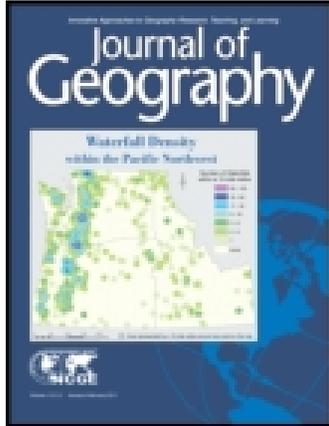


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Journal of Geography

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/rjog20>

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Published online: 18 Feb 2014.

To cite this article: Injeong Jo & Sarah Witham Bednarz (2014) Dispositions Toward Teaching Spatial Thinking Through Geography: Conceptualization and an Exemplar Assessment, Journal of Geography, 113:5, 198-207, DOI: [10.1080/00221341.2014.881409](https://doi.org/10.1080/00221341.2014.881409)

To link to this article: <http://dx.doi.org/10.1080/00221341.2014.881409>

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Dispositions Toward Teaching Spatial Thinking Through Geography: Conceptualization and an Exemplar Assessment

Injeong Jo and Sarah Witham Bednarz

ABSTRACT

The primary objectives of this article are: (1) to conceptualize teacher dispositions related to teaching spatial thinking in geography classrooms; and (2) to propose an exemplar assessment that can be used to prepare teachers who are disposed toward teaching spatial thinking through geography. A detailed description of the construction procedures and potential uses of the assessment are presented with suggestions for future research and applications.

Key Words: *disposition, teacher preparation, spatial thinking, exemplar, assessment*

INTRODUCTION

The recently released report of the Geography Education Research Committee for the Road Map for 21st Century Geography Project (Bednarz, Heffron, and Huynh 2013) makes thirteen recommendations to improve and enhance geography education research. Recommendation 5 calls for research on teacher preparation in geography, especially teachers' beliefs about geography and how these beliefs shape the implementation of practices in geography" (59) while Recommendation 8 advocates that researchers develop and use exemplary items (exemplars) to build an understanding about how people develop geography knowledge, skills, and practices. An exemplar, in this instance, is "an agreed upon focal point for research that can be used in common to develop and accumulate knowledge" (60). This article uses these two recommendations as a starting point, combining a focus on teacher beliefs (in this case disposition toward teaching spatial thinking) with the development of an instrument that can be used to explore those beliefs. We begin with a review of the literature on teacher dispositions to propose a conceptualization of a geography-specific teacher disposition focused on teaching spatial thinking through geography. Then we suggest an exemplar, a tool to measure relevant dispositions and ultimately to assist in preparing teachers committed to and capable of teaching geography and spatial thinking. Recent efforts to introduce spatial thinking into geography instruction have not taken into account research on teacher dispositions related to it. No instrument is available that teacher educators can use to assess prospective teachers' dispositions or begin to develop interventions to encourage positive dispositions toward teaching spatial thinking. This article aims to fill this gap.

TEACHER DISPOSITIONS

Recent research on teacher education stresses teacher dispositions as an important factor that accounts for effective teaching (Interstate New Teacher Assessment and Support Consortium 1992; National Council for the Accreditation of Teacher Education 2002, 2008; Dottin 2009; Stooksberry, Schussler, and Bercaw 2009; Lee and Hemer-Patnode 2010; Ruitenberg 2011; Miller and Maninger 2012). Having certain knowledge and skills is not sufficient (although necessary) for quality teaching because it does not guarantee a teacher's inclination and willingness to employ them in the classroom (Borko, Liston, and Whitcomb 2007; Dottin 2009; Almerico 2011). In the United States, research on teacher disposition has increased in the last decade particularly due to its inclusion in accreditation and professional standards for teachers such as those set by the National Council for Accreditation of Teacher Education (2002). Despite increased attention and emphasis, there is a lack of consensus on what a disposition is let alone how to assess it (Schussler 2006; Borko, Liston, and Whitcomb 2007; Diez 2007; Stooksberry, Schussler, and Bercaw 2009; Duplass and Cruz 2010; Ruitenberg 2011). Varying definitions sometimes reflect fundamentally different views. For example, some definitions indicate that dispositions are static so largely unchangeable. Others view dispositions as malleable, and thus, things that can and should be shaped through educational experiences (Dewey 1916; Perkins, Jay, and Tishman 1993; Perkins *et al.* 2000). Some researchers relate dispositions only to observable behaviors and actions (Katz and Rath 1985); others emphasize internal characteristics such as awareness, inclination, and beliefs (Perkins *et al.* 2000; Schussler 2006; Oja and Reiman 2007; Villegas 2007; Dottin 2009; Stooksberry, Schussler, and Bercaw 2009). As Serdyukov and Ferguson (2011, 109) state:

