSS resources and classroom lessons available	26	22
Teaching about Weather	Teaching about Weather	18	8

2018 I am knowledgeable about	2019 I am knowledgeable about	2018 Average Percent Gain	2019 Average Percent Gain
ASU Planetarium	ASU Planetarium	40	28
ASU School of Earth and Space Exploration	ASU School of Earth and Space Exploration	42	30
Using Sentence Frames	Using Sentence Frames	6	14
Using Word Walls	Using Word Walls	8	8
Using Quick Writes or Chats	Using Quick Writes or Chats	24	16
Using 10 Important Sentences	Using 10 Important Sentences	28	22
Using Color Coding	Using Color Coding	18	22
Using Authentic Big Books	Using Authentic Big Books	12	22
Using Graphic Organisers	Using Graphic Organisers	40	10
Using Interactive Notebooks	Using Interactive Notebooks	14	22
How to write a lesson in Binko format	Using Timely Quick Chat and Quick Write	34	20
How to write a lesson in Binko format	How to write a lesson in Binko format	42	28
How to present to adults in Binko format	How to present to adults in Binko format	42	26
The benefits of being a Teacher Consultant (TC)	The benefits of being a Teacher Consultant (TC)	26	26
The features of the Arizona Geographic Alliance (AzGA) website	The features of the Arizona Geographic Alliance (AzGA) website	16	22
The teaching of Engineering		24	--
Engineering resources and classroom lessons available		22	--
Teaching with Primary Sources		12	--
How to use Primary Sources with a geographic lens		36	--
GeoSpatial Technologies (drones, GPS units, infrared thermometers)		36	--
Break Out Box Strategies		34	--
Ask a Biologist website		38	--
Preparing for Natural Disasters		0	--
Odyssea		40	--
	6 Key Principles for ELL Instruction and Language Functions	--	20
	eTools and Blogging	--	22

2018 I am knowledgeable about	2019 I am knowledgeable about	2018 Average Percent Gain	2019 Average Percent Gain
	Assessing ELLs	--	12
	Urban and Environmental Planning	--	26
	Air Quality	--	16
	AZDEQ's program offerings	--	36
	Infiniscope	--	34
	ASU Center for Education Through eXploration	--	30
	Butterfly Wonderland	--	24
	Using Engaging Murals and Pictorial Input Charts	--	22
	Using Songs and Chants	--	16

-- content, location, and pedagogy were not addressed in year's ASGI.

is based on self-assessment and not some objective test instrument, and Table 1 reflects the individuals' perceived gain from before to after an ASGI experience. Second, the surveys involve a Likert scale, where the ASGI participants are asked to finish the sentence "I am knowledgeable about …" various topics on a scale of 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree). The problem is that Likert scales are ordinal, where the differences between 1, 2, 3 and 4 are not necessarily the same. Because Table 1 summarises survey results as a percentage averaging all participants from a particular ASGI year, a percentage average is only valid for an interval scale. Furthermore, no error bars are presented in the table for the standard deviation of the average. Ultimately, however, we are not interpreting any data in Table 1 strictly.

The value of Table 1 rests not in objectivity but in developing a general understanding of the subjective views of ASGI participants in their self-perceptions of growth in knowledge. The connection to the research question, thus, rests in an out-of-field teacher's self-confidence to develop a new lesson that tries to get their students to learn real geography. Therefore, we feel that our attempt to summarise the gain in self-confidence in learning via Table 1 is an appropriate way to present our survey results that the ASGI participants felt more confident in their understanding of and teaching of geography.

Table 2 presents the scoring by Moll and Dorn of the geography lessons developed by the 2018, 2019, and 2022 participants with a summary analysis. A limitation of our scoring given in Table 2 is that it is inherently subjective—simply the opinions of two individuals, each with multiple geography degrees. Our intent is not to be definitive but fully transparent and allow the reader to replicate our scoring because Table 2 presents the URLs of the lessons plans and teaching materials for each lesson.

The informal interviews of ASGI alums who taught or who are teaching courses for a college of education are summarised below. Six additional participants took a pathway from being a TC to teaching social studies methods courses in an Arizona College of Education but did not wish to have their paths disclosed.

