Reference to Materials in Written Argumentations of Students in Geography Lessons

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Abstract

Until now, geography teaching has only touched upon the way in which students write argumentations focused on geographical topics, and the challenges of doing this. In order to shed light on this process, this study considers the problems and challenges students face when using material-based written argumentation in geography lessons. The results from 19 evaluated text products and sound thinking protocols, which were collected in the 8th grade of a comprehensive school, are presented and analyzed. These results show that simultaneously handling several materials at once is a challenge for the students in material-based writing due to a lack of processing techniques.

Keywords: argumentation, geographieunterricht, materialgestütztes schreiben, argumentation, geography lessons, material-based writing

1. Introduction

The aim of geography classes is to educate students to become responsible citizens and to empower them to engage in social discourse. The national educational standards for geography state that students should be able to recognize and understand collective geographical contexts on the basis of sound factual knowledge, judgment and problem-solving skills (Wuttke, 2005). As a result, being able to link content-related knowledge with the formation of one's own opinion is a key skill to develop (Budke & Meyer, 2015). The resulting argumentations can oral or written. This article focuses on written argumentations.

Writing develops students' language awareness whilst also promoting the development of intellectual structuring for use in organizing world and subject knowledge (Thürmann et al., 2015). In geography classes, written argumentation is used to understand real conflicts and local disputes that are played out in society. It is also used to develop one's own position. Writing in geography classes is an important tool for students' learning, helping them to absorb in depth knowledge and to aid in their understanding of content, particularly for developing argumentations where technical evidence has to be linked logically to an individual’s positions. However, formulating a written argument presents some challenges for students, as they have to simulate a dialogical exchange that gives the reader the impression of being in a real argumentative debate. They also have to weigh up the different sides of the argument against each other and support them with relevant, knowledge-based information without losing reference to their own opinion. Ultimately, the student’s own text must be formulated in a way that is reader-friendly and comprehensible (Feilke & Tophinke, 2017).

Empirical research by Budke and Uhlenwinkel (2013) illustrated that students often forget to include geographical content in their argumentations (Budke & Uhlenwinkel, 2013). Another study by Uhlenwinkel (2015) showed that students and pupils rarely used geographical arguments to support their claims. In many cases, technically relevant evidence was missing from students' argumentation, which is important for the geography teaching context, as it is characterized by material-based argumentation. In material-based argumentative writing, students learn to structure and organize their text with the aim of writing an argumentative text based on material. This approach promotes the application of general writing strategies (Philipp, 2017) and methodological competence. Although material-based argumentation should be taught as a central skill in geography classes, there has not been any empirical research on

the problems students face when required to produce this type of text. The investigation presented starts exactly at this point.

The aim of this study is to investigate how students in geography classes integrate different geographical materials into their argumentations, and the challenges and problems they face whilst doing this. In addition, how different materials are integrated into argumentations by students will also be analysed.

The following two questions will be considered:

1. To what extent do students refer to materials while composing a written argumentation? This question includes the following sub-questions: What main materials and types of materials were used by the students? How were the materials interlinked (monotextual, polytextual) and what were the main actors/positions named in relation to the debate?
2. What are the problems that students face when undertaking material-based argumentative writing with regard to the integration of materials?

As there has been no published literature on the subject of geography didactics that has addressed these questions previously, an preliminary explorative study was conducted first, which involved 8th grade students at a comprehensive school in North Rhine-Westphalia, and focused on the qualitative and quantitative analysis of students' argumentative texts.

After a theoretical overview of subject-related argumentation and material-based writing, the survey undertaken and the evaluation methods used will be presented. Subsequently, the results of the survey will be presented and critically discussed.

2. Theory

2.1 Status of Research on Argumentation in Geography Teaching

2.1.1 Argumentation in the Classroom

Argumentation is an important component of verbal and written communication. More specifically, it can be described as the reasoned proof for controversial facts, opinions, or questions (Spiegel 1999). Argumentation is about tracing something contentious back to something uncontroversial (Budke & Meyer 2015). The basic structure of argumentation was presented by Toulmin (1996); according to this structure, an argument always contains a unique base frame that is composed of a number of different elements. A claim is made based on facts (data). The warrant connects the data to the claim and can be reinforced by backing (Toulmin 2003). The data aspect has a significant impact on the quality of an argument as it is not possible to formulate a convincing conclusion without a factual or normative base that is recognized in a given context. Every argumentation is about communicative, dialogic action and the communication of contrasting elements of knowledge (Feilke & Tophinke 2017). This also applies to written argumentations, in which the opponents and the associated controversial views are usually introduced by the author of the argumentation. The main goal of an argument is to develop an individual position about a certain topic and to argue this position convincingly on the basis of data presented. In geography lessons, students usually obtain subject-related data using materials that are provided to them, consisting of continuous and discontinuous texts such as maps, pictures, diagrams and statistics. If the relevant information is taken from these materials incorrectly a substantial part of the basis for the argumentation is missing. The convincing verbalization of arguments requires a good argumentative competence, which is defined as the ability of students to "understand oral and written argumentations in different discipline contexts, to produce their own argumentations and to react adequately to argumentations when interacting with others (...)" (Budke, 2013). Prior research into various disciplines has identified the relevance of argumentation in a school setting. Wuttke (2005) showed that linking old knowledge and new learning content through argumentation intensively promotes subject-specific learning among students. Other overall findings of various studies have illustrated that students have significant problems with formulating argumentations (Jiménez-Aleixandre, Rodriguez & Duschl, 2000; Kelly & Takao, 2002; Kolstø et al., 2006) because they do not have access to an in depth understanding of the subject matter (Mason & Scirica, 2006; Nussbaum, Sinatra, & Poliquin, 2008).

