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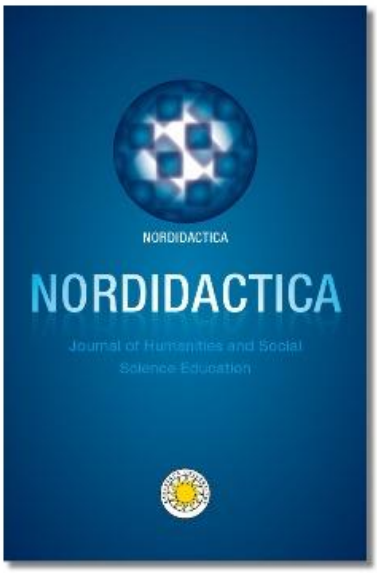

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The pedagogical content knowledge of Danish geography teachers in a changing schooling context

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Abstract: This study examines the self-reported, topic-specific professional knowledge (TSPK) of Danish geography teachers seen as an aspect of their pedagogical content knowledge (PCK) when teaching weather formation and climate change. This topic is considered representative of geography teaching in Denmark. In the last ten years Danish primary and lower-secondary schooling has undergone several significant changes, including the introduction of a final multiple-choice exam in geography in 2007, and a fundamental reconstruction of the curriculum in 2014. These changes are expected to influence the TSPK of geography teachers in ways that potentially have an impact on their classroom practice. Teachers´ responses to specific questions relating to their choice of learning goals and the content and organisation of their lessons show that geography teachers take into account not only the knowledge aspects which point to the final multiple-choice exam, but also the 'bildung' perspectives of the subject equipping students to develop their own opinions when dealing with socio-scientific issues (SSI).

KEYWORDS: GEOGRAPHY TEACHERS, WEATHER FORMATION AND CLIMATE CHANGE, KNOWLEDGE AND BILDUNG.

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> *"Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems"* (Intergovernmental Panel on Climate Change, 2014).

Introduction

The quote above shows that climate change is one of the most important challenges of our time, and that the attention of international organisations is now focused on the problem. It must therefore be regarded as an important part of the school curriculum in general, including the subject of geography. We know that the teacher is the determining factor for student learning (Hattie, 2009), and that the teacher´s pedagogical content knowledge (PCK) is crucial for the quality of the teaching (Shulman, 1986). This paper focuses on the self-reported, topic-specific professional knowledge of geography teachers (TSPK), which forms part of their PCK (Gess-Newsome, 2015), concerning the socio-scientific issue (SSI) of weather formation and climate change. When working with this SSI, students have to learn some key concepts related to weather, climate and climate change, as well as being prepared to take a personal stand regarding central democratic questions influenced by the challenges of climate change (Feierabend & Eilks, 2010; Ratcliffe & Grace, 2003). In other words, a central part of PCK for teaching climate change is the teacher's considerations regarding how students can both learn some given facts and learn to become informed citizens. In this paper, this duality is defined as "the dual perspective". The way in which geography teachers comprehend and act in relation to this dual perspective has not been well described in the research literature. This is particularly interesting given the fact that they are acting in a highly changeable context under the influence of accountability, something which is indeed true of all Danish primary and lower-secondary school teachers. Thus, using the concept of PCK, this paper focuses on the self-reported TSPK of Danish geography teachers when making decisions related to their choice of learning goals and the content and organisation of their lessons. The paper gives an indirect perspective on how the PCK of Danish geography teachers has been influenced by external changes at a macro level in the educational system over the last fifteen years.

Background

Climate change is of considerable interest to the public, politicians and scientists (see e.g., United Nations A/Res/70/1), because it affects many people's daily lives and is a current problem in most societies. Whether climate change is a school topic or a subject which is debated in the news (Schmidt, Ivanova & Schäfer, 2013)[1], it calls for

[1] See also e.g. http://www.theguardian.com/environment/climate-change (31.08.2016).

knowledge from both the natural and social sciences, and can therefore be regarded as an SSI (Feierabend & Eilks, 2010; Ratcliffe & Grace, 2003).

Teaching climate change in geography classes is a rather complex and difficult thing to do (Korsager & Slotta, 2015), because the topic includes some key concepts, theories and models from physical geography related to weather formation which are necessary to understand some of the imprints of climate change (e.g. the increase of hurricanes). But it also contains some key concepts and theories from human geography related to man's interaction with nature, e.g. how emissions of CO_2 and CH_4 have an impact on the greenhouse effect, and how the greenhouse effect actually changes people's living conditions around the world[2]. In a further educational perspective, the teaching of climate change involves making the students aware of the fact that they are the adult generation of the future, and that they are therefore part of a democratic process that secures a sustainable development for the future environment. This can also be called education for sustainable development (ESD) (e.g. Bolstad, 2003; Huckle, 2014; Morelli, 2011), and is connected to the formation of the students' personality or 'bildung'. The purpose of education for sustainable development is to develop the ability of students to take action (their 'action competence'), which is not an educational goal, but an educational ideal closely related to liberal education, democracy and human rights (Mogensen & Schnack, 2010). Apart from more general skills, such as cooperation and reading, the development of action competence also requires knowledge/insight, commitment, vision and action experiences (Jensen and Schnack, 1997). In the Nordic countries, the importance of connecting scientific knowledge with aspects of democracy is also emphasised by several authors (e.g. Breiting et al., 1999; Gustafsson, 2007; Paulsen, 2012; Sjøberg, 2005). In the Danish Education Act emphasis is actually placed on the development of students' action competence: "*The school must prepare students for participation, joint responsibility, rights and duties in a society based on freedom and democracy*", (Danish Ministry of Education, 2016, Education Act § 1.3). Each subject in Danish schools, including geography, must comply with this requirement.

