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CONCEPTUALIZING GEOGRAPHY TEACHERS` SUBJECT-SPECIFIC NOTICING DURING INSTRUCTION

Nina SCHOLTEN
Universität Hamburg, Geography Education, Hamburg, Germany
nina.scholten@uni-hamburg.de

Dietmar HÖTTECKE
Universität Hamburg, Physics Education, Hamburg, Germany
dietmar.hoettecke@uni-hamburg.de

Sandra SPRENGER
Universität Hamburg, Geography Education, Hamburg, Germany
sandra.sprenger@uni-hamburg.de

Abstract

During instruction teachers are exposed to multiple stimuli. Expert teachers manage this complex classroom situation by noticing incidents relevant to learning while neglecting others. Besides issues of classroom management, teachers must notice subject-specific incidents while teaching to support students` subject-specific learning. This paper deals with the question of how geography-specific noticing can be conceptualized. More specifically the aim of the article is to elucidate features of a geographical noticing incident. In order to achieve this aim the article considers the pertinent literature on teacher noticing (i.e. the PID model and the noticing construct) and deduces defining features thereof. These features are then discussed theoretically in relation to geography education to determine subject specificities. The result is a compilation of features of geographical noticing incidents. The theoretical ideas are substantiated in a geographical noticing incident which is presented in the form of a written vignette to demonstrate the utility of the concept.

Keywords*: teacher competence, noticing, teacher education, vignette, teacher performance*

1. INTRODUCTION

Numerous studies have indicated that the teacher plays a pivotal role in student learning (Hattie 2009; Lipowsky 2006). Recent educational research aims at disentangling, exploring, describing, and fostering what characterizes teacher professionality.

In geography education as in other fields, several authors refer to Shulman`s taxonomy, which consists of teachers` content knowledge (CK), pedagogical content knowledge (PCK), and pedagogical knowledge (PK), to provide a theoretical basis for research (Jo and Bednarz 2014; Lane 2011; Blankman et al. 2015). In the German discourse the COACTIV generic model of professional competence (Baumert and Kunter 2013) is prevalent (Schulze, Gryl, and Kanwischer 2015; Fögele 2016). The COACTIV model enriches Shulman`s model with the concepts of teachers' beliefs, motivations, and self-regulation. Based on this theoretical

framework, studies are conducted with a special focus on geography teachers` professional competence. There have been studies on geography teachers` knowledge, such as PCK (Jo and Bednarz 2014; Lane 2009) and CK (Anderson and Leinhardt 2002; Lambert 2002; Reinfried 2006), as well as studies focusing on geography teachers` attitudes, motivations, and beliefs (Ilic 2014; Molin et al., 2015).

The rationale behind this type of research is based on a causal relationship between a particular teacher`s professional competence and gains in student learning. Simply put: A teacher`s knowledge serves as a resource for his/her performance, and his/her performance supports students` learning activities, which in turn lead to gains in learning. As demonstrated, this simplified rationale comprises several implicit assumptions. One important question is: Which processes mediate between a teacher`s dispositions, such as his/her professional knowledge, beliefs, attitudes, and/or self-regulation and his/her actual performance? Many researchers are aware of the fact that there must be a missing link that has hitherto not been described and sufficiently understood (Hellberg-Rode, Schrüfer, and Hemmer 2014; Meyer 2011; Dickel 2011). These researchers emphasize the importance of the contextual dimension of teacher competence (Brooks 2010; Martin 2008; Bednarz, Heffron, and Huynh 2013).

One relevant process which influences teachers` performance (Sherin and van Es 2009) and subsequently has a potential for fostering student learning (Roth et al. 2011; Kersting et al. 2012) is the teacher`s noticing. During instruction a teacher is exposed to multiple stimuli which change rapidly and which even occur simultaneously in different modes (auditory, visual, olfactory) (Doyle 1986). The teacher is charged with the task of managing this information overload. According to Jacobs, Lamb, and Philipp (2010) “distinct patterns of noticing have evolved for groups of individuals who hold similar goals and experiences, such as groups of professionals” (p. 170). Despite the subjective nature of noticing in everyday situations, professional teacher noticing is specialized. While monitoring the classroom, professional teachers pay selective attention to those aspects which are relevant to student learning and disregard others. Educational research puts forward different theoretical approaches/constructs in the effort to represent teacher noticing.