2.1.2 Written Argumentation in Geography Lessons

German geography classes usually deal with current issues such as climate change, social and spatial disparities, migration and urban planning, which are all generally the source of controversial debates in society. In addition to basic geographic knowledge, students need to be able to understand the different positions and argumentations of the

actors involved in each case, so that they are able to formulate their own, fact-based opinions. Therefore, it is important to teach the students how to develop their perspective and approach an issue from different points of view. The curriculum for the German state of North Rhine-Westphalia includes a requirement for students to engage in discussions that take into account the various views of different actors on geographical issues. In the decision-making competence for grades 7-10, students are required to "make well-founded judgments taking into account different perspectives in complex local and global geographical contexts" (Ministry for School and Further Education NRW, 2012). In addition, as part of the competency to act, students should "simply represent given positions in simulated discussions" (Ministry for School and Further Education NRW 2012). For both the "making a decision" and "taking a position" competencies, the use of arguments is fundamental, as both have to be substantiated by well-founded arguments in order to be convincing. German educational standards for geography classify the areas of competence required into 'subject knowledge', 'spatial orientation', 'knowledge acquisition and methods', 'communication', 'assessment and evaluation', and 'action' (DGfG, 2014). Argumentative writing is required and promotes competencies in each of these areas (Budke & Meyer, 2015). In the competence area 'Communication', for example, it is stated that students should be able to "S5 characterize the logical, technical and argumentative quality of their own and other people's statements in the context of geographical questions as well as react appropriately and S6 weigh up technical statements and evaluations on the basis of selected examples and develop a well-founded opinion and/or compromise in a discussion (e.g. role plays, scenarios)" (DGfG, 2020). Furthermore, it is stated that: "Geography lessons are thus not limited to doubtless or unambiguous factual knowledge, but include diverse trains of thought and argumentation figures (e.g. when weighing interests and dealing with conflicts in planning [...]"(DGfG, 2020). Consequently, argumentation deserves high priority in geography education in Germany.

Even if geography lessons do teach students about socially relevant topics and should enable them to take a position on them and to state their opinion with adequate evidence, classroom observations show that argumentation in geography lessons is rather rare (Budke 2012). Furthermore, while some studies have been conducted on argumentative writing in geography classrooms, material-based argumentation has not yet been investigated in depth within the field of geography didactics. Budke and Uhlenwinkel (2011) showed in their study that students are able to formulate geographical arguments according to Toulmin's structure, but that it was difficult for them to correctly include relevant information from material in their arguments, and to incorporate this information as evidence in their arguments. These results are in agreement with those of Sandoval & Millwood (2005) and Kelly & Bazerman (2003) regarding argumentation in science classes. They also show that students often ignore or distort facts relevant to their argumentation in order to align them with their own ideas (Sandoval & Millwood, 2005).

To formulate arguments in geography classes, students need to engage with the geographic issue at hand, using classroom materials to obtain data that supports their own point of view. A special feature of geography lessons is that students can link arguments from the natural sciences (physical geography) and the social sciences (human geography), and that factual and normative argumentation can be involved (Budke, 2013). Good geographic argumentation usually requires the consideration of different societal views on the problem to be assessed. In doing so, the actors and their everyday "geography-making", as well as the different interests and perspectives involved (Rhode-Jüchtern, 1995), have to be considered and related to the societal discourse in the argumentation (Felgenhauer, 2015). In addition to multi-perspectivity, spatial reference is another quality criterion of geographic argumentation. If different levels, such as local, regional, national and international, are included in the argumentation question, it can be answered and discussed comprehensively. "Arguments that thematically refer to space link the explicit and implicit spatial knowledge of the arguers in a rule- and norm-guided way" (Felgenhauer, 2015). Facts, geographic contexts, and the state of current scientific and social debate are usually taken from teaching materials such as textbooks, worksheets, atlases, or the internet. Students have to understand what they have read first and have to prepare and reproduce the information correctly in their argumentation. Furthermore, the elaboration of information from different sources (reception level) is quite complex (Philipp, 2017, 2020). Various research studies have shown that a large proportion of students have difficulties in formulating an argumentation (Spiegel, 2006; Petersen, 2013; Stimming, 2019). Empirical studies on material-based writing illustrate that problems with writing performance start in lower secondary school and continue up into higher education. Students have major problems in understanding, writing and structuring their own argumentations (Becker-Mrotzek, 2017). Moreover, other findings for science-based subjects (e.g., Sampson & Clark, 2008; Zohar & Nemet, 2002) have shown that students have problems with coherence and making sense of ideas. Additionally, many students do not support their arguments adequately with evidence.