INDIVIDUAL A: A former elementary educator, stated the ASGI experience was not the triggering event that led to the move from K-12 teaching to a college of education. Instead, direct contact with a former AzGA co-coordinator and professor led to discussions on possible graduate research topics linking geography to teaching. The experience of being a TC exposed this individual to leadership discussions on possible grants linking K-12 geography teaching to language arts and math subjects that were assessed on Arizona-state-mandated student testing. The TCs are the organisational leaders, and a steering committee decides the future projects taken on by AzGA. This individual linked dissertation research to one of these funded grants. This PhD research, in turn, led to a faculty position that involved teaching social studies methods courses that were infused with geography (e.g., cultural, physical, historical, environmental) content.

Table 2: Analysis of new TC lesson plans as to whether the lessons help their students obtain a deep and sound level of understanding of geography. The lesson scoring is on a relative Likert scale of: 1 (not at all), 2 (in a shallow way), 3 (somewhat), 4 (mostly), and 5 (heavily). Where you see the 0.5 decimal is where Dorn and Moll differed in their scoring. Grade levels in this table are indicated by year number, with "K" referring to Kindergarten, and "HS" referring to US education grades 9 through 12.

ASGI Year	Grade Level	Field of Geography	Lesson URL	Scoring	Analysis Summary
2018	5	Energy Geography	http://geoalliance.asu.edu/wind	4	Introduces core ideas in energy geography, but the lesson doesn't need a mapping component to show locations suitable for wind energy.
2018	5	Cultural Geography	https://geoalliance.asu.edu/Memory	5	Exercises like those presented are similar to many used in Introductory Human Geography.
2018	HS	Historical Geography	http://geoalliance.asu.edu/Kindertransport	5	This lesson links spatial perspectives to interpreting an urban geography in the past.
2018	4	Historical Geography	http://geoalliance.asu.edu/archaeology	3.5	Does not really get at spatial or place-based aspects of the archaeological feature of rock engravings (petroglyphs).
2018	6	Biogeography	http://geoalliance.asu.edu/oceanzones	5	While at first glance, the topic might not seem geographical, researcher in this field views it as highly geographic.
2018	2	Physical Geography	http://geoalliance.asu.edu/SimpleMachines	4.5	The topic of ocean currents and plastic pollution in the Earth's oceans are core concerns in physical geography.
2018	2	Biogeography	https://geoalliance.asu.edu/Animal	5	Research geography faculty certainly view this topic core basic biogeography.
2018	1	Biogeography	http://geoalliance.asu.edu/buzz	3	The mapping done by state aspect is not a core aspect of the lesson's objectives.
2018	3	Biogeography	https://geoalliance.asu.edu/Monarch	4.5	Migration is a classic topic in biogeography.
2018	HS	Geomorphology	https://geoalliance.asu.edu/Runoff	4.5	This lesson covers an important component of physical geography, but it maps links to lesson content.
2018	5	Physical Geography	http://geoalliance.asu.edu/GarbageIsland	3.5	The lesson's focus is not geography, even if the topic is geographic.

ASGI Year	Grade Level	Field of Geography	Lesson URL	Scoring	Analysis Summary
2018	3	Environmental Geography	http://geoalliance.asu.edu/campus	3	There is little geography in this lesson other than the broader issue of garbage being part of environmental geography.
2018	4	Biogeography	http://geoalliance.asu.edu/Ecosystems	4.5	Biomes are a basic and important topic in biogeography, but it could be enhanced by moving towards the teaching of ecoregions, even in the 4th grade.
2018	5	Historical Geography	http://geoalliance.asu.edu/Steam	3.5	A lesson on steam engines and "expansion" has much potential, but the lesson does not involve any substantive geographic learning.
2018	2	Biogeography	http://geoalliance.asu.edu/bee	1.5	The topic of insect preservation is an important one, but this lesson has no link to geographical thinking.
2018	7	Lunar Geography	http://geoalliance.asu.edu/Touchdown	3.5	Geographers engage in spatial thinking and research on planets other than Earth. Applying basic geographical skills, such as lunar mapping, is part of geography.
2018	K	Cultural Geography	https://geoalliance.asu.edu/Fort	4	Fiction often employs deep and sound geographic thinking, and this lesson is a wonderful exemplar of how fiction can be a tool for spatial thinking.
2018	8	Regional Geography	http://geoalliance.asu.edu/Games	4	The "Hunger Games" trilogy has considerable potential to help students grasp the complexities of geography through the lens of regional geography.
2018	1	Physical Geography	http://geoalliance.asu.edu/Dirt	4	Soils are an important topic in physical geography. Soil texture varies around a school site and examination of where would provide more spatial thinking.