Apart from multiple aspects of classroom management, teachers must notice subject-specific incidents during instruction. We call here a situation relevant to learning an incident. Adaptive and responsive geography teaching requires a teacher`s geography-specific noticing in situ as a prerequisite for effective action. Hence, the concept of noticing needs to be specified for geography education as for any other domain. Geography teacher noticing has not as yet been investigated. This article aims at answering the question of what constitutes subject-specific noticing in geography education. For this purpose three sub-questions are addressed:

- Which features are suitable for characterizing noticing?
- What is subject-specific about noticing in geography education?
- How can geography-specific incidents be constructed and represented in a vignette?

To this end three steps are taken: Firstly, the pertinent literature on noticing is reviewed to establish an understanding of teacher noticing in the form of defining features. Secondly, this concept is theoretically transferred to geography teaching. Finally, the theoretical ideas are substantiated in examples of geography-specific noticing incidents to demonstrate the utility of the concept.

2. CONCEPTUALIZATIONS OF TEACHER NOTICING IN OTHER DOMAINS

First, this section elucidates the term noticing by considering relevant literature on the noticing construct and on the PID model, in order to deduce defining features.

2.1 Noticing

The idea that perception is an important aspect of expertise is well documented within other domains (De Groot 1978; Chase and Simon 1973; Goodwin 1994, 606; Endsley 1988). Goodwin (1994), for instance, argues that archaeologists working at an archaeological field excavation share particular perceptual frameworks when viewing the excavation site. He coins the term "professional vision" and defines it as "socially organized ways of seeing and understanding events that are answerable to the distinctive interest of a particular social group" (Goodwin 1994, 606). This idea has been adopted in educational research. Those involved in mathematics education have been particularly influential in the debate on teacher noticing, having produced an extensive body of literature, particularly in the field of teacher noticing as regards the learning of mathematics (Sherin, Jacobs, and Philipp 2011; Mason 2002; Stahnke, Schueler, and Roesken-Winter 2016). The framework they predominantly refer to is "noticing" (Sherin, Jacobs, and Philipp 2011).

Sherin, Jacobs, and Philipp (2011) define noticing as "…the process through which teachers manage the 'blooming, buzzing confusion of sensory data' with which they are faced, that is, the ongoing information with which they are presented during instruction" (p. 5). Noticing comprises a teacher`s cognitive process in a classroom situation. According to Doyle (1986) a classroom situation is characterized by properties such as multidimensionality, immediacy and unpredictability which distinguishes noticing from other cognitive processes in which a teacher is involved in lesson planning or post-reflection after the lesson. The time pressure faced in this practice is different from any "armchair" reflection (Erickson 2011).

Noticing works as an umbrella term for a number of different conceptualizations, as researchers include different aspects of teachers` thinking in their work (Sherin and Star 2011; Sherin, Russ, and Colestock 2011) as it is an emerging construct (Jacobs 2017). It begins with conceptualizations which define noticing merely as the process in which the teacher "perceives" or "attends to" (Van Es 2011, 134) noteworthy stimuli in the classroom and disregards other ones (Star and Strickland 2008). This constitutes the first component. Besides this initial filtering of stimuli, most conceptualizations include as a second component teachers` "interpretation of" or "making sense of" (Sherin, Russ, and Colestock 2011, 81) or "reasoning about" (Van Es 2011, 134) a given stimulus. Furthermore, it is not easy to pinpoint what "interpretation" precisely means and which components a teacher`s "interpretation" of a given stimulus might comprise (Sherin, Jacobs, and Philipp 2011; Star, Lynch, and Perova 2011). As a third component, authors include considerations of teachers` instructional response, however not the execution of the response as this requires a different set of skills (Sherin, Jacobs, and Philipp 2011; Sherin and Star 2011). The dominant conceptualizations consists of the three cognitive processes of perception, interpretation, and decision-making (Van Es 2011).