2.2 Material-Based Writing in the Geography Classroom

Typically, German geography lessons involve evaluating and relating information from different continuous and

discontinuous materials (Brucker et al., 2016; Rinschede, 2007). Material evaluation and linking can be done both orally and in written form during class. One way of doing this is by writing argumentations. Through writing, deep knowledge generation can occur, as students can engage intensively with the content, cognitive barriers are broken and deeper thinking and understanding are promoted (Feilke, 2015).

A special requirement for material-based argumentative writing is "the identification of contentious issues and related arguments as well as ordering, structuring, and relating arguments from the materials, which often have no direct reference to each other" (Feilke, 2016). In order to write a detailed argumentation, students have to be competent in reception and production. Schüler (2017) provides a relevant contribution to materials-based writing in German classrooms. In her research, she examined students' work according to the aspects of the planning process, the conceptualization process, and the production process, and concluded that students' reading performance correlates strongly with text quality. In this context, text quality is characterized by students' own structuring, synthesizing information into their own text, and using multiple source materials (Schüler, 2017).

Even in geography classes, material-based argumentation is a demanding writing activity. Before writing their own argumentation (argumentation production), students have to decode arguments from different forms of material, filter information, and connect the concepts and ideas cognitively (argumentation reception) (Budke & Meyer, 2015). In addition, they are required to have a multifaceted understanding of documents, as they have to reproduce, link, and refer to the individual materials (Feilke, 2017b). This complex work linking materials can be challenging for many learners, as they first have to understand what they have read, then select, evaluate, and finally combine it to address their own question (Beese et al., 2014).

Material-based argumentative writing is epistemic writing, i.e., writing in which mental concepts are formed and connections are made. During this process, students should engage intensively with the subject content and write an addressee-informing or an explanatory-argumentative text. By dealing with continuous and discontinuous texts, the method of material-based writing can support the students in writing a text addressing their own question (Feilke, 2017). In this way, reading and writing are linked, as a student's own arguments and explanations always have to be related to different sources (Feilke et al., 2016).

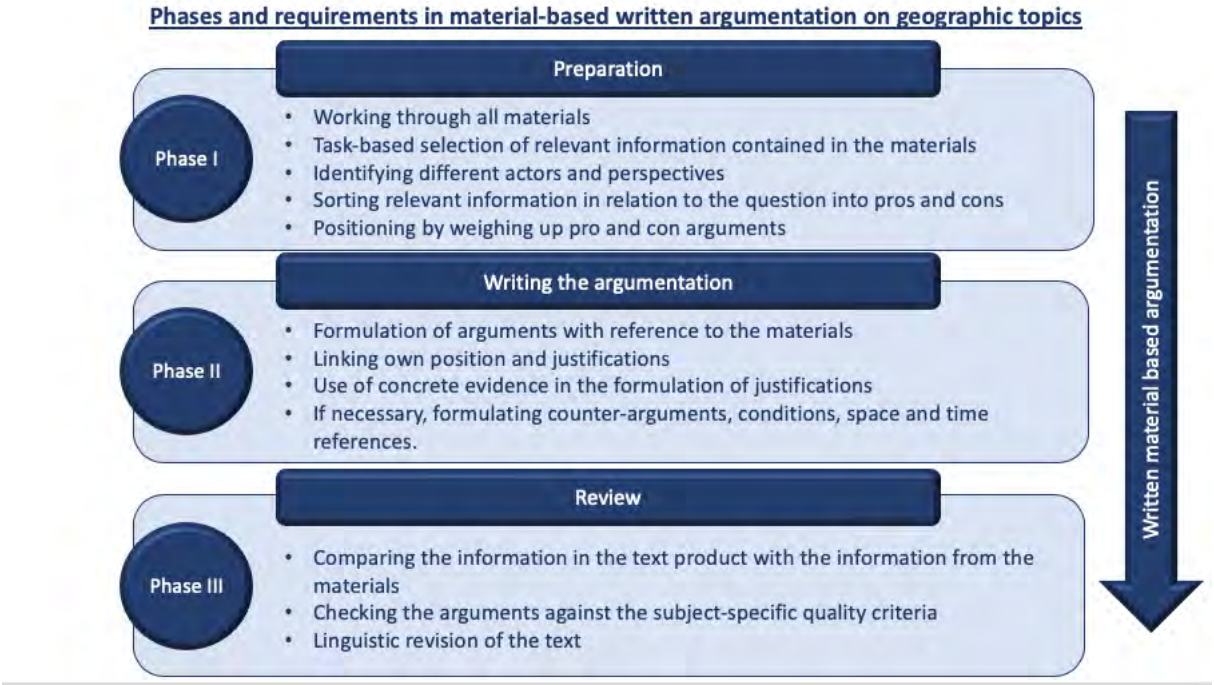

Figure 1. Phases and Requirements in Material-Supported Written Argumentation on Geographical Topics (own presentation)

As shown in Fig. 1, there are three typical phases which each have different levels of requirements in the context of material-supported argumentation on geographic topics, which the students have to deal with. The foundation for a material-supported written argumentation is formed by teaching materials such as maps, newspaper articles, the internet, etc., from which the current state of knowledge on the topic, the actors involved and their positions can be determined. In the first phase, preparation, all materials have to be reviewed and essential information has to be filtered. It is also important to identify the different actors and their perspectives. Information must be evaluated and finally sorted and weighed into arguments for and against. In the second phase, the argumentation is written. At this stage, the students have to formulate arguments and refer to the materials. The students' own position must be linked to concrete evidence, which should be cited. Space and time references should be established and counter-arguments and conditions should be formulated. In the third phase, revision is undertaken, in which the information in the text is compared with the information from the materials. The arguments also need to be checked against the quality criteria. Furthermore, the linguistic revision of the text product should take place in this phase, which can be done through a variety of methods, including peer reviews (Morawski & Budke, 2018).