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[T]oo little is known about what dispositions actually are, how to identify them, how to measure them, how they impact a candidate's performance in the class and overall actions, and how to change or improve them.

Despite how murky the concept is, researchers seem to agree that dispositions greatly affect how teachers translate their knowledge and skills to students in classrooms and, "consequently, student learning outcomes and behaviors" (Serdyukov and Ferguson 2011, 108). Dispositions are viewed as "both a point of convergence, representing a filter through which a teacher frames his or her thinking and behaviors, and a point of inception, from which knowledge and behaviors emanate" (Schussler 2006, 259–260). It would be the case, therefore, that the degree to which teachers incorporate new ideas and innovations into practice will depend not only on their knowledge and skills but also dispositions toward the application of the ideas and innovations.

DEFINING DISPOSITIONS

The controversy and ambiguity around the concept of teacher disposition is often associated with whether dispositions are viewed as a person's internal characteristics, such as attitudes, beliefs, and values, or as behaviors that are externally observed. Katz and Rath (1985) argue that dispositions can be addressed legitimately in teacher education only when clearly linked to teaching behaviors rather than to a teacher's personal attributes. Like Buss and Craik's (1983, 105) conceptualization of dispositions as "summaries of act frequencies," Katz and Rath (1985, 301) proposed to define dispositions as "an attributed characteristic of a teacher, one that summarizes the trend of a teacher's actions in particular contexts." The rationale focusing only on behaviors is, as Katz and Rath (1985, 302) stated:

Obviously, teachers, like all other persons, have many dispositions, drives, moods, and emotions. Yet focusing on dispositions likely to be related to teaching effectively minimizes the need for teacher educators to act as surrogate clinical psychologists.

Other researchers also point out that the character-related approach to defining and assessing dispositions is problematic because many difficult ethical issues can be raised if teacher education programs try to systematically examine and attempt to regulate teacher candidates' personal beliefs, attitudes, or feelings (Rath 2001; Jung and Rhodes 2008). Those who conceptualize dispositions as a summary of observable behaviors suggest that beliefs and attitudes rather be "*pre-*dispositions to act" (Katz and Rath 1985, 302) because attitudes and beliefs, although they affect behavioral intentions, do not always entail actions (Katz and Rath 1985; Pancer, George, and Gebotys 1992; Jung and Rhodes 2008).

Shifting the focus away from predispositions to dispositions seems to benefit teacher educators because they are not tasked to change prospective teachers' personal characteristics but only to strengthen dispositions desirable for effective teaching (Rath 2001). However, this approach is subject to criticism in that it is a limited conception to consider behaviors as the only indicator of dispositions. For example, Stooksberry, Schussler, and Bercaw (2009, 721) assert that dispositions are conceptually distinct from behaviors, and the conception that connects dispositions only to external behaviors "fails to acknowledge that dispositions occur internally." Schussler (2006, 257) also notes that "dispositions involve awareness, inclination, and reflection on behaviors and thinking—not just the behaviors or the thinking themselves." Jung and Rhodes (2008, 651) defined dispositions as "predispositions with competence," indicating that predispositions are distinct from, but still closely related to, dispositions.

A more appropriate way to define dispositions may be to acknowledge underlying attitudes and beliefs that would affect dispositions, while keeping the focus on teachers' professional behaviors observed for assessment purposes. Villegas's (2007, 373) definition, "tendencies for individuals to act in a particular manner under particular circumstances, based on their beliefs," and Schussler, Stooksberry, and Bercaw's (2010, 351), "the inclination of a teacher to achieve particular purposes and the awareness of the self and the context of a given situation to employ appropriate knowledge and skills to achieve those purposes," are examples taking this approach. To summarize, teacher dispositions can be defined as the tendencies of a teacher's behavior employing particular knowledge and skills to achieve certain teaching goals; the behaviors should be intentional and draw from the teacher's awareness of related beliefs and values as well as the ability to discern the appropriate context in which to use the particular knowledge and skills.