ASGI Year	Grade Level	Field of Geography	Lesson URL	Scoring	Analysis Summary
2018	1	Biogeography	https://geoalliance.asu.edu/Butterfly	3	This lesson is almost all non-geographic in nature. Without reference to urban change, the scoring would have been a 1.
2018	2	Biogeography	http://geoalliance.asu.edu/Seaturtle	3.5	This lesson has considerable potential to help students think geographically but only has a trivial mapping component.
2018	8	Economic Geography	http://geoalliance.asu.edu/Food	4.5	A good and simple lesson to having adolescents begin to think about economic interdependence.
2018	3	Biogeography	http://geoalliance.asu.edu/Frog	3.5	The lesson has great potential, but the connection to deep and sound geographic thinking by students is low.
2018	5	Mathematics	http://geoalliance.asu.edu/Counting	1	This lesson does not contain any meaningful element of geography.
2018	HS	Environmental Geography	http://geoalliance.asu.edu/Manhattan	5	Although written for high school, this lesson/activity could easily be found in a first-year college course.
2018	5	Population Geography	http://geoalliance.asu.edu/Esperanza	5	Everything about this lesson asks students to think deeply about migration.
2018	K	Biogeography	https://geoalliance.asu.edu/Pals	3	Getting 5-year-olds to even think about the connection between life and location at the level of oceans and continents is admirable and certainly geographic.
2018	K	Biogeography	http://geoalliance.asu.edu/ngooceanzones	4	While at first glance, the topic might not seem geographical, in reality, the geographic experts in this field would view it as highly geographic.
2018	2	Environmental Geography	https://geoalliance.asu.edu/Hudson	3.5	This lesson barely scratches the potential of land-use change's impact on aquatic life.

ASGI Year	Grade Level	Field of Geography	Lesson URL	Scoring	Analysis Summary
2018	6	Geomorphology	https://geoalliance.asu.edu/StegallBRivers	5	This lesson does a very nice job of linking the spatial awareness of different watersheds in the region where the student lives and various processes, such as river discharge.
2018	8	Physical Geography	http://geoalliance.asu.edu/degradation	4.5	This lesson shows how to link soils to modern concerns about the impact of environmental change.
2019	2	Biogeography	http://geoalliance.asu.edu/habitat	2	There's no hint of a geographic component to the concept of a habitat, even though geography is an inherent aspect of a habitat.
2019	4	Historical Geography	http://geoalliance.asu.edu/americas	4	This lesson begins to dabble at the fringes of the potential of early trade routes to infuse geographic thinking.
2019	2	Regional Geography	https://geoalliance.asu.edu/Crow	5	This lesson has incredibly rich potential to spread an inherently strong, deep, and sound way of thinking about geography to this age group.
2019	2	Cartography	http://geoalliance.asu.edu/pirate	5	Anytime you can use a 7-year-old's inherent fascination with pirates to get the kids to think spatially and geographically by having them learn some basic map-making skills is a wonderful way to enrich their perspectives with geographic thinking.
2019	3	Historical Geography	http://geoalliance.asu.edu/Yuma	5	Having students think about connections to places and connections that led their families to migrate to where they now live remain a rich and fertile way to get 9 to 10-year-olds to think geographically.

ASGI Year	Grade Level	Field of Geography	Lesson URL	Scoring	Analysis Summary
2019	6	Cartography	https://geoalliance.asu.edu/maplap	5	Learning about different types of maps remains a classic tool in this age range to encourage students to think geographically.
2019	3	Biogeography	http://geoalliance.asu.edu/AZBiomes	4.5	Biomes are a basic and important topic in biogeography.
2019	5	Historical Geography	https://geoalliance.asu.edu/Plain	3	Push-pull factors associated with the westward movement of the European-derived population of the USA are inherently geographical. Still, almost nothing beyond the concept of movement makes this lesson get students to think geographically.
2019	6	Astronomy	http://geoalliance.asu.edu/Patch	1	Learning about space travel can be geographical. Geographers do engage in spatial thinking and research on other planetary bodies. However, this lesson does not have anything to do with geography.
2019	K	Geomorphology	http://geoalliance.asu.edu/Floods	3.5	Flooding is certainly a part of physical geography, but this lesson does not get students to think geographically beyond the trivial level.
2019	5	Environmental Geography	http://geoalliance.asu.edu/cause	4.5	This lesson takes an iconic location and tasks students to think critically about what changes occur associated with turning natural into urban landscapes.
2019	7	Regional Geography	http://geoalliance.asu.edu/Sudan	4.5	The notion of comparing regions (South Sudan to Arizona) is a regional comparison that makes this a powerful geography learning lesson.