3. Methods

3.1 Test Subjects

The present explorative study was conducted at a comprehensive school in Cologne. The type of school was specifically chosen because the learning level and the competencies of the students are heterogeneous and hence a broad range of material-based writing was to be expected. The 19 participants in the study (10 boys and 9 girls) were students in an inclusive 8th grade. Four students had a diagnosed special need: two students in the area of 'emotional and social development' and one student each in the areas of 'learning' and 'emotional development'. Even though all students were born in Germany, three quarters of the learning group had a migratory background, which means in the context of our survey that at least one parent was not born with German citizenship (Petschel & Will, 2020).

3.2 Design and Survey Procedure

The study was conducted using empirical classroom research as part of the project "SpiGU ─ Language-sensitive teaching and learning in inclusive geography classrooms: supporting formats in materials-based argumentative writing."

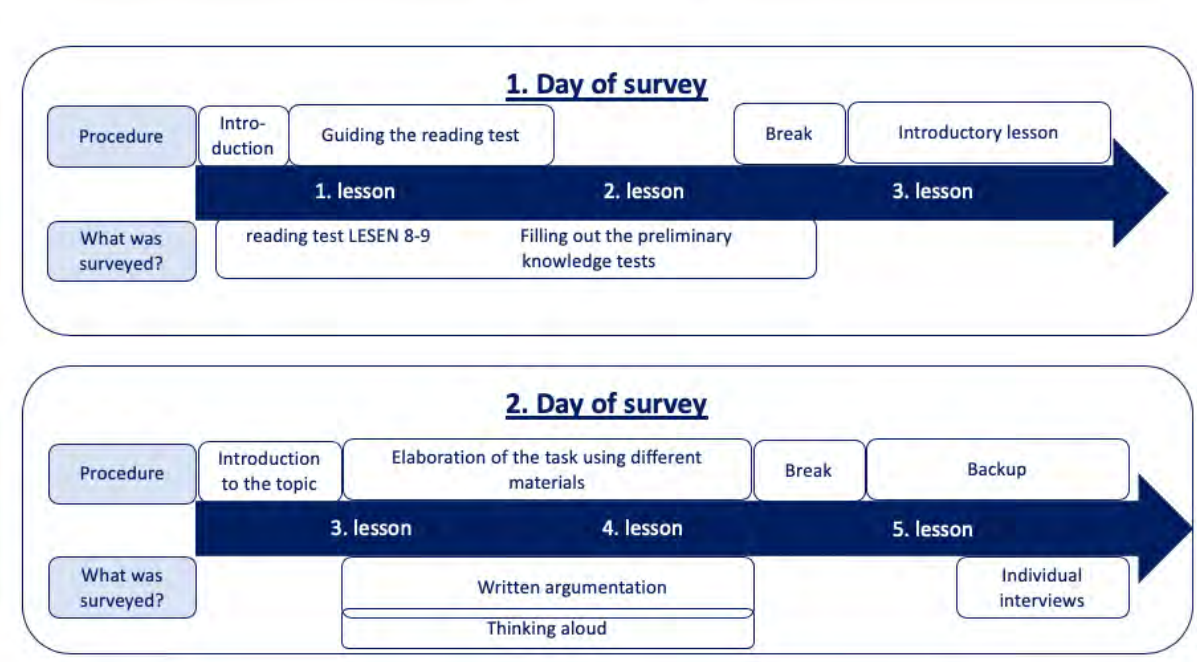

Figure 2. Survey Procedure (own representation)

Fig. 2 shows the time frame of the assessment days. On the first day of the study, the reading test LESEN 8-9 (Bäuerlein et al. 2012) was administered to the learners as a pretest. This procedure was used to find out the connection between reading competence, which is relevant to material evaluation, and competences for material-based writing in geography lessons. It was followed by a prior knowledge test in the form of a questionnaire. After a break the students were then prepared for the topic of the next lesson through an introductory session.

On the second day of the study, the students were asked to write their own opinions on a local conflict of land use in individual work. The land use conflict was that the Cologne Football Club wanted to expand the already existing training grounds around the clubhouse in the Cologne green belt (a recreational area) by adding seven sports fields and a performance center; many local residents and the nature conservation association were trying to prevent this. The question for the lesson and the written argumentation was: Should the Cologne Football Club be allowed to build a new training ground in the green belt?