CONCEPTUALIZING DISPOSITIONS TOWARD TEACHING SPATIAL THINKING THROUGH GEOGRAPHY

Domains of Dispositions

The definition above is, even if comprehensive, too broad to serve as a practical guide to teacher educators concerning teaching effectiveness for specific disciplines or areas of study (e.g., geography). It is still unclear where to orient efforts to help prospective teachers develop appropriate dispositions to achieve specific teaching and learning goals. Consider Katz and Rath's (1985, 302) examples of dispositions, such as "the dispositions to suspend judgment about children's behavior; to consider alternative interpretation of it," and "the disposition to experiment with alternative methods of teaching; to examine the effects of methods used and modify them accordingly." Would these dispositional goals be useful and concrete enough to measure effective

teaching of geography or, in our case, spatial thinking? We believe that if the concept of dispositions is to be infused at the individual course level in teacher education programs, disciplinary-specific conceptualization is necessary since each discipline may have specific sets of knowledge and skills to emphasize and probably a different focus on dispositions related to those knowledge and skills.

Schussler, Stooksberry, and Bercaw (2010) heuristic framework of three domains of dispositions is useful to contextualize our discussion on whether dispositions are likely to be discipline-specific. The three disposition domains essential for effective teaching are: (1) the cultural domain, (2) the moral domain, and (3) the intellectual domain (Schussler, Stooksberry, and Bercaw 2010). Dispositions in the cultural domain represent “teachers’ inclination and desire to meet the needs of all learners in the classroom” (352) and concern how teachers’ awareness and understanding of cultures and identities, both of themselves and the students, affect teaching effectiveness. The moral domain involves how a teacher’s value system guides his or her decisions in various teaching situations. It is defined as “awareness of one’s moral values, the inclination to think through the assumptions and ramifications behind those values, considering desirable ends and the processes to achieve those ends, and the responsibility one has to others and to helping others meet their needs” (353). The last domain, the intellectual domain, concerns how teachers’ beliefs about student learning and awareness of themselves as professionals affect their decisions on a variety of teaching practices. Intellectual dispositions are defined as “teachers’ inclination to process knowledge of content and pedagogy, their awareness of what the educational context requires for desired learning outcomes to be reached, and their inclination to put their knowledge and awareness to use accordingly in the classroom” (352). According to Schussler, Stooksberry, and Bercaw (2010), intellectual dispositions go beyond mere knowledge and skills in that they represent how teachers’ knowledge is enacted in the classroom in relation to the teachers’ awareness of the appropriate contexts and inclinations to employ the knowledge and skills.

Goals to cultivate prospective teachers’ cultural and moral dispositions seem to be applicable across disciplines. For example, understanding of students’ cultures (cultural disposition) and responsibility to others and care (moral disposition) must be critical aspects of effective teachers regardless of the subjects they will be teaching. These dispositional goals could be used to construct overarching program goals for teacher preparation programs. Goal statements to foster intellectual dispositions, on the other hand, may vary among disciplines due to the differences in the types of knowledge, skills, and practices emphasized. For instance, teachers’ inclination to adopt knowledge about and skills to use geospatial technologies to facilitate students’ geographic thinking (disciplinary-specific intellectual dispositions) may not be a priority in mathematics teacher education.

DISPOSITIONS TOWARD TEACHING SPATIAL THINKING THROUGH GEOGRAPHY

We define the disposition to teach spatial thinking through geography as the behavioral tendencies, beliefs, and inclinations of teachers to use the knowledge, skills, and practices required to foster students’ spatial thinking skills through instruction in geography. Based on a review of various standards for teacher education and geography education as well as the literature on spatial cognition, we identify five categories of dispositional characteristics that would promote teachers’ proclivity to teach spatial thinking in geography. These are beliefs and inclinations related to: (1) teaching thinking skills; (2) teaching spatial thinking skills; (3) spatial thinking in geography; (4) explicit teaching of spatial concepts; and (5) adopting spatial representations and geospatial technologies in instruction. Rationales for each of these conceptual categories follow.