The relation among the three components is crucial. Up to this point it seems as if stimuli from the environment are taken in, in a unidirectional, bottom-up manner: from the surrounding environment all the way up to the individuals` awareness. However, human perception is actually more complicated, since a person is not only passively exposed to the stimuli which he/she passively receives from the environment. Instead, perception presumes an active engagement (Sherin, Jacobs, and Philipp 2011), which leads to the question of how

to separate perception from interpretation (Sherin and Star 2011). The person`s perception is guided by pre-existing knowledge and expectations, which is a top-down process. We recognize patterns or structures in the environment because we have constructed mental representations about them earlier. Thus it would seem that perception is inextricably intertwined with bottom-up and top-down processes, which occur simultaneously and most likely continuously, as the teacher monitors his/her environment while teaching (Sherin and Star 2011). The situation is in a reciprocal relationship with the cognitive process of noticing. With reference to Neisser`s perceptional cycle model, Scheiner (2016) concludes that perception, cognition, and the present environment influence each other and cannot be viewed separately.

Moreover, it is debatable whether to treat decision-making separately from the perception and interpretation of a given stimulus, since, although a teacher might perceive and interpret a classroom situation adequately, he/she might nevertheless come to an inappropriate or poor decision, and vice versa (Endsley 2000). Authors in education argue that a teacher who notices a particular situation while teaching is driven by the demand to respond to the situation, even though he/she might decide against any action in the end. Perceiving and interpreting a given situation are not ends in themselves. Teachers notice instrumentally, in order to take action (Erickson 2011). In addition, cognitive psychology and expert-novice research assume that the knowledge used in noticing is stored in the form of schemata. Schemata are mental models of prototypical situations. They act like frames, encompassing particular features and patterns which characterize a certain situation from a particular perspective. Expert teachers have at their disposal schemata for recurrent teaching situations which are flexible and therefore adaptable to various situations. Expert teachers have the ability to activate an adequate schema for the present environment. This leads their perception and allows them to disregard other activities in the classroom (Carter et al. 1988).

2.2 PID Model

A similar line of research, which emphasizes teacher`s noticing as an important competence facet, has been introduced by Blömeke, Gustafsson, and Shavelson (2015) who put forward a heuristic model of teacher competence, in which the teacher`s situational skills are considered and are linked with other factors of teacher competence. The authors create their model against the backdrop of two competing conceptualizations of teacher competence in mathematics education. Competence has been understood either from a cognitive perspective as disposition, or from a situational perspective as performance. Blömeke et al. (2015) dismiss this dichotomous thinking and conceptualize teacher competence as a continuum. They state that “knowledge, skill, and affective-motivation components underlie performance but they change during the in-situation performance as the situation moves along” (Blömeke, Gustafsson, and Shavelson 2015, 7).

However, the interplay of the different resources remains unclear (Blömeke, Gustafsson, and Shavelson 2015). The authors bridge the gap between a teacher`s cognitive, affective, and motivational disposition to performance with situation-specific skills. The situation-specific skills are specified by the PID model, which is an acronym for a teacher`s perception (P), interpretation (I), and decision-making (D) and as such approximates the tripartite noticing concept. However, the number of components and expressions are determined and embedded here in a professional framework, which suggests that noticing is based on teachers` dispositions and leads to performance.

Apart from these two frameworks (noticing, PID), empirical research in mathematics also frames teachers' noticing in notions of (situated) professional knowledge (Stahnke, Schueler, and Roesken-Winter 2016). Since conceptualizations of noticing embedded in "professional knowledge" conceptions are heterogeneous and "noticing names a process rather than a static category of knowledge" (Sherin, Jacobs, and Philipp 2011) the article does not consider them.

2.3 Features of teacher noticing

Based on these considerations teacher noticing comprises both: teachers`cognitive process and the specific context and environment in which it occurs. Features of the cognitive process are: it is an ad hoc cognitive process, it is theoretically divided into perception, interpretation and decision-making, thoughts and ideas concerning a specific situation of learning and instruction are organised in schemata and the cognitive process is based on teachers` dispositions and finally leads to performance.

Since noticing is inextricably intertwined with the present environment and the article aims to construct a noticing incident, the features of a noticing incident, based on the noticing literature, are made explicit in the following. The features are summed up in Table 1.