Geography in Danish schools

In lower-secondary Danish schools geography is regarded as a science subject alongside biology, physics/chemistry and mathematics. The geography curriculum contains aspects of both physical geography and human geography, and this makes the content of the subject rather extensive. Even so, less emphasis is placed on the teaching of geography than on the teaching of other subjects (Nikolajsen & Larsen, 2013). The geography curriculum has changed over the last ten years. Previously, the curriculum was described in terms of student knowledge, and according to weather

[2] See e.g. footnote 1 or one of IPCC´s publications: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml (31.08.2016).

formation and climate change, said: "…*that students have acquired knowledge and skills that enable them to describe important aspects of weather, climate and climate change on Earth [..] and give examples of human exploitation of natural resources in the context of sustainability*" (Danish Ministry of Education, 2009). By contrast, the most recent revision of the geography curriculum in 2014 states that the goal is "…*that students can explore the impact of climate on local and global conditions [..] and the students can explain the current consequences of exploiting natural resources*" (Danish Ministry of Education, 2014). When teaching weather formation and climate change, Danish geography teachers must therefore help the students to acquire the above-mentioned knowledge but also make it possible for them to develop action competence in relation to the environment.

This dual perspective of teaching weather formation and climate change makes it rather demanding and complex to teach geography. So the knowledge that teachers need, which could be called pedagogical content knowledge (PCK) (Shulman, 1986), differs from the knowledge of scientists (Cochran, DeRuiter & King, 1993; Lee & Luft, 2008; Shulman, 1986). According to Shulman (1986, pp. 9-10), PCK consists of both subject knowledge and pedagogical knowledge, and PCK is defined as: "… *the ways of representing and formulating the subject that make it comprehensible to others [..]… an understanding of what makes the learning of a specific topic easy or difficult*" (Shulman, 1986, p. 9). Other scholars have described PCK as a synthesis of three components: subject knowledge, pedagogical knowledge and knowledge of context (Abell, 2008). The latest model to be developed is the so-called PCK consensus model, which regards PCK as personal knowledge, skills and enactment related to the teacher's classroom practice, but also depends on more general and public professional knowledge bases like the teacher's topic-specific professional knowledge (TSPK), and filtered through the teacher's beliefs (Gess-Newsome, 2015). This topic specificity is important because: *"Even though each concept being explored is found in both domains* (e.g. the concept of temperature, when adapted by a chemistry teacher as kinetic molecular theory, or a physics teacher as the measure of heat lost or gained in a system), *the teaching styles, methods, and approaches to representing these topics usually differ. These differences legitimate the need for developing topic-specific PCK as an instructional paradigm for prospective science teachers*" (Veal and MaKinster, 1999). The topic-specific nature of teachers' PCK has also been emphasised by other educational researchers (Birdsall, 2015; Lane, 2015; Shulman, 1986; Van Driel & Berry, 2012). This means that the PCK required to teach weather formation and climate change can be expected to be different from the PCK required to teach plate tectonics or demography, for instance.

A number of approaches have been used with a view to researching teachers' PCK. Kleickmann et al. (2013) have compared two groups of different mathematic teachers with their educational backgrounds using a quantitative methodology, whereas Birdsall (2015) and Lane (2015) have applied qualitative methods to give in-depth insight into a small number of teachers' PCK concerning geography and environmental matters. This study uses a survey to ask Danish geography teachers about their TSPK (Gess-Newsome, 2015) concerning weather formation and climate

change. The latest research survey concerning the pedagogical abilities of Danish geography teachers in lower-secondary schools was conducted in 1998 (Jensen et al., 2000) and emphasised, among other things, the ways in which geography teachers choose their content and organise their lessons. Since this survey was conducted, many changes have taken place in the Danish schooling system as the result of government initiatives.

The macro educational level and external influences

According to Dolin (2005), most educational systems can be divided into three educational levels: micro, meso and macro level, each focusing on different aspects of educational matters (figure 1). The macro level greatly affects the two other levels when changing curricula, goals, organisation or other educational intentions; whereas changes at the micro level only have a minor impact at the two other educational levels.