Teaching Thinking Skills

The most fundamental belief that a teacher should possess is that thinking skills can and should be taught. A teacher should also understand that various forms of thinking skills such as critical thinking and mathematical thinking (numeracy) are fostered in schools; spatial thinking is just one of many different forms of thinking. In order to be inclined to emphasize spatial thinking as an important thinking skill that students need to learn, a teacher should first believe that students can and should learn how to think.

Newmann (1990) proposed a list of teacher behaviors that are effective to promote students’ thinking skills in classrooms. Those behaviors include:

- Asking challenging questions and tasks rather than requiring mere retrieval of information;
- Carefully evaluating students’ explanations and reasons for conclusions;
- Pressing students to consider the validity of evidence and reasoning and to suggest alternative perspectives;
- Encouraging students to generate original and unconventional ideas and solutions to problems for promoting mental flexibility; and
- Being a model of thoughtfulness (Newmann 1990, 51–52).

Various standards for teacher education, such as the Interstate New Teacher Assessment and Support Consortium (INTASC) Core Standards (1992), confirm that the dispositional characteristics listed should be important goals for teacher preparation programs (See Interstate New Teacher Assessment and Support Consortium 1992 for a complete list of dispositional standards). Thus, we conclude that teachers’ beliefs in the teachability of thinking skills, inclinations to prioritize developing students’ thinking skills, and willingness to stimulate students’ thinking skills using a variety of instructional strategies are essential dispositions for a teacher who will incorporate spatial thinking into classrooms.

Teaching to Think Spatially

Despite being fundamental, a disposition toward teaching thinking skills, in a general sense, does not guarantee the inclination to teach spatial thinking, which is a unique form of thinking. Given that spatial thinking has not been recognized and appreciated until recently, it is unlikely that teachers incorporate spatial thinking into their instructional practices. The significance of developing students' spatial thinking, however, increasingly has been emphasized following the National Research Council (NRC) landmark study, *Learning to Think Spatially*, and emerging research on the effect of education on students' spatial abilities (e.g., Davies and Uttal 2007; Lee and Bednarz 2009; Sorby 2009; Newcombe 2010; Weakley 2010). The NRC study defines spatial thinking as "a collection of cognitive skills comprised of knowing concepts of space, using tools of representation, and reasoning processes" (National Research Council 2006, 12) and makes the case that spatial thinking is a powerful skill that can be developed through education.

Considering the increased awareness of the importance and value of spatial thinking and efforts among geography education communities to support spatial thinking in the classroom, it is imperative that geography teachers are prepared to teach it. Now is the time to examine whether prospective teachers know what spatial thinking is, value its power and applicability to a variety of contexts in students' lives, and know some of the instructional strategies to nurture it.

Teaching Spatial Thinking in Geography

The National Geography Standards *Geography for Life* (Heffron and Downs 2012, 17) emphasize two key perspectives that geographers use to understand and interpret the world: the spatial perspective and the ecological perspective. The document explicitly states:

[G]eography is concerned with the spatial dimension of human experience (space and place) . . . Understanding spatial patterns and processes is essential to appreciating how people live on Earth. People who approach knowing and doing with a habit of inquiring about whereness possesses a spatial perspective.

As the National Research Council's (2006, 116) report on spatial thinking points out:

Spatial thinking underpins the intellectual structure of the geography standards . . . The geography standards demonstrate the possibility and power of infusing spatial thinking into a discipline.

Teachers who appreciate spatial thinking as an important goal of education may or may not value geography as an effective subject to achieve the goal. The better a teacher can connect aspects of spatial thinking to learning geography,

the more the teacher is likely to be disposed toward teaching geography in a way that promotes students' spatial thinking skills.