Table 1. Defining features of a noticing incident

Reference Letter	A noticing incident
(A)	…occurs in an instructional situation,
(B)	…provides indicators for students` thoughts
(C)	…is central in the context
(D)	…supports or hinders students` learning
(E)	…belongs to an abstract category of education
(F)	…must render an option to make a decision
(G)	…is typical or common place

According to theory, the cognitive process occurs (A) in an instructional situation, which is characterized by certain properties (see above). In addition, the teacher`s cognitive process consists of perception, interpretation and decision-making, it can be deduced that the incident must render the three cognitive actions possible. It is a prerquisite for the teacher`s perception that (B) students express their thoughts and feelings in the incident either verbatim or gestural. Students' thoughts need to become sufficiently apparent in their actions, allowing for reasonable inferences to be made by the teacher. And, in order to be perceived, (C) the situation has to have a certain degree of centrality within the particular teaching phase. Thus, the incident has to be focal in the wider instructional context. For instance a student`s error in a debriefing phase, concerning the activity or content, which should have been acquired during the working phase of the lesson, is central. If the student shows an insuffcient understanding of the new insights, the teacher has to notice the misunderstanding because the debriefing phase has the function to transfer and apply new insights. However, if a student mispronounces a technical term in the final minutes of the lesson while the teacher already announces the homework, the student mistake can be regarded as marginal in the situation.

Since we are concerned with teachers` professional perception, (D) the incident must be relevant to student learning because the incident either supports or hinders student learning. In order to be interpretable from a professional perspective (E) the incident must be a "case of" (Shulman 1986) a broader principle, a more abstract category of teaching and learning i.e.

a matter of education. It must be possible for the teacher to make sense of the incident against this background. Based on the interpretation decision-making must basically be possible (F).

As mentioned above, the knowledge on which noticing is based upon is cognitively organised in schemata. The incident needs to activate teacher`s cognitive schemata. Cognitive schemata indicate that (G) the incident is neither rare, nor exceptional but rather typical and commonplace in everyday teaching otherwise no cognitive schema is available and applicable to the incident.

These features characterize a noticing incident, which trigger the teacher`s cognitive process. The features are based on theory and set up a frame to characterize a noticing incident. The features are sufficient but might not be exhaustive.

3. APPLYING THE THEORETICAL CONCEPT OF NOTICING TO THE DOMAIN OF GEOGRAPHY

In this section the previously deduced features of a noticing incident will be related to geography teaching. Domain specificity has an impact on noticing/PID. Blomberg, Stürmer, and Seidel (2011) indicate that noticing "takes place under both generic and subject related aspects" (Blomberg, Stürmer, and Seidel 2011, 137) and assume that subject specificity is based on teachers` knowledge as well as subject-specific socialization, in addition to personality traits, which motivate the studying of a particular subject. The subject specificity of noticing is supported by Steffensky et al. (2015) who report mid-level correlations between pedagogical and domain-specific professional vision (r= .605). These findings lead to the conclusion that domain-specific noticing and generic noticing "are positively associated but distinct constructs" (p. 364). According to Blomberg, Stürmer, and Seidel (2011) "little is known about professional vision in different domains or about the extent to which the subject in question impacts professional vision" (p.1132).

In the following we focus in more detail on the deduced situational features of noticing discussed above (see Table 1) with a special focus on the subject-specificity of the aspects A to G. At the end of each paragraph a guiding question is asked. These guiding questions will be later used as a framework for the design of a teaching and learning incident in geography education which embodies our ideas on geography-specific noticing.

Feature (A) states that a teacher's noticing is embedded in instructional situations. Generally spoken, a multitude of different classroom settings do exist in geography teaching due to its hybrid character blending the natural and social sciences. The conduction of an experiment in small groups is as typical as performing a role play or holding a plenary discussion. A noticing incident in geography can occur in various manners of classroom arrangement. Apart from those classroom settings, one specific type of subject-specific instructional situation is the field trip. Field trips are a distinct teaching method in geography and probably deserve a special kind of teacher noticing, however, in so far this article focuses on instructional situations within the geography classroom.

More importantly the subject specificity of an instructional situation results from its subject-specific content. The subject-specific incident needs a geographic issue at its core. Since geography is a multiparadigmatic and dynamic discipline, determining its contents (CK) has been a matter of debate even within the discipline. However, geography educators agree on the content of geographical education in the "International Charter on Geographical Education"(IGU 1994). The contents of geography was outlined in the original Charta and taken as an antecedents in an updated version (Van der Schee and Lidstone 2016). The authors of the charta state that the contents of geography education can be retrieved by means of three different approaches: a systematic approach, i.e., from the subdisciplines of human