Educational levels	Main elements	Actors
Macro level: intentions	Educational policy: visions, relationships, resources	Government, NGOs
	(Geography) curriculum development: goals, organisation, etc.	Ministry, researchers, NGOs
	Educational research and science subject (geography) research	Research institutions: traditions and co-operation
	(Geography) student teacher education and in-service (geography) teacher training: structure and resources	Ministry, municipality, NGOs
Meso level: implementation	School culture and values	School management
	Academic environment at school	(Geography) colleagues, collaborative culture
	In-service (geography) teacher training: structure and resources	Professional organisations, University Colleges
	(Geography) teacher: attitudes, experience, professionalism etc.	(Geography) teachers
Micro level: realization	(Geography) student: attitudes, assumptions etc.	(Geography) students

FIGURE 1.

Three educational levels including the main elements and actors (modified based on Dolin, 2005)

In the last twenty years, the educational macro levels of many countries have been under the influence of several international large-scale assessment programmes

(Kirsch et al., 2013; Ritzen, 2013; Sortkær, 2015), which have been developed with the aim of comparing students' competences in different countries. The International Association for the Evaluation of Educational Achievement (IEA) launched the Third International Mathematics and Science Study (TIMSS) in 1995 (Weng, 1996), followed by the Progress in Reading Literacy Study (PIRLS) in 2001 (Kirsch et al., 2013). The best known of these programmes is probably the Programme for International Student Assessment (PISA), initiated by the Organization for Economic Co-operation and Development (OECD) (Breakspear, 2012; Gustafsson, 2008; Lie et al., 2003; Ritzen, 2013; Sortkær, 2015). PISA was carried out for the first time in 2000 and has since been conducted every third year with a view to estimating the competences of 15-year-old students in terms of reading, mathematics and science, although each time the focus is placed on one of these subjects in particular. Assessing the students' competences instead of their knowledge has resulted in a shift of focus from student input to student output (Neumann, Fischer & Kauertz, 2010), which might have influenced the teachers' ways of teaching and, accordingly, their TSPK.

The results achieved in Finland have been in the top 15 ever since PISA began, whereas the results in other Nordic countries (Norway, Sweden, Iceland and Denmark) have been mediocre (Egelund, 2013; Lie et al., 2003), as have the PISA results in Germany. Large-scale international surveys like PISA have changed the focus from explanatory purposes towards descriptive purposes, making it possible for national governments to interpret the results themselves, diagnose potential educational problems, and initiate various actions to solve these educational problems (Gustavsson, 2008). Since the PISA survey results were first announced at the beginning of the millennium, national educational policies have been influenced by them to varying degrees, depending on how the results aligned with the expectations of the countries in question (Breakspear, 2012; Egelund, 2008; Grek, 2009). As in Germany, the PISA results in Denmark had a relatively high impact on educational policy (Breakspear, 2012; Ritzen, 2013; Schmidt, 2015; Sortkær, 2015), leading politicians to an increased focus on student outcomes and, subsequently, to the implementation of national tests in Denmark and a comprehensive school reform in 2014 (Sortkær, 2015). The school reform implemented in 2014 in the compulsory schooling system in Denmark caused fundamental changes both in the curricula for the different subjects and in the teachers' pedagogical approach (Sortkær, 2015). As an example of some of these changes in the Danish schooling system, the Danish Ministry of Education introduced a final multiple-choice exam in geography in lower-secondary schooling applied for grade 9 at their final exam, summer 2007. Unlike previous curricula, the 2014 curriculum described the learning outcome in terms of student competences. The new geography curriculum was divided into four main academic areas, with a fifth area covering students' general science skills and communication skills.

These changes at macro-educational level are of importance for the practice of geography teachers. However, there is a general lack of knowledge about the characteristics of Danish geography teachers as professionals. One of these characteristics concerns the way in which geography teachers choose their learning

goals and content areas, and the way they organise their teaching. These aspects of the PCK of geography teachers might be influenced by the many politically induced school reforms which have taken place within the last fifteen years.

Research Questions

The aim of this paper is to examine the characteristics of the topic-specific professional knowledge of Danish geography teachers, based on their own reports of their instructional strategies and practices when teaching the topic of weather formation and climate change. The focus is placed on what these teachers regard as the most important learning goals and content, and on the way in which they choose their content and organise their geography lessons.

Research question 1: What do Danish geography teachers consider to be the most important learning goals and content when teaching weather formation and climate change?

Research question 2: How do Danish geography teachers choose their lesson content and organise lessons when teaching weather formation and climate change?

Methodology

In this study a survey (S15) was sent to all 192 geography teachers at 72 schools in the central part of Jutland in the spring of 2015. The 72 schools selected were evenly distributed according to size (between 100-1,000 students) and geography (villages, towns, cities). The geography teachers reported how they chose content and organised lessons, and what they considered to be the three main learning goals and content areas when teaching weather formation and climate change. Consequently, it is important to notice that in this paper the self-reported PCK of the teachers is studied through a quantitative survey, which means that the classroom level is only indirectly studied.