After the introduction, in which the different actors were presented on the blackboard, 10 different materials (discontinuous and continuous texts) were handed out to the students. Based on these materials, they were able to work individually to find evidence to justify their statements. These materials were designed in such a way that all the usual material types used in geography lessons could be found (Brucker et al., 2016). Thus, the students were given maps, texts of varying lengths, diagrams, tables, and pictures. When creating the materials, we made sure that the texts were formulated in a language that was appropriate for the students. The comprehensibility of the materials was ensured by the pretest (https://geodidaktik.uni-koeln.de/multimedia/raumnutzungskonflikt-innerer-gruenguertel-koeln?no_cache=1#c8833). Each of the texts contained its own information, so that there was no duplication of information and so that the materials the students had used could be identified on the basis of the students' texts. To record the students' thinking process, the method "thinking aloud" was used with dictaphones, which is thought to help to construct the students' working processes as well as to identify problems that show up in the formulations in their texts. In addition, the method was intended to give further insight into the students' mental processes and intermediate steps in writing (Dannecker 2018). To prevent the learners from feeling observed and therefore potentially inhibited from expressing their thoughts, the students were distributed into several rooms and a privacy screen was placed on the tables between students. The time allowed for the task was 75 minutes, followed by a break. After the break the students were divided into groups by color cards as they entered the classroom. Each group represented an actor in the conflict they had worked on in the previous session. The goal was for each group to collect arguments relevant to the actor they had been allocated. This panel formed the end of the lesson. During the last lesson, individual interviews were conducted with some of the students.

3.2 Data Evaluation

Evaluation of the collected data was done using a mixed-methods approach. This method combines qualitative and quantitative data evaluation in order to obtain the most comprehensive answer to the research question (Roch 2017). The first step was the quantitative evaluation, which was carried out with a analysis grid specifically designed to undertake evaluation of argumentative text products, in which the scoring of individual categories can take place (https://geodidaktik.uni-koeln.de/multimedia/textanalyseraster-zur-auswertung-von-argumentativen-textprodukten).

The individual subtotals of the three central areas 'language' (max. 49 points), 'use of material' (max. 45 points), and 'quality of argumentation' (max. 8 points per argument) allowed the first conclusions about the learning situation and challenges of the students in material-based argumentative writing to be drawn. The analysis grid is divided into four parts. For our study, the third and fourth parts of the grid were relevant because they focused on the use of material and the quality of the argumentation in terms of content. The third part analyzed the content-related correctness of the material reproduction and the linguistic processing of the information in the materials. The fourth part considered the quality of content argumentation in the text. The correctness of the content was assessed by checking whether the students presented the information from the respective materials in their argumentation correctly. In the case of linguistic information processing, the extent to which the students processed the information from the materials in their own text was analyzed. Once again, a differentiation was made between implicit and explicit material reference, which is characterized by the existence of text references (https://geodidaktik.uni-koeln.de/multimedia/textanalyseraster-zur-auswertung-von-argumentativen-textprodukten). Furthermore, this categorization made it possible to identify the extent to which students linked the distributed materials, which should serve as a basis for their argumentation. The study examined whether the students referred to only one material (monotextual) or information from at least two materials (polytextual). A polytextual approach is better for the quality of the argumentation, as different types of material and actor perspectives are used and linked

and multiple perspectives are adopted.

Table 1. Categories for the Evaluation of the Thinking Aloud Protocols (own representation)

	Category	Explanation	Example of student statements
material-related approach to thinking aloud	Reference to materials	Student refers to the materials by verbally stating what kind of material is presented and what is addressed in this material. Implicit: The material is not mentioned. Explicit: name or material number is mentioned. (e.g. M1, argument, etc.)	Implicit:: "Here I see a text. It's long. (...) Here they talk about the training ground." 2II Explicit: "Now on the next sheet is an argument." 20II
	Writing	Student verbally expresses that he/she is writing his/her own text.	"So, yeah. How do you want me to start? (...) What I think when I write? Just my own opinion/ so (...)" 11II
	Description of action	Student expresses how he/she looks at a specific material	*"Now I'll take a look at the next page." 16II*
	Positioning	The student states his/her position on the issue. It is clear that this is the student's own opinion.	*"I mean you have to take care of the environment and that you just don't do that then and that so many are for it too." 11II*
	Other conspicuous features	Any abnormalities that the other categories do not pick up on, such as talking to classmates, etc.	*"It's too noisy here. (...) I can't concentrate." 13II*
Material linkage	Linked materials	It becomes clear that materials are linked together as the student expresses a connection between two or more materials or makes cross-references between materials.	*"I mean, they're already saying in another text that if they build somewhere else, the cost would be a lot/ that it would cost way too much and now they're saying they want to pay for the bus themselves." 11II*
	Type of material linked	It is clear that the student links materials implicitly (i.e., material is not named) or explicitly (i.e., material is named).	*Implicit: "It is written here that mainly the men are supported who play there. I don't think that's so good, because there's also a women's team and it's unfair if they're not treated equally (...)." 20II* *Explicit: "But on the sheet with this argument where/ the man also said again that the journey is a problem. And that's why I'm looking to see if I can find a rail line or something somewhere on this map at M1 now." 20II*
	Frequency of linked materials	Set of material links verbally expressed	*Zitate, die eine Materialverknüpfung verdeutlichen werden ausgezählt.*
Striking problems	Language	The student has problems with technical words. The student expresses that there are problems with understanding due to linguistic aspects.	"Yes and now I see here many speech bubbles from a member (deciphers the word initiative) no idea green belt and board 1. FC Cologne" 8II
	Material	The student expresses that they cannot understand the information. In addition, it becomes clear that the problem is not understood or that materials are incorrectly assigned to the context.	"And that is that this 1. FC Cologne training ground (...) is to be built in Sülz and in Zollstock, so between Sülz and Zollstock. (...)" 1IAaCa
	Text/Font	Verbal expressions make clear that the student is having difficulty beginning or continuing the writing process.	"What's next? Now it's getting hard" 12II

The categories presented were summarized in the evaluation of the results into the categories ‘material use’, ‘correct information reproduction’ (which includes the categories ‘correctness of the content of the material reproduction’ and ‘linguistic information processing of the materials’), and ‘material linkage’. The fourth part of the grid, the quality of the content-related argumentation, measured how many arguments are mentioned, whether the conflict is correctly described, whether relevant actors and their position are correctly portrayed, and whether counterarguments and the spatial conditions of the conflict are correctly presented. These categories were adopted for the evaluation of the results.