Explicit Teaching of Spatial Concepts

Concepts are the building blocks of thinking, thus spatial concepts are the building blocks for spatial thinking. The application of spatial concepts, such as location, distance, scale, distribution, and pattern, make spatial thinking a distinctive form of thinking and allow the use of space as a framework for understanding, structuring, and solving problems (National Research Council 2006). Taking space into account is essential in spatial thinking, and such knowledge is obtained, understood, and communicated more effectively through using spatial concepts (Golledge and Stimson 1997; Golledge 2002; National Research Council 2006). For instance, it is very hard for students to describe geographic patterns without the use of spatial concepts like location, distribution, and density. While there is no hard evidence accounting for a direct relationship between learning spatial concepts, or vocabularies, and enhanced spatial thinking skills, findings from previous research suggest that spatial language and vocabulary affect one's spatial cognition (e.g., Choi 2006; Bednarz and Bednarz 2008; Newcombe 2010).

The importance of spatial concepts to thinking about the world "in spatial terms" is also manifested in the National Geography Standards (Heffron and Downs 2012). Spatial concepts provide "a language for describing the arrangement of people, places, and environments," and spatial concepts are "powerful tools for explaining the world at all scales, local to global" (31) along with spatial patterns and processes and spatial models. Thus, teachers disposed toward teaching spatial thinking through geography should know the importance of spatial concepts, to learning to think spatially in geography and be willing to explicitly teach these concepts.

Adopting Spatial Representations and Geospatial Technologies

Numerous studies demonstrate that spatial representations, such as maps, diagrams, and graphs, help students to learn and solve problems (Hegarty *et al.* 1999; Shah, Mayer, and Hegarty 1999; Pape and Tchoshanov 2001; Tversky 2001; Stern, Aprea, and Ebner 2003; Kolloffel, Eysink, and de Jong 2010, 2011), and that the ability to use and create spatial representations is one of the key components in spatial thinking (National Research Council 2006; Sorby 2009). It is reasonable to expect teachers disposed toward teaching spatial thinking through geography would share three characteristics: (1) an awareness that maps, globes, graphs, diagrams, and aerial and satellite images are key geographic modes of representation; (2) an understanding of how geospatial technologies, such as geographic information systems (GIS), global positioning systems (GPS), and remote sensing (RS) can facilitate

students' practice of spatial and geographic thinking and help students "analyze and represent geographic data in powerful ways" (Heffron and Downs 2012, 21); and (3) a commitment to use a variety of spatial representations as a means to support the development of students' spatial thinking and to encouraging students to create and use their own representations to acquire, understand, and communicate information (Meira 1995; Vellom and Pape 2000; Kolloffel, Eysink, and de Jong 2010, 2011).

AN EXEMPLAR TO ASSESS DISPOSITIONS TOWARD TEACHING SPATIAL THINKING THROUGH GEOGRAPHY

Teaching Spatial Thinking through Geography Disposition Inventory

We defined the disposition to teach spatial thinking through geography as the behavioral tendencies, beliefs, and inclinations of teachers to use the knowledge, skills, and practices required to foster students' spatial thinking skills through instruction in geography. Further, we identified five categories of dispositional characteristics that would promote teachers' proclivity to teach spatial thinking in geography. These are beliefs and inclinations related to: (1) teaching thinking skills; (2) teaching spatial thinking skills; (3) spatial thinking in geography; (4) explicit teaching of spatial concepts; and (5) adopting spatial representations and geospatial technologies in instruction. Based on the definition and the five conceptual categories of dispositions toward teaching spatial thinking through geography, we developed an exemplar—Teaching Spatial Thinking through Geography Disposition Inventory—that can be used in courses and programs educating prospective geography teachers. The assessment consists of forty items clustered in categories of dispositions to be rated on a scale from one to five (i.e., 1 = strongly disagree; 2 = disagree; 3 = neutral or don't know; 4 = agree; 5 = strongly agree) (Appendix).

The first category, *teaching thinking skills*, consists of seven items (items #1 through #7) and addresses dispositions focused on the importance and teachability of students' thinking skills. Newmann's (1990, 1992) characterizations of *thoughtful classrooms* and the professional disposition standards for teachers (Interstate New Teacher Assessment and Support Consortium 1992; National Council for the Accreditation of Teacher Education 2008) were referred to for the construction of these items.

Seven items (items #8 through #14) constitute the *teaching spatial thinking* category and attempt to identify the characteristics of a teacher who believes that spatial thinking is a powerful skill that students can utilize in a variety of contexts and that it needs to be nurtured in schools. A belief in the teachability of spatial thinking and the awareness of domain-specificity of certain types of spatial thinking are also addressed in this category. These items draw mainly on the research findings about the nature of spatial thinking

illustrated in the book *Learning to Think Spatially* (National Research Council 2006).