The survey was sent electronically to the school secretaries, asking them to distribute it to all the lower-secondary geography teachers in the 2014-2015 school year. After sending two reminders, the response rate was around 10%. Following a personal visit to the schools, handing out a document with a link to the survey to each geography teacher, a total of fifty-five teachers responded to the survey – equivalent to a response rate of 29%. This relatively low rate of response might be explained by the fact that an extensive school reform was implemented on 1 August 2014. Table 1 shows the results from various surveys among lower-secondary Danish geography teachers, all of whom have a teaching diploma in geography.

TABLE 1.

Response rate and competencies among lower-secondary geography teachers in Denmark.

	Geospørg´98 (Jensen et al., 2000)		**Uni-C 2013** (Nikolajsen, & Larsen, 2013)		**S15**	
	Number	%	Number	%	Number	%
Teachers possessing a teaching diploma in geography.	106/309	34%	-	53%	28/55	52%
No. of responses relative to total no. of geography teachers in DK.	-	-	-	-	55/3143	1.7%

According to Table 1, the response rate of geography teachers with a teaching diploma in geography was low in the Geospørg ´98 survey. But the rate was higher in the Uni-C 2013 (Nikolajsen & Larsen, 2013) and S15 surveys. Results from the S15 survey also show that 28% of the geography teachers taking part have taken short-term training courses, whereas only 12% have taken long-term training courses. Some of the teachers might have taken both long- and short-term courses. The proportion of geography teachers with a teaching diploma in geography in Denmark is roughly the same as the proportion in Sweden, where 1/3 of all geography teachers at lower-secondary level have a teaching diploma in geography, and 58% have taken 30 university credits ("högskolepoäng") or more (Bladh, 2014). However, the number of geography teachers taking part in the S15 survey is only a small fraction of the number of geography teachers in Denmark (1.7%), which is why the results in the S15 survey must be treated with caution.

Construction of the S15 survey

The S15 survey consisted of several open-ended and closed questions. However, this article only deals with two openended questions and two closed questions, each of which consisted of several sub-questions.

Using open-ended questions has the advantage that the geography teachers have the opportunity to express their own opinion without dealing with fixed response categories. After collecting the geography teachers' answers, the data was processed by coding and categorising it, which is a heuristic process (Saldana, 2013, p. 8). The two open-ended questions in the S15 survey were constructed in such a way that the geography teachers were asked to write their three most important learning goals

(question 1, Q1) and three most important content areas (question 2, Q2). The teachers could write whatever they wanted. After collecting all the answers, an iterative, heuristic data-processing procedure was conducted, ending up with the five answer categories (Table 2) that the teachers considered to be the most important learning goals and content areas with regard to teaching weather formation and climate change.

TABLE 2.

Code categories and examples when analysing the open-ended answers.

Category	**Code**	**Example of learning goals (Q1)**	**Example of content (Q2)**
1	Concepts, theories and models associated with weather formation and climate zones, often connected to physical geography.	"*Knowledge of the global atmospheric circulation and the global water cycle*".	"*Pressure and wind - redistribution of heat on Earth*".
2	Human interaction with nature. Often connected to human geography and problems in the world derived from climate changes.	"*That students recognize that climate change is caused by the burning of fossil fuels*".	"*The global warming´s impacts on the wild weather in Denmark and in other parts of the world*".
3	Action competence. Connected to students' personal involvement and personal stand on problems associated with climate change.	"…*how they* (students) *can play an active part in counteracting climate change*".	"*Visions of the future, including uncertainties and source criticism*".
4	Student acquisition of skills from instruction on teaching weather formation and climate change.	"(That students must) *be able to make measurements of the weather*".	"*Students make observations of the weather*".
5	Other categories.	"*World population / population distribution - the poor and the rich world*".	

The two closed questions incorporated in this paper were similar to two closed questions in a previous survey, Geospørg ´98 (Jensen et al., 2000), making it possible to compare results from the two surveys. A five-point Likert scale was used in the S15 survey, whereas the Geospørg ´98 survey used a four-point Likert scale, leaving out a middle category. Krosnick & Presser (2010) suggest the use of either a five-point or a seven-point Likert scale, since leaving out a middle answer category, as in a four- or a six-point Likert scale, might force the respondent to take a stand with which they do not entirely concur. The use of different Likert scales in the two surveys means that it is not possible to make a statistical comparison between the two surveys. For each of the two closed questions in the S15 survey there are several sub-questions, which geography teachers have to relate to on the Likert scale. The sub-questions can be seen in figure 3 and 4.

Before dispatching the S15 survey it was piloted by a colleague, three in-service geography teachers and three geography student teachers. The survey was conducted using surveyXact software.

Results

Results from the S15 survey are shown in Figures 2, 3 and 4. Figure 2 shows the teachers' responses regarding their three most important learning goals (blue) and three most important content areas (red) when teaching weather formation and climate change. The teachers' responses concerning what made them choose the educational content are shown in Figure 3, and Figure 4 shows their responses concerning how often they organised lessons in different ways when teaching weather formation and climate change.