ASGI Year	Grade Level	Field of Geography	Lesson URL	Scoring	Analysis Summary
2022	7	Cultural Geography	http://geoalliance.asu.edu/Healing	5	A comparison of cultures from two different regions on Earth, infused with compassion and caring, is a cross-cultural comparison appropriate to the age.
2022	6	Geographic Techniques	http://geoalliance.asu.edu/GPS	4	Geocaching lessons about latitude, longitude, and GPS are like teaching place names; potential exists, but the lesson does not delve deeply into geographic thinking.
2022	7	Urban Geography	http://geoalliance.asu.edu/urbanization	3.5	While the topic of the lesson is "hard core" geography, the lesson does not have students engage in deep or sound thinking about geography.
2022	1	Regional Geography	http://geoalliance.asu.edu/Gagich	5	Tasking six-year-olds to think about the physical (natural) and human characteristics of different places is an appropriate and meaningful way to have first graders think geographically.
2022	HS	Urban Geography	http://geoalliance.asu.edu/Green	5	Urban resilience, urban sustainability, and other "buzzwords" abound in urban geography and the related field of urban planning. This lesson tasks high school (ages 14–18) students with thinking about these concepts.
2022	7	Human Geography	https://geoalliance.asu.edu/Surviving	5	The "five themes" of geography was a pedagogical device designed to "make it simple" for out-of-field teachers to think geographically and to develop lessons. By passing on this way of thinking to 7th-grade (ages 11–12) students, the students are thinking much more deeply and soundly about geography and the nature of space and place.

ASGI Year	Grade Level	Field of Geography	Lesson URL	Scoring	Analysis Summary
2022	2	Human Geography	http://geoalliance.asu.edu/Urban	5	Asking seven-year-olds to differentiate urban, suburban and rural settings is certainly appropriate for a geography lesson.
2022	HS	Biogeography	https://geoalliance.asu.edu/Armadillo	4	The impact of environmental change on the distribution of animals (and plants) is an important research focus.

INDIVIDUAL B: A former elementary educator, stated the ASGI experience was "a life changer". Self-described as "almost burned out", this individual made lifelong friends with ASGI co-participants. Re-infused with a passion for squeezing real geography into a language arts position, this individual produced many different lesson exemplars of how to infuse cultural geography into a language arts curriculum. Scared to present at a United States national meeting of geography educators, this individual attended anyway and discovered a passion for mentoring. This mentoring passion then led to accepting a teaching position at a college of education that involved one-on-one discussions with pre-service teachers on how to avoid burnout through finding love for geography.

INDIVIDUAL C: A former middle school educator, stated the ASGI experience did not re-infuse a passion for teaching but simply opened the door to a peer group with a similar priority to experience lifelong professional development. Sharing a desire to travel internationally, this individual persuaded other TCs to apply to teacher travel abroad opportunities that exist for US public school educators. Various organisations get grants to infuse their organisational priorities (e.g., learning about Korea, learning about Arabic culture, learning about German culture) into US classrooms through teachers. AzGA co-coordinators enable this by sometimes providing supplemental travel funds and always writing letters of recommendation on why the TC is a great investment because the lessons developed for the travel abroad will be taught to other teachers at national, state, and local conferences. Upon retirement from K-12 teaching, this individual's desire for ongoing learning led to teaching social studies methods courses that naturally involved pre-service teachers learning how to teach cultural geography (the focus of the travel abroad lesson development).

INDIVIDUAL D: A former elementary educator, stated the ASGI experience was the key trigger to move towards employment in a college of education. Upon being exposed to other TCs who travelled the world (at no cost), who went to national conferences (heavily subsidised), and who were teaching part-time or full-time in a college of education, this individual decided on a slow pathway towards the goal of teaching pre-service aspiring teachers. The ASGI experience itself simply provided examples of geographic thought, and this individual's focus on science led to creative lessons on linking deep geography thinking to scientific or technological processes. This individual was also exposed by being a TC to grant writing. Having a passion for those students who were struggling with English language, the grants focused on how geography lessons can also enhance academic language skills of English language learners (ELL). This individual, along with like-minded others, led AzGA down the current pathway of ensuring that most lessons on the website exemplify best practices in ELL instruction. This cumulative professional development led to a full-time teaching position in a college of education, where social studies methods courses infuse deep geography learning and also ELL best practices.