In order to empirically reconstruct the learning situation and the challenges of the students further, the quantitative evaluation was supplemented by qualitative evaluation steps. For this purpose, the individual categories of the three central areas, language, use of materials, and content were examined in depth and analyzed on the basis of the following questions: Which materials and types of materials were used most frequently by the students? How were the materials linked to each other (monotextual, polytextual)? Which actors/positions were most often mentioned in relation to the conflict? The texts, as well as the thinking aloud protocols, were also examined individually for each student to identify any abnormalities, such as materials or linguistic links (verbal and non-verbal) used particularly frequently.

The transcripts of the audio recordings on thinking aloud were generated using the software f4 and analyzed with the help of qualitative content analysis, following Mayring (2010). On a qualitative level, the method of content structuring was used to evaluate the results, as this method aims to "filter out and summarize certain topics, contents, aspects from the material" (Mayring 2010: 98). This first involved forming categories based on the theoretical considerations, which helped to evaluate and analyze the data. Subsequently, the main categories and subcategories were formed, which were filtered by paraphrases, so that in the end the most relevant statements could be worked out and were available for interpretation (Mayring 2010). In the case of thinking aloud, the focus was also on the use of material. In Table 1, the categories for the evaluation of the thinking aloud protocols are presented, explained, and supported by examples. Additionally, an SPSS file was created for all variables (analysis grid and thinking aloud) in which the quantitative result for each variable was documented.

4. Results

In the following section, the results with regard to the research questions “To what extent does a material reference take place when the students compose a written argumentation?” and “What problems do the students have in material-based argumentative writing in terms of material inclusion?” are presented.

4.1 Use of Materials

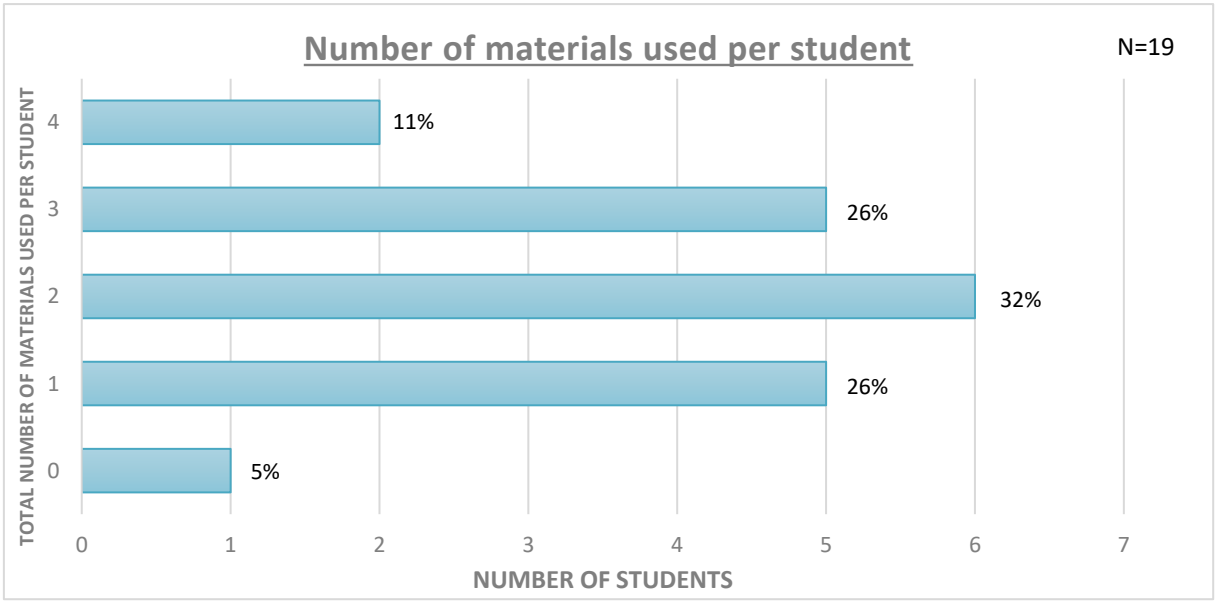

Figure 3. Materials Used per Student (own representation)

All 19 students were given ten different materials that they could use for their argumentation. Consequently, a total of 190 uses of materials could have been included in the texts. The actual amount of materials used was 37, 19 % of the total amount, which indicates a very low use of material.

Two students processed information from four materials for their argumentation, which corresponds to a maximum use of 40% of the available materials, whilst one student did not use any material. All other students extracted information from one to three materials. The average was 1.9 materials (Fig. 3).