Items #15 through #20 under the category of *spatial thinking in geography* are concerned with how teachers perceive geography and geography learning and the awareness of close relationships between spatial thinking and learning geographic knowledge, skills, and practices. The National Geography Standards (Heffron and Downs 2012) offered rationales for this essential disposition.

Eleven items (items #21 through #31) in the *explicit teaching of spatial concepts* category assess whether prospective teachers are willing to explicitly teach a range of spatial concepts—from simple to more complex (Jo and Bednarz 2009)—to support students' spatial thinking while learning geography.

The last category, *adopting spatial representations and geospatial technologies* includes nine items. Considering the important role of representations and geospatial technologies in spatial thinking and learning geography (National Research Council 2006; Heffron and Downs 2012), these items intend to measure the degree of teachers' inclination to utilize a variety of representations and geospatial technologies as a tool to facilitate students' learning of spatial thinking in geography.

There are five counterstatement items (items #4, #11, #15, #16, and #34). They represent either insufficient knowledge about spatial thinking or perspectives that would hinder effective incorporation of spatial thinking into teaching. The purpose of these statements is to ensure that participants pay sufficient attention to the questionnaire and to filter out possible contradictions in a person's responses. For example, it would be considered contradictory if one strongly agrees with the idea that geography has much to do with asking questions and solving problems (item #17), but believes that geography is best learned through rote memorization of facts (item #16). It would be more reasonable that the individual agrees to one statement but disagrees with the other.

USING THE INVENTORY AS A DIAGNOSTIC AND DESIGN TOOL FOR PREPARING SPATIALLY DISPOSED TEACHERS

Overall Scores

The inventory can be used to assess effectiveness of a program, curriculum, or course in preparing teachers to be sufficiently disposed to teach spatial thinking. Overall disposition scores are calculated by summing up the numbers (i.e., strongly disagree = 1; strongly agree = 5) that preservice teachers use to indicate their opinions on each of the forty statements. As explained, five items (#4, #11, #15, #16, and #34) were scored with a reverse-scale (i.e., strongly disagree = 5; strongly agree = 1) because a strong agreement on these items indicates less likelihood to implement spatial thinking into teaching practices. A possible disposition score one could obtain ranges, therefore, from 40 (1×40)

to 200 (5×40) with a minimum mean score of 1.0 and a maximum mean score of 5.0. As a general guide, although theoretical rather than empirical, one would be considered fairly disposed with a mean of greater than 4.0. Comparisons among preservice teachers' disposition scores over time (e.g., between semesters or over an academic year) would inform whether and how certain courses and other learning experiences in the program affect the development of dispositions toward teaching spatial thinking through geography.

Category Scores

Disposition scores analyzed by category will allow a detection of strengths and weaknesses in teacher candidates' dispositions related to teaching spatial thinking and, therefore, help teacher preparation programs and educators identify areas that need improvement. Low scores on the *teaching thinking skills* category are likely to represent skepticism about the teachability of thinking skills or a low priority on developing students' thinking skills in the classroom. Low scores on the *teaching spatial thinking* category may indicate a lack of understanding about the nature of spatial thinking and its relevance to a variety of educational goals. Insufficient understanding of the relationship of spatial thinking to geographic knowledge, skills, and practices would be represented by low scores on the *spatial thinking in geography* category. Low scores on the *explicit teaching of spatial concepts* category may be attributed to the lack of knowledge and confidence related to teaching spatial concepts. Category scores would be more useful than overall scores to identify specific areas of weakness and, therefore, to make plans for improvement.