As indicated above, six other individuals had pathways towards teaching in an Arizona college of education but did not share their cases. We think that the above four individuals explain the linkages between an ASGI and teaching geographical (in a social studies methods course) pedagogy to aspiring elementary educators.

Discussion

Having a PhD in Geography, or even having had a single formal geographic degree, is not required to become a professor teaching geography at a college or university. The most recent rankings of PhD Geography units by the US National Research Council (Kuh and Voytuk, 2011) puts University of California at Santa Barbara in the top five, and yet only two current faculty have degrees in

geography. Even a cursory review of academic geography units across the world reveals that many university faculty teach in PhD-granting geography units without having formal geographic training. Multiple members of the National Academy of Sciences have had lengthy careers doing geographic research without a geography degree. The broader meaning of this paragraph is that being an out-of-field geography teacher is not restricted to pre-college classrooms, and that out-of-field geography teachers could be naturally predisposed towards developing a passion for geography.

Before we scored the lessons of the last three ASGI, we hoped that perhaps half would be ranked at a 4 or 5 (Table 2): mostly or heavily contributing to K-12 students' deeper and more sound understanding of geography. However, two-thirds of the lessons had this ranking. We encourage the reader to go through the lessons in Table 2 and replicate our rankings.

We are not inferring that the geography content of lessons developed for ASGIs and published on the AzGA website (https://geoalliance.asu.edu/) are anything more than the views of individuals who lack formal geography training. Also, many of these lessons required extensive help from ASGI staff and co-coordinators to beef up the geography content. Still, our interpretation is that just as an undergraduate geography major grows in knowledge and skills over time, so do TCs—by being sponsored to attend geography education conferences and by attending advanced training in such areas as physical or environmental geography.

The rise and collapse of National Geographic's state alliance movement spawned a number of articles about US state alliance activities (e.g., Imperatore & Wilms, 1991; Cole 1995; Fredrich & Osborn, 2003), as well as masters theses and dissertations by TCs seeking higher degrees (e.g., Berry, 1992; Teseniar, 1998; Marroquin, 2000; McClure, 2018) that used the same sorts of surveys and focus-group discussions as those employed here to understand their ASGI experiences. These articles, theses and dissertations often reach the same conclusion for their states: that an ASGI can be a life-changing experience for new TCs.

Our analyses of the ASGI survey results provide some additional explanation for how out-of-field teachers began their journey as geographers. Critically, mentoring of ASGI participants by experienced TCs influenced ASGI participants' lesson choice, lesson development, and positive attitude towards training others in how to teach geography. Similarly, prior research shows that mentoring yields benefits to both the mentor geography teacher and mentee (Bednarz et al., 2005; Tapsfield, 2015; Healy et al., 2022; Smith, 2022).

Our survey analyses also emphasise: (a) the power of field trips for out-of-field geography teachers to grasp core concepts (Fredrich and Osborn, 2003); (b) the importance of social interactions in building group camaraderie about a shared passion for geographic instruction and promoting geographic literacy; (c) the power of professional growth opportunities that are not limited by perceived status of being "just a teacher"; (d) the importance of being recognised by university faculty during the ASGI as being professional experts in pedagogy; and much more.

Conclusion

In an ever-changing world of education, it is important to develop trainings that truly assist teachers, especially out-of-field teachers. Over the last 30 years, the Arizona Geographic Alliance held 23 different ASGI trainings. Based on survey data analysed here for just three of those ASGIs, each ASGI led to a consistent increase in teacher participant knowledge of content, teaching strategies, local organisations, and geographical places. Most teacher participants have had positive experiences and continue to support and participate in AzGA-sponsored events. Many have found lifelong friends in fellow TCs. A few have gone on to second careers in Arizona's colleges of education, teaching aspiring elementary teachers geography in social studies methods courses. We discovered here that the ASGI experience played an essential part in helping out-of-field participant teachers infuse a deep and sound understanding of the field of geography into their classroom lessons.

Survey data is available from the corresponding first author on request.

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