Looking at the results of the reading test, a correlation can be seen with regard to the use of materials. The students who scored below average on the reading test used no materials, or only one, in their argumentation. The two students who scored above average on the reading test also used the most materials in writing their texts.

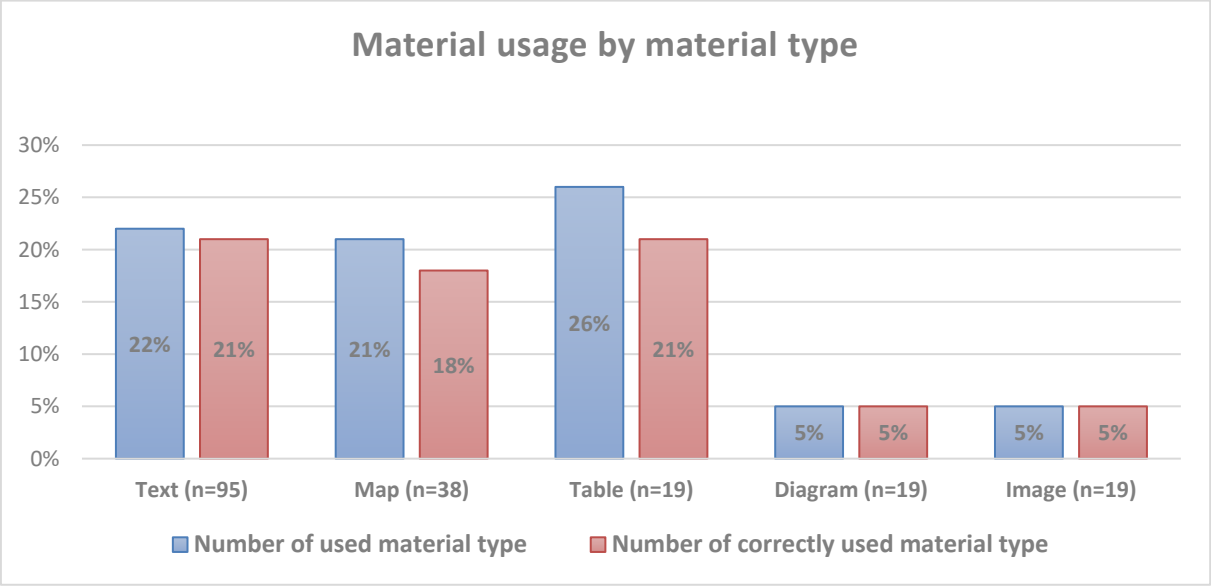

Figure 4. Use of Materials According to Material Type (own representation)

In Fig. 4, how the materials were used according to individual material types was considered. To achieve this, the number of material types used was multiplied by the 19 students participating for n, since the amount of material types varied. It can be seen that most of the students correctly reproduced the information they used from the materials in their own text. There was no significant difference between the use of continuous and discontinuous texts. Obviously, working with the medium of text does not seem to be easier for the students than working with maps or tables. Diagrams and pictures were rarely used, which suggests that the students seemed to have more problems incorporating these media (Fig. 4).

Predominantly, the facts that were reproduced were correct. The problems that arose were rather that the students did not select meaningful evidence for their argumentation, so they tended to include irrelevant information from the materials in their text. For example, for M4, which was a table showing the distribution of signatures for and against the expansion of the training grounds in the individual districts, only one student named a group of people from the district of Kalk, which is thought to be because that is where the student came from. The students could have identified that the district of Lindenthal, which is located in the conflict area, had the most votes against an expansion and that the majority of respondents from all districts are against the expansion ("I live in Kalk myself. There, 638 people were in favor and 219 people were against." Quote 2II) from the table.

The method of reviewing the materials was the same for all students. The materials were viewed chronologically by all students, and notes were rarely made or underlined. The writing process took place after reviewing the material in all cases. 21% of the students looked at individual materials for a second time when producing the text, whilst all the other students relied on their memory, which may explain the missing material references and the number of errors in the content.

The evaluation of the thinking aloud protocols showed that 95% of the students looked at the materials, but that they only used them a little in their text products. On average, each student looked at five materials when thinking aloud, but only integrated information from an average of 1.9 materials into their own text. The discrepancy between thinking aloud and written text processing is likely to be due to the lack of competence in reproducing information from the materials and the lack of experience in editing and linking several materials. In total, the students talked about the materials used 129 times during the thinking aloud process, and referred to the material type most frequently (49%), which was also the case for the text products. In comparison, the other types of material were rarely considered (cards 20%, table 11%, diagram 10%, picture 10%). Overall, the materials were talked about more than used.

4.2 Quality of Information Reproduction

In terms of naming the conflict, the overall information treatment was acceptable. 68% of the students were able to name the topic of the conflict in their argumentation. However, the students had problems with describing the conflict in more detail. As shown in Fig. 5, 83% of the students only named 1. FC Köln club as an actor, and were therefore unable to describe the conflict, in which a number of actors are involved. This led to a limited representation of the conflict and the relevant arguments. The Citizens' Green Belt Initiative, City of Cologne, and the residents (mentioned by 6% of the students) were only named once in the material. The environmental association was not mentioned as a relevant actor in any argumentation, although the commonly used material *M6-Text Newspaper article with picture* thematizes the position of the environmental association. Overall, only three students mentioned more than one actor, which indicates that the conflict was not understood by the majority of the students, and that they did not take a multi-perspective view in their arguments.