Item Scores

At the most concrete level, scores can be analyzed by item. A closer look at the disposition scores for each item can reveal certain beliefs and attitudes of preservice teachers that could hinder them from incorporating spatial thinking. For example, if the scores on items #3 and #4 (reversely scaled) were relatively lower than those on items #1 and #2, it is likely that the preservice teachers encourage their students to memorize and recall information and that the students would not be able to have opportunities to practice higher-level thinking as much. Another example would be the case that preservice teachers believed that spatial thinking is innate (item #11, reversely scaled). They might think that it was associated with certain items in a psychological test of spatial ability that they may have taken. Or, they might envision spatial thinking only as way-finding skills. Whatever their personal conceptions, if many of the preservice teachers thought spatial thinking skills were something people are born with rather than developed and learned through the education process, they would not even try to nurture such skills. The third example would be related to their conceptualization of geography. If many preservice teachers thought that geography was

merely a collection of information (item #15, reversely scaled) and has much to do with rote memorization of isolated facts (item #16, reversely scaled), it would be highly unlikely that the teacher would address thinking skills and problem-solving skills in his or her geography classroom however much they value the importance of teaching thinking skills. The last example is associated with preservice teachers' attitudes toward teaching spatial concepts and teaching with representations and geospatial technologies. Preservice teachers might be less disposed to teach complex-spatial concepts, such as spatial pattern, scale, density, and spatial diffusion (items #25 through #31), than simple-spatial concepts, like location, place, and region (items #22, #23, and #24). This could be attributed to their lack of understanding of the relevance of complex-spatial concepts to geography or the lack of confidence to teach these concepts. In either case, if teachers are not inclined to teach these concepts, students will not be able to have opportunities to learn them. Low scores on items related to using spatial representations and geospatial technologies could be interpreted similarly. Careful examination of item scores will provide teacher educators with concrete ideas on the design of learning experiences that can tackle such dispositions.

CONCLUSION

The main objective of this article was to respond to recommendations of the report of the Geography Education Research Committee for the Road Map for 21st Century Geography Education Project by providing: (1) a conceptual framework of dispositions toward teaching spatial thinking through geography; and (2) an exemplar assessment that can be used in efforts to prepare teachers who are disposed toward teaching spatial thinking through geography. The significance of this article is threefold. First, this is an attempt to draw geography education researchers' attention to teacher dispositions. Considering the fact that teacher education researchers have discussed the importance of dispositions to effective teaching for over a decade, the need for research on geography teachers' dispositions is evident. It also takes a step forward to address one of the recommendations by the Geography Education Research Committee for the Road Map for 21st Century Geography Education Project that "research also should address teachers' beliefs about geography and how these beliefs shape the implementation of practices in geography" (Bednarz, Heffron, and Huynh 2013, 59).

Second, this article contributes to filling a gap in geography education research on strategies to enhance students' spatial thinking skills. Most research related to incorporating spatial thinking into K-12 classrooms focuses on the curriculum, in a broad sense, including formal courses, students' classroom activities, and technologies implemented to support spatial thinking. Few examine how to prepare teachers as a mechanism to implement spatial thinking effectively into the geography classroom

(Jo 2011). Even studies dealing with geography teachers focus heavily on teachers' knowledge with little consideration of dispositions. This article addresses this gap by approaching the issue of the development of students' spatial thinking skills from the perspective of producing spatially informed teachers who are equipped with strong dispositions in addition to knowledge and skills.

Finally, we developed an example assessment—Teaching Spatial Thinking through Geography Disposition Inventory—that both teacher educators and teachers in training can use. Although future research is required to ensure the validity and reliability of this assessment as it has been created solely based on the literature, it can be useful as it is for a purpose to give teacher candidates an opportunity to think about their own dispositions. As Stooksberry, Schussler, and Bercaw (2009, 724–725) stress, it is important that teacher education programs provide “opportunities for candidates to question their intellectual filter(s), to unpack assumptions around what they believe about knowledge and learning, and to bridge new concepts and theories from teacher preparation into practical application in the classroom.” While taking this assessment, prospective teachers will be able to reflect on their beliefs and awareness related to teaching spatial thinking and geography. The assessment will also allow teacher educators to examine where to put more effort to help prospective teachers develop sufficient dispositions to teach spatial thinking in their future geography classrooms.

The most basic remedy to address a general deficiency of dispositions toward teaching spatial thinking through geography would be to expose preservice teachers to information about the nature of spatial thinking, such as what it is and how important it is. Jo (2011) showed that a one-day workshop, explicitly focused on spatial thinking and teaching geography, could enhance preservice teachers' willingness to teach spatial thinking. Such a workshop should not be difficult to implement with the current practices of teacher preparation. Positive dispositions toward teaching spatial thinking, however, will prove worthwhile only when teachers possess the appropriate knowledge and skills to do so. Considering the time and practice required to develop sufficient knowledge and skills as well as the importance of explicit attention to spatial thinking in the context of geography education, one-time professional development doesn't seem to be capable of addressing all of these requirements. A more promising approach would be to offer a geography education course in which the focus is explicitly on teaching geography with an emphasis on spatial thinking.