Connection between learning goals and content

The geography teachers were asked two open-ended questions about what they regarded as the three most important learning goals (Q1) and three most important content areas (Q2) when teaching this topic. The answers were coded into five different analytic categories. In Figure 2, the teachers' responses to the two questions are indicated by two different colours on the bars, and the five categories are shown on the X axis. The sum of each of the bar-colour gives 100%. The category mentioned most frequently is 'knowledge', both as a learning goal and as a content area when teaching weather formation and climate change. About 48% of the respondents say knowledge about weather and climate is an important content dimension, whereas 42% of the respondents say knowledge about weather and climate is an important goal. Around 37% of the respondents mention 'human interaction with nature' both as a learning goal and as a content area. This indicates good correspondence between the teachers' intentions (goals) and what they say is important (content) when teaching weather formation and climate change. About 12% of the respondents say that the third category ('action competence') is an important learning goal; whereas only about

3% say that it is an important content dimension when teaching weather formation and climate change. Only about 6% of the respondents say that practical work is an important learning goal and content area.

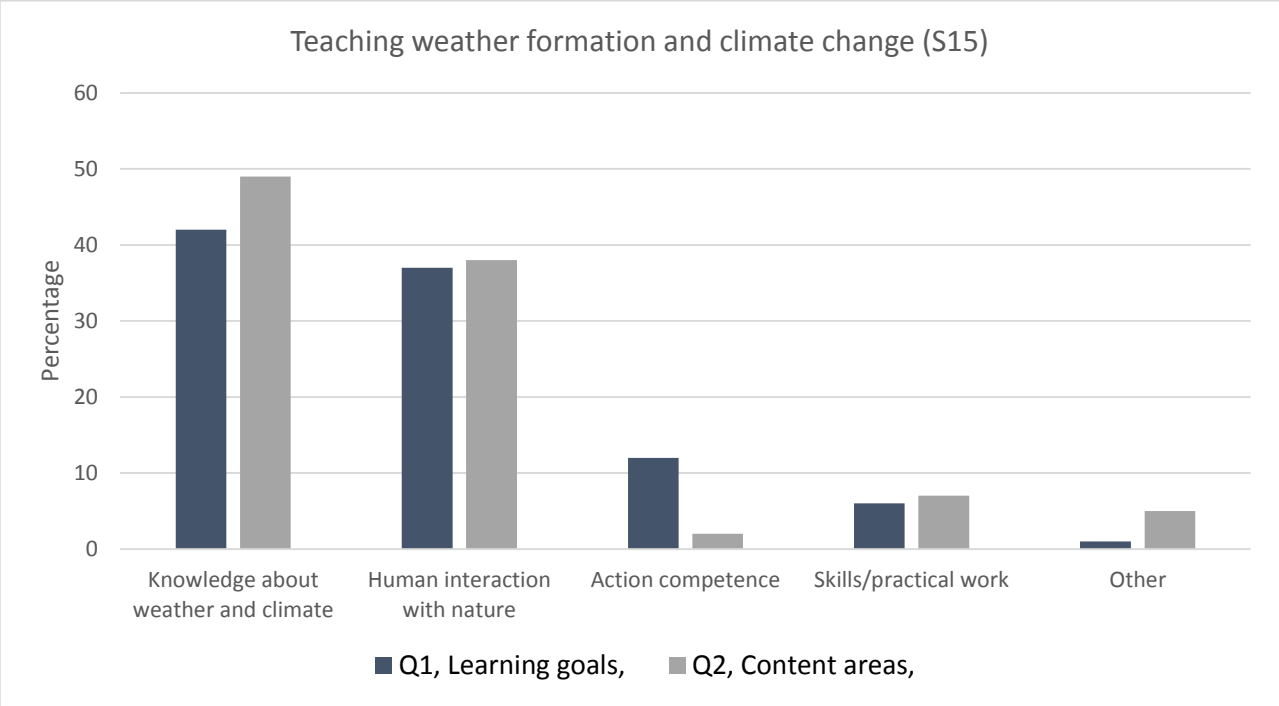

FIGURE 2.

Responses of Danish geography teachers when asked about their three most important learning goals (Q1) and content areas (Q2) when teaching weather formation and climate change.

Choosing content

Figure 3 shows the reasons stated by Danish geography teachers for choosing educational content when teaching weather formation and climate change. The most frequent reason is current interest, followed by educational material, the teachers' own interests, the internet and exams. Both student requests and practical work had relatively low frequencies.