and physical geography such as geomorphology and population geography; an issues-based approach, from topics such as urbanization, hazards, and disasters; or a systems-based approach, drawing on such topics as the soil system, transport system, or ecosystem. The updated edition – as well as several other publications on the content of the school subject (DGfG 2012) – emphasize key global problems such as climate change, food security, overexploitation of natural resources, energy choices, and urbanization (Van der Schee and Lidstone 2016) as genuinely geographic issues, due to the fact that they are spatially represented and they result from interactions between physical conditions and human activities. Although possible thematic fields are noted, the thematic scope is broad and definition of disciplinary boundaries remains difficult. Key concepts help to frame and shape the subject`s core (Brooks 2013; Gersmehl 2014; Lambert and Morgan 2010; Leat 2016). Different authors participate in the debate on key concepts. The authors differ in the terminology and the number of concepts they include (Taylor 2008). Nevertheless, similar ideas of key concepts can be identified. From a German perspective on learning and teaching in geography, Fögele (2016) assembles the following key concepts for geography. Fögeles` compilation of key concepts is based on the conceptual ideas contained within the National Standards (DGfG 2012), continuities within the discipline, continuities within geography education, and the international debate: human-environment system: structure, function, process; the four concepts of space; the sustainability quadrangle (Education for Sustainable Development ESD); scale; and time. The key concepts are an enormous aid in grasping the subject specificity of geography. The resulting question is: Does the incident represent a geographic issue during instruction?

Feature (B) states that students need to express their thoughts in order to be perceived by the teacher. This is a general prerequisite without a subject specific imprint and leads to the question: Is student thinking discernible in the incident.

Whether a particular classroom interaction is central in the context, feature (C), and requires a teacher`s attention because it is beneficial to geography learning or whether it hinders geography learning, feature (D) can only partly be theoretically derived, but needs to be considered and justified within the specific situation. The definition of what supports geography learning at the classroom level and therefore requires noticing by the teacher has no defined contour because many factors need to be considered, which are specific to a particular context and situation. However, in constructing a concrete noticing incident these are central thoughts, which result in the question: Is the incident central in the context? and Does the incident support or hinder geography learning?

Feature (E) declares that a noticing incident needs to belong to an abstract category of education. In reference to geography education this means the subject-specific incident needs to relate to the pedagogical content knowledge (PCK) of geography. Different approaches have been developed how to conceptualize PCK for the domain of geography (Blankman et al. 2015; Martin 2008; IGU 1994).

Many authors in geography refer back to Shulman (1986). Shulman states that the PCK of a subject includes the “most useful forms of representation (…) the most powerful analogies, illustrations, examples, explanations and demonstrations” (Shulman 1986, 9) of a subject to make it comprehensible to others. This can be specified only in relation to a particular topic. In addition, PCK consists of an “understanding of what makes the learning of specific topics easy or difficult” (Shulman 1986, 9). As a corollary, the teacher should have knowledge of strategies for overcoming/transforming pre-conceptions (Shulman 1986). Geography refers to conceptual change research, which proposes a framework for modifying students` pre-conceptions (Posner et al. 1982; Reinfried 2015).

Apart from Shulman`s approach to define the PCK of geography, what belongs to the PCK of geography is often determined by the dominant educational discourse in the subject, expressed through publications. The discourse establishes abstract categories of teaching and learning geography. If an incident in the classroom does not relate to an abstract category of teaching and learning in geography, then the instance, although practical and concrete, will not qualify as a subject-specific noticing incident, therefore the question is: To which category of geography teaching and learning does the incident belong?

Feature (F) states that a decision-making must be possible on the basis of the interpretation. Does the situation demand a certain kind of decision-making?

Feature (G) demands to determine typical or common place situations in geography education theoretically. This is difficult because, literature on the micro level of geography teaching is rare (Wieser 2010) and our knowledge about typical incidents in geography education on such a fine-grained level is limited. Can it be assumed that the incident is commonplace in geography teaching?

On the basis of this transfer from our theoretical discussion of noticing to the specifics of geography education as set out above, exemplary geography-specific incidents are constructed in the following section. These incidents serve as examples of how to understand and represent noticing in geography education.