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APPENDIX. TEACHING SPATIAL THINKING THROUGH GEOGRAPHY DISPOSITION INVENTORY

Teaching Spatial Thinking Through Geography Disposition Inventory					
[Direction] Please read each statement carefully and indicate your opinion based on the following scale. 1 = strongly disagree; 2 = disagree; 3 = neutral or do not know; 4 = agree; 5 = strongly agree					
1.	I believe that thinking skills can be taught.	1	2	3	4 5
2.	I believe that thinking skills should be taught.	1	2	3	4 5
3.	Developing students' thinking skills is going to be my highest priority goal.	1	2	3	4 5
4.	I will feel satisfied when students remember exactly what I have said.	1	2	3	4 5
5.	I will frequently challenge students through questions and tasks.	1	2	3	4 5
6.	I will show students how I think through a problem rather than just providing a final answer.	1	2	3	4 5
7.	I will ask students to provide explanations and reasons to support their answers.	1	2	3	4 5
8.	I know what spatial thinking is.	1	2	3	4 5
9.	I believe that spatial thinking is powerful.	1	2	3	4 5
10.	I believe that spatial thinking is integral to everyday life and the workplace.	1	2	3	4 5
11.	I believe that spatial thinking is a skill that is innate.	1	2	3	4 5
11.	I believe that spatial thinking skills can be taught.	1	2	3	4 5
13.	I believe that spatial thinking is transferable across disciplines, such as math, science, and engineering.	1	2	3	4 5
14.	I believe that spatial thinking should be taught in schools.	1	2	3	4 5
15.	I believe that geography is a collection of factual information.	1	2	3	4 5
16.	I believe that geography is best learned by rote memorization of facts.	1	2	3	4 5
17.	I believe that asking questions and solving problems is important in geography.	1	2	3	4 5
18.	I believe that geography is the study of spatial aspects of human existence.	1	2	3	4 5
19.	I believe that understanding spatial patterns and processes is essential in learning geography.	1	2	3	4 5
20.	I believe that spatial thinking is an essential part of learning geography.	1	2	3	4 5
21.	I believe that knowing spatial concepts is essential in learning geography.	1	2	3	4 5
22.	I will explicitly teach the concept of location.	1	2	3	4 5
23.	I will explicitly teach the concepts of place and region.	1	2	3	4 5
24.	I will explicitly teach concepts of distance and direction.	1	2	3	4 5
25.	I will explicitly teach the concept of scale.	1	2	3	4 5
26.	I will explicitly teach the concept of overlay.	1	2	3	4 5
27.	I will explicitly teach the concepts of distribution and pattern.	1	2	3	4 5
28.	I will explicitly teach the concept of map projection.	1	2	3	4 5
29.	I will explicitly teach the concept of density.	1	2	3	4 5
30.	I will explicitly teach the concept of diffusion.	1	2	3	4 5
31.	I will explicitly teach the concept of spatial correlation.	1	2	3	4 5
32.	I believe that using and creating spatial representations, such as maps, diagrams, and graphs, are essential for spatial thinking.	1	2	3	4 5
33.	I believe that using and creating spatial representations are essential for learning geography.	1	2	3	4 5
34.	I believe that students can readily interpret spatial representations without a guided practice.	1	2	3	4 5
35.	I will demonstrate to students how to reason using maps, diagrams, and graphs.	1	2	3	4 5
36.	I will frequently ask students to create their own spatial representations.	1	2	3	4 5
37.	I believe that geospatial technologies, such as geographic information systems (GIS) and global positioning systems (GPS), are powerful tools for spatial thinking.	1	2	3	4 5
38.	I believe that geospatial technologies are a powerful tool for learning geography.	1	2	3	4 5
39.	I am familiar with the educational uses of geospatial technologies.	1	2	3	4 5
40.	I will demonstrate to students how geospatial technologies can be used to solve problems and make decisions.	1	2	3	4 5