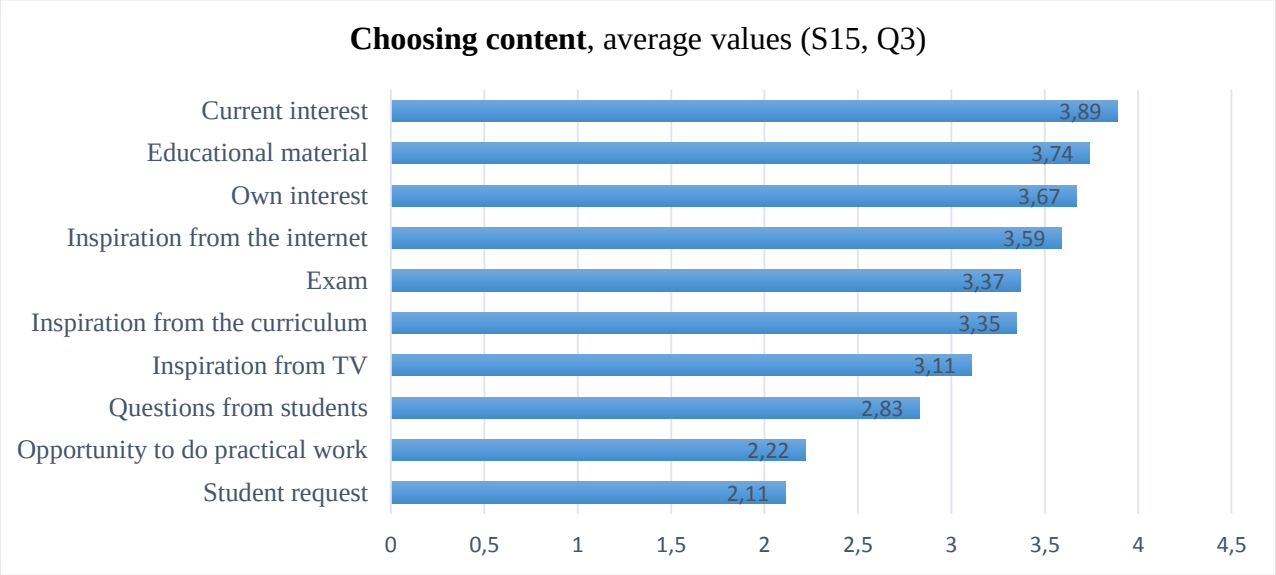

FIGURE 3.

Responses of Danish geography teachers regarding what made them choose educational content when teaching weather formation and climate change.

Organisation of lessons

When teaching weather formation and climate change, the responses of the geography teachers in Figure 4 show that the most frequent forms of lesson organisation are group work and classroom discussions. Other frequent methods are film, teacher talks, project work and question-and-answer sessions. According to the teachers, the organisational forms they employed least frequently were outdoor practical work, individual work and laboratory work.

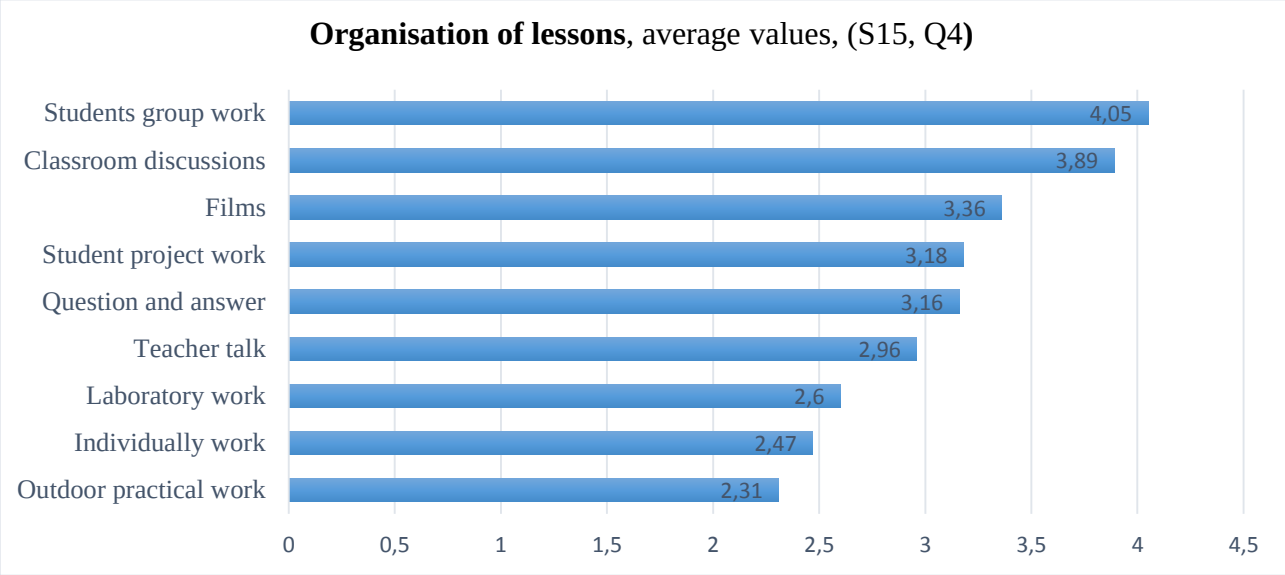

FIGURE 4.

Responses of Danish geography teachers when asked how often they organised lessons in different ways when teaching weather formation and climate change.

Summary of results

When asked about the most important learning goals and content areas, the geography teachers emphasised knowledge about weather and climate and human interaction, whereas action competence and practical work were less important. Action competence has greater importance as a learning goal than as a content area.

When asked about what made them choose content when teaching weather formation and climate change, the teachers emphasised current interest, educational material, own interests and exams; whereas student requests, practical work and questions from students had less importance.