4. REPRESENTING GEOGRAPHY-SPECIFIC NOTICING INCIDENTS BY VIGNETTES

A common way to operationalize the noticing construct is to work with a vignette (Stahnke, Schueler, and Roesken-Winter 2016) because the construct of noticing is defined by many situational features which can be represented using this medium. Vignettes can serve as research tools. In the educational sciences a vignette is a medium, neither a method nor a content (Brophy 2004). Vignettes are brief and depict a self-contained situation (Schratz, Schwarz, and Westfall-Greiter 2012), a coherent idea. A vignette can be presented in different ways, either as a written text, a video or audio. Furthermore, vignettes may be differentiated according to the style of presentation (dialogue, narration), the degrees of reality (scripted vignettes, actual teaching situations), and the purpose it serves (research, teaching).

This paper combines the theoretical ideas about noticing and the “written vignette” as a medium. It uses a scripted written vignette (two more vignettes can be found in the Appendix) in the form of a dialogue to provide examples of geography-specific noticing incidents. The vignette is scripted because this allows for the integration of selected domain-specific noticing incidents, and a dialogue style is used as this more closely resembles the classroom situation than does a narrative style, which is more abstract.

The setting of the vignette is a geography lesson in year 9 with 25 students in a German high school. The topics are common topics in year 9 in Germany. The vignette starts with a brief introduction, in which the unit to which the lesson belongs, is named. Then the intention of the lesson and the lesson plan is briefly described. A short extract of the specific classroom situation is offered. Gestures are described in italics.

Table 2. Vignette 1: The simple ozone depletion model

Context: The teaching unit focuses on climate change and its impact on humans. In one of the first lessons the teacher deals with the processes involved in the greenhouse effect. She begins with a newspaper headline on global warming which leads to the question of why average global temperatures are increasing. She has prepared material for the students to explain the greenhouse effect. The students and the teacher compare the results in class. For the debriefing phase, the teacher has planned a plenary discussion in which the students debate on what can be done about the anthropogenic greenhouse effect. The following is an extract of a possible class conversation: Teacher: Having explained the anthropogenic greenhouse effect and thus the rise in temperature – what can be done against it? (*several students raise their hands*) … Philipp? Philipp: I think people should use more public transport… and ride a bike…because then fewer toxic substances are emitted. Then the ozone layer would not be destroyed and people would be protected from harmful radiation. Teacher: What do the others think about this? ... Clare? Clare: I think it`s true, but it`s not always easy to ride a bike because sometimes the distance is too great or there is no bike path … but yes, of course it is a good idea … and … and … Philipp (*interrupts*): …and in addition skin cancer is reduced and that`s also important. Teacher: Philipp, let Clare finish her sentence! Clare, please go on …

To highlight why the particular situation qualifies as subject-specific noticing, we used the features and the resulting questions from the latter section and listed them in the first column of Table 3. The answers to the questions for the three particular situations are given in the following rows. Table 3 offers a synoptic presentation.

Table 3. Noticing features, guiding questions and the vignette

Noticing features and guiding questions	Vignette 1: Simple ozone depletion model
A) …occurs in an instructional situation	
1) Does the vignette represent a geographic issue during instruction?	• Climate change • Key concepts: This is an example of the interaction of the human-environment system and is an ESD topic
B) …provides indicators for students` thoughts	
2) Is student thinking discernible in the vignette?	• Verbal indicators: "Then the ozone layer would not be destroyed and people would be protected from harmful radiation" and "in addition, skin cancer is reduced"
C) …is central in the context	
6) Is the incident central in the given context?	• Yes, because the aim of the lesson is to convey to the students an understanding of the processes involved in the greenhouse effect. If the student continues to refer to his/her pre-conception even during the debriefing phase, the teacher must acknowledge this misunderstanding
D) …supports or hinders students` learning	
7) Does the incident support or hinder geography learning?	• Student endorses the "simple ozone depletion model" (Schuler 2011), which comprises the idea that the emission of substances such as CO2 and FCKWs, which attack the ozone layer, leads to a hole in the layer. The presence of this hole allows more sunrays and thus more intensive radiation to reach the earth`s surface, subsequently warming the atmosphere • Philipp`s pre-conception should not escape the teacher's attention, because it leads to incorrect assumptions as to the reasons for and consequences of the greenhouse effect and eventually to unsustainable actions.
E) …belongs to an abstract category of education	
8) To which category of geography teaching and learning does the vignette belong?	• Students` pre-concepts of geography
F) …must render a decision-making possible	
9) Does the vignette demand a certain type of decision-making?	• Ideal decision could be based on conceptual change research and its classroom implications (Schuler 2011).
G) …is typical or common place	
8) Can it be assumed that the incident is commonplace in geography teaching?	• Empirical studies have shown that the given pre-conception is prevalent among students (Boyes and Stanisstreet 1993; Schuler 2011)

The questions and the examples given in the vignette help to convey the idea of subject-specific noticing which is not easy to grasp due to its concrete situational nature. Multiple subject-specific noticing incidents are possible (see Appendix). However, not every classroom interaction qualifies as a subject-specific noting incident. As is apparent, the incidents can refer to different fields of geography and different categories of geography teaching and learning.