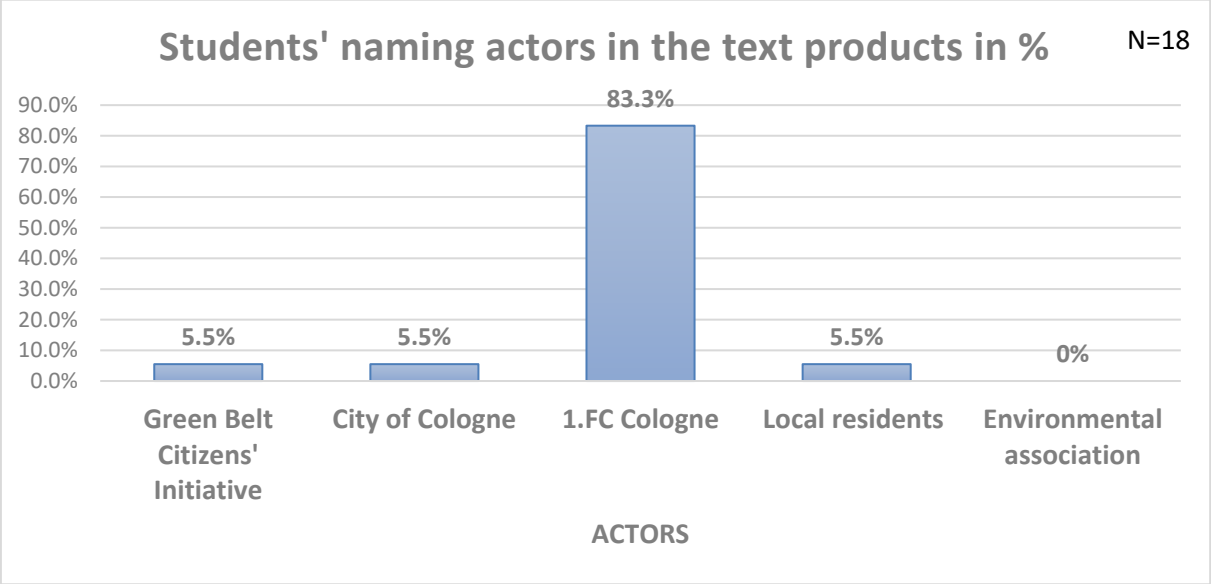

Figure 5. Names of the Actors Involved in the Conflict Mentioned in Students' Text (own presentation)

Also notable was that only a small amount of information was transferred by the students from the materials into their own text. For example, in the case of the M1 map of the training grounds, there was an opportunity to describe how many and what types of training areas were available in the grounds. The location of the training ground could also have been described in detail. This space aspect is particularly important, as space and time conditions could have been presented in the argumentation. More training opportunities, the central location of the training grounds and the nearby Elsa Brändström School, which is an elite soccer school, could have been arguments in favor of the expansion. The loss of green space and its leisure function due to the new developments could have been mentioned as arguments against the expansion. The students only stated that there were enough sports fields. One student named six instead of seven training fields ("There are already 6 fields if they share it well." 22II). The main problem was the correct and task-related reading of the map, which was also the case for the second map which was given to the

students. Even from the most used material, the newspaper article, only a few pieces of mainly superficial information were extracted. For example, the evidence to support the opinion that the training area should not be expanded included the protection of historical monuments, sealing, environmental damage, or the danger to animals. However, these aspects were not explained in more depth. As the following quote shows, the student simply summarized the information from the material. A reference to the thesis represented was neither explained nor used as evidence ("(...)and another argument for the fact that they have to change the ground from the new terrain and have to seal the ground to art grass and thereby the animals are damaged" 13II). This student did not explain why the animals would be hurt by the synthetic grass and why this evidence supported the thesis previously stated. Connections were not clear at this point because the information from the material was reproduced rather than integrated into the argument.

All students mentioned the topic of traffic, with the construction of a bus stop by FC Cologne being mentioned several times. The logical connections and explanations between opinion and evidence were also missing ("(...) because it would then cost too much, but then want to pay for the bus and the bus stop themselves." 11II). In this case, two pieces of information from the materials (1. FC Köln would like to build a bus stop and the costs for the reconstruction of the training ground were too high) were reproduced, but not conclusively linked to each other. It is interesting that a lot of information was recognized in the *M8 photo*, although it was over-interpreted, as the following quote shows ("(...) people who like to go jogging don't have as much protection and the drivers are hit more and there are more accidents (...)" 18IAa). The picture showed a jogger, bikers, and people picnicking. It showed neither cars nor buses. Nevertheless, accidents were interpreted from it. The quote is to be understood in such a way that the student may have assumed that the green belt would disappear if the training ground is expanded. However, this is not the case, which shows a misinterpretation or misunderstanding of the information at this point. Thus, it can be concluded from this that taking information from the materials and incorporating it into the argumentation was a major problem for the students. The space reference as a quality criterion of geographic argumentation was barely considered, or not at all, by the students during the formulation of their argumentations. The missing reference to space is further evidence that the conflict was not considered in a complex way or comprehensively