When asked how they organised their lessons, group work and classroom discussions were the most frequent forms of organisation. But films, project work, question-and-answer sessions and teacher talks were also quite common; whereas outdoor practical work, individual work and laboratory work were less frequent.

All the geography teachers' answers to the questions Q1, Q2, Q3 and Q4 show that practical work has little emphasis when teaching weather formation and climate change.

Discussion

The teaching of weather formation and climate change is part of education for sustainable development, which is a complex field (Korsager, & Slotta, 2015). Students find it difficult to understand many of the concepts, models and theories related to the topic of weather formation and climate change (Andersson & Wallin, 2000; Daniel, Stanisstreet & Boyes, 2004; Ekborg &

Areskoug, 2012; Papadimitriou, 2004). Another aspect of teaching the topic is the personal development of the students into active citizens in a democratic society. This educational perspective in education might be achieved through the development of students' action competence (Mogensen & Schnack, 2010; Jensen & Schnack, 1997). However, the development of action competence by students is by its very nature an educational utopia or ideal which can never be fully achieved (Mogensen & Schnack, 2010), and the professionalism of geography teachers with regard to this particular educational goal might be affected by external factors.

The results of this survey of the self-reported TSPK of Danish geography teachers show that they attach great importance to knowledge and human interaction with nature, both as learning goals and content areas. On the other hand, action competence and practical work are given relatively little emphasis compared with the above-mentioned categories, although teachers emphasise the importance of action competence far more as a learning goal than as a content area. It is complex to work with the category 'human interaction with nature' because this would require the students to combine concepts, models and theories from different sub-topics from both human and physical geography (see for example Table 2, learning goal: "*That students recognise that climate change is caused by the burning of fossil fuels*"). So teaching the category 'human interaction with nature' requires a thorough overview of the entire subject. Teaching knowledge and human interaction with nature might indirectly be part of the preparation (and therefore the foundation) needed to develop students' action competence, because the concept of action competence is an amalgam of students, knowledge, commitment, visions and action experiences (Jensen & Schnack, 1997).

From a democratic point of view, it is desirable that students develop action competence, which means that students might become informed citizens (Jensen & Schnack, 1997). However, from the teachers' point of view, developing students' action competence is a difficult task because success depends on the teachers having good knowledge of human geography and physical geography, engaging their students with their commitment and visions, and not least including action experiences in their teaching. In addition, assessing student levels of action competence in a multiple-choice exam is impossible. These may be the reasons why the teachers, according to the survey, underplay the importance of action competence as a specific content dimension.

The most frequent parameter in the S15 survey with regard to choosing content is current interest, followed by educational material, the teachers' own interests and exams. In the Geospørg´ 98 survey (Jensen et al., 2000), inspiration from the curriculum, educational material, own interests and current interest were the most frequent parameters when it came to choosing content. These results indicate that current interest, educational material and the teachers' own interests are important parameters in both studies. Climate change has increasingly been promoted in the media (Schmidt, Ivanova & Schäfer, 2013), and since 1990 the IPCC has regularly published reports on the state of the climate which have attracted international focus (IPCC, 2016). However, teachers' educational philosophies may also have an

influence on which didactic typologies the teachers are influenced by (Molin, 2006; Molin & Grubbström, 2013; Molin et al., 2015). Molin (2006, p. 68) recognises "*five different didactic typologies in the school subject geography: traditional value-based, natural science-based, social science-based, multidisciplinary-based, and actuality- and value-based teaching*". Each of these typologies leads to different ontological and epistemological views on the teaching of geography and is linked to early experiences in teachers' lives affecting their didactic choices (Molin et al., 2015). When the Danish geography teachers report how they choose content, it might be interpreted as they expressions of different didactic typologies, e.g. an actuality- and value-based tradition (= current interest and own interest) or a traditional value-based tradition (= educational material). However, this study is based on a survey (S15) which gives no information about the participants' educational/philosophical inclinations.

When the teachers reported what was of importance when choosing content in the S15 survey, the exam was mentioned. In the Geospørg ´98 survey there were no questions about exams because geography exams were not introduced until 2007. The reported importance of exams with regard to the way the teachers choose content may be due to the "wash-back-effect" (Cheng, 2004), so it may influence the teachers' TSPK and beliefs.

The teachers in the S15 survey reported that they attached little emphasis to practical work as a learning goal, content dimension and means of organising lessons. Nonetheless, there are abundant opportunities to conduct practical work dealing with the topic of weather formation and climate change. Practical work can be conducted by measuring the weather outdoors, but a large number of indoor experiments are also possible (e.g. with air pressure, density or the melting of ice). There might be different explanations why the practical dimension has been given a low priority in the teachers' responses. Firstly, practical work in science and geography lessons is time-consuming, but also demanding in terms of teacher knowledge and skills (Abrahams & Millar, 2008; Hudson, 1996). In Sweden, field studies are rarely included in the work of geography teachers, which might be due to lack of time or timetable issues (Molin et al., 2015). Secondly, only half of the teachers have a teaching diploma in geography (Table 1), so they lack the required knowledge and skills, or self-efficacy, to conduct this kind of teaching activity, which is quite demanding and might change the teachers' usual didactic approach. There are a large number of untrained geography teachers in Sweden, which means that these geography teachers teach as they were taught in geography, so there is a conservation of the subject´s teaching tradition (Molin et al., 2015). This might also be the case in Denmark. Thirdly, the final exam in geography is a multiple-choice exam which cannot test students' practical skills. Instead, some geography teachers might be more inclined to teach-to-the-test, which means focusing on commonly tested areas, with the consequence of narrowing the curriculum (Au, 2007; Smith, 1991; Volante, 2004).