5. CONCLUSION AND OUTLOOK

The overall aim of this article is to transfer the construct of noticing, which is a subject of current research in other domains, to geography education and thus to raise geography educators` awareness of this field of research. In the foregoing, the following three aspects have been demonstrated:

(1) Noticing and its subject specificity: The concept of noticing – as an important facet of teachers` competence – is located between a teacher`s knowledge and beliefs and his/her performance. The introduction of the concept of noticing to geography education is necessary because noticing – as research has already indicated – needs to be considered from a subject-specific perspective. This article has identified the defining features of noticing from the relevant literature in other domains to elucidate the concept of noticing. These tangible defining features provide a basis for further academic discussion and subject-specific application. Noticing is particularly subject-specific in several respects: The incident needs to relate to geography CK and geography PCK. The incident occurs during geography instruction and is to a certain degree typical of geography learning. These aspects set geography-specific noticing apart from noticing in other domains. Whether geography teachers have a specific way of noticing, which differs from that of teachers in other domains – excluding the differences mentioned above – is an empirical question difficult to explore as teachers usually teach more than one subject.

Until now, subject-specific noticing in geography has been defined on a theoretical basis. At this point further research on an empirical basis is needed to investigate what comprises subject-specific noticing competence.

(2) Geography-specific incidents: To substantiate these assumptions the article provides examples of noticing incidents in geography teaching. Table 3 offers guiding questions and illustrates the geography-specific aspects in the vignette. In constructing the incidents one aspect turned out to be a sensitive issue. Noticing incidents express themselves in the classroom through verbal (and in part non-verbal) indicators, which the expert teacher can immediately decipher. It needs to be decided which student behavior qualifies as an indicator for the noticing incident, if the addition of indicators is necessary, and how an indicator needs to be formulated. Minor differences in the frequency and quality of the indicators might account for major differences in the perception, interpretation, and decision-making of the teacher.

(3) Working with vignettes in higher education of geography: We have explored the medium of “written vignettes” and described the construction of a written vignette for its usage as a research tool. The vignette as medium is the ideal representation for initial exploration of subject-specific noticing. In the future written vignettes can be transformed into video vignettes which represent the complexity of the classroom even better and are therefore suited to the noticing construct. Vignettes could be used to diagnose pre-service geography teachers` competences in a contextualized manner. In addition, such vignettes can be applied in the enhancement of geography teacher training (c.f. Brysch and Boehm 2014) as they allow for the representation of a classroom situation on a finely tuned level of teaching practice, which may help to bridge the gap between theory and practice.

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Appendix

Appendix 1. Vignette 2: Earthquake-proof houses

Context:
The teaching unit concerns earthquakes. In this lesson the students are working on a mystery which revolves around the earthquake in Kobe in 1995. It presents the causes of the earthquake and focuses on the primary and secondary effects thereof. The content is incorporated into the story of the Endo family, who lost their mother due to the secondary effects of the earthquake. The father and son survived because aht the time the father was visiting the son, who lives in an earthquake resistant building (Vankan, Rohwer, and Schuler 2007).
The students have completed the activity and are discussing their results. The following is an extract of a possible the class conversation during the debriefing phase:

Teacher: Could the death of Mrs Endo have been prevented? (several students raise their hand)…Willem.

Willem: Yes, of course, the Endos could have moved to another country.

Teacher (looks around the classrooom, several hands are still raised): Greg!

Greg: I thought the Endos could have moved into an earthquake-proof house. They have such houses there. It`s their own fault, if they live in such a dangerous area and do nothing to protect themselves.

Willem (interrupts): I think so, too. It is simple.

Teacher: Would anybody like to comment on this contribution? (two students raise their hands)… Susan.