Practical work and outdoor learning experiences in geography lessons are important to pave the way for students' interest in geography (Molin et al., 2015). However, the Danish geography teachers report that they give relatively low priority to practical work, which is in line with results from Sweden (Molin et al., 2015), and

this is probably due not to any one of the above-mentioned explanations, but rather to a mix of them.

When the geography teachers report how they organise their lessons, it appears that they place considerable emphasis on student group work, classroom discussions and student project work, which indicates a student-centred and a socio-cultural teaching approach. Instead of a teaching-to-the-test approach which narrows the curriculum, the teachers' responses indicate that they try to engage students actively in the classroom. However, this is in contrast to the way in which teachers choose content, because questions from students and student requests are not considered important by the geography teachers.

In the light of the purpose and curriculum of geography as a teaching subject, it is relevant to ask how the dual perspective (the acquisition of knowledge by students, and equipping them to become informed citizens in a democratic society) can be achieved. As discussed earlier when considering important learning goals and choosing content, the teachers emphasised the category 'knowledge'. This is also reflected in their answers about what made them choose content. On the other hand, the results also show that the teachers organise their lessons in ways that open up for classroom discussion and student group work, which implies a student-centred teaching approach where possible to discuss different points of view connected to the SSI. One of the main goals of teaching geography as a subject is to develop the students' action competence (Danish Ministry of Education, 2014). According to Jensen & Schnack (1997), action competence is an amalgam of knowledge, commitment, visions and action experiences. This study shows that the geography teachers emphasise the importance of classroom discussions and student group work, which might help the students to develop commitment and visions. The teachers' responses also show that practical work is given low priority, which is why it might be difficult for the students to acquire action experience.

Conclusion

The aim of this study was to investigate the characteristics of the TSPK of Danish geography teachers. This was done by asking the teachers what they thought were the most important learning goals and content areas, and how they chose content and organised lessons when teaching weather formation and climate change. A survey (S15) among 55 geography teachers in the lower-secondary school was conducted and results were analysed. The response rate amounted to approximately 1.7% of all the Danish geography teachers in the lower-secondary school, so the results must be treated with caution.

The TSKP of Danish geography teachers can be characterised by emphasising that the categories 'knowledge' and 'human interaction with nature' are the most important learning goals and content areas. The category 'action competence' had less importance as a learning goal and even less importance as a content area, indicating a lack of alignment between how the teachers rate the importance of learning goals and

content areas. The category 'practical work' has little importance, either as a learning goal or as a content area. The teachers' responses with regard to choosing educational content revealed that the most important factors were current interest, the teachers' own interests, exams and educational material. In their responses regarding the way they organised their lessons, they emphasised classroom discussions and student group work.

As in other Northern European countries, the Danish educational system, at macro level, has been greatly influenced by large-scale international assessment programmes such as the PISA programme, which started in 2000 (Egelund, 2013; Lie et al., 2003; Ritzen, 2013; Sortkær, 2015). During the last fifteen years, this has resulted in a number of changes in the schooling system, and for the subject of geography the changes have included a final multiple-choice exam and a new curriculum describing the required kind of student competence.

These changes in the schooling system might be one explanation of some of the results in the S15 survey, for example the implementation of a multiple-choice exam as one of the important factors governing the teachers' choice of content, and the fact that teachers strongly emphasise the category 'knowledge' as a learning goal and content dimension. On the other hand, the teachers emphasise that classroom discussion and student group work are important ways of organising the lessons. They also emphasise the category 'human interaction with nature' as an important learning goal and content dimension, and to a lesser extent the category 'action competence' as a learning goal. These results indicate that Danish geography teachers not only narrow the curriculum by teaching-to-the-test (Au, 2007; Smith, 1991; Volante, 2004), but also have a broader purpose when teaching weather formation and climate change.

Weather formation and climate change are frequently mentioned in the news, and as a teaching topic they can be regarded as an SSI (Ratcliffe & Grace, 2003). When the geography teachers´ reports they organise the lessons with a high degree of student involvement, the teachers make it possible for the students to interact and become informed citizens. However, the results also show that the teachers attach little emphasis to practical work when teaching weather formation and climate change, which might prevent the students from developing action competence.

This article is only based on a small-scale survey which emphasises the self-reported TSPK of Danish geography teachers. It should be followed up by a larger survey covering geography and extending to other subjects in the Danish schooling system, as well as by in-depth studies of the enacted PCK of some of the geography teachers.

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