Susan: Well, but if they had lived there for a long time…I think one of the clues in the mystery said that they had been living there their since the 1960s. Maybe they were born nearby. They felt attached to their home. And earthquake-proof houses are probably very expensive.

Appendix 2. Vignette 3: Geographic coordinates

Context:
The teaching unit focuses on climate change and its impact on humans. In one of the first lessons the teacher deals with the processes involved in the greenhouse effect. She begins with a newspaper headline on global warming which leads to the question of why average global temperatures are increasing. She has prepared material for the students to explain the greenhouse effect. The students and the teacher compare the results in class. For the debriefing phase, the teacher has planned a plenary discussion in which the students debate on what can be done about the anthropogenic greenhouse effect.
The following is an extract of a possible class conversation:
Teacher: Having explained the anthropogenic greenhouse effect and thus the rise in temperature – what can be done against it? (*several students raise their hand*) … Philipp?

Philipp: I think people should use more public transport… and ride a bike…because then fewer toxic substances are emitted. Then the ozone layer would not be destroyed and people would be protected from harmful radiation.

Teacher: What do the others think about this? ... Clare?

Clare: I think it`s true, but it`s not always easy to ride a bike because sometimes the distance is too great or there is no bike path … but yes, of course it is a good idea … and … and …

Philipp (*interrupts*): …and in addition skin cancer is reduced and that`s also important.

Teacher: Philipp, let Clare finish her sentence! Clare, please go on …

Appendix 3. Noticing features, guiding questions and vignettes

Noticing features and guiding questions	Vignette 2: Earthquake-proof houses	Vignette 3: Geographic coordinates
A) …occurs in an instructional situation		
1) Does the vignette represent a geographic issue during instruction?	• Natural hazards • Key concepts: human-environment system, human adaptation or mitigation strategies for coping with natural hazards, implementation of strategies depends on individual perspective • Fundamental thinking strategy of geographers (Vankan, Rohwer, and Schuler 2007)	• Key concepts: concepts of space, location • Common geographic practice to locate phenomenon, geographic coordinates serve as most important orientation grid
B) …provides indicators for students` thoughts		
2) Is student thinking discernible in the vignette?	• Verbal indicators: "Well, but if they had lived there for a long time…I think one of the clues in the mystery said that they had been living there since the 1960s. Maybe they were born in the nearby. They felt attached to their home. And earthquake-proof houses are probably very expensive."	• Verbal indicators: "and 115 to 125 degrees eastern latitude."
C) …is central in the context		
6) Is the incident central in the given context?	• Yes, because the focus of the discussion in this sequence is on prevention strategies. Particularly in contrast to the previous comments, Susan`s contribution is an important relativization. It questions Greg`s simplistic solution and reveals its limitations. • Since the teacher has selected a "Thinking Through Geography" method (in this case: Mystery), geographical thinking must be an objective in his lesson.	• Yes, because the central concept behind this sequence is the location of a phenomenon and the naming of the coordinates belonging to it. • Critical moment because other students are also observing the scene. • Routine practice
D) …supports or hinders students` learning		
7) Does the incident support or hinder geography learning?	• Student is able to adopt the perspective of another and argues from someone else`s point of view • She puts forward two arguments from this perspective: emotional attachment and financial resources	• Student confuses "eastern latitude" with "western longitude" and thus makes a mistake in two different areas: general geographic location (east vs. west) and terminology •

E) …belongs to an abstract category of education		
8) To which category of geography teaching and learning does the vignette belong?	• Student geographic thinking, reasoning skills (Leat 1998), change of perspective (Vankan, Rohwer and Schuler 2007)	• Map skills, map analysis competence, map decoding (Hemmer et al. 2010)
F) …must render a decision-making possible		
9) Does the vignette demand a certain type of decision-making?	• It is opportune at this moment to emphasize the student`s thinking, for example by praising the student`s comment in the plenary discussion	• Incident requires further investigation: is this an error or a mistake? Finally, the error/mistake needs to be corrected
G) …is typical or common place		
8) Can it be assumed that the incident is commonplace in geography teaching?	• Geography education often works with foreign examples, a change of perspective is often required for the students to grasp the complexity of geographical phenomena	• Naming of geographic coordinates difficult for students: order, technical terminology and finding the correct degree in the margin of the map: common error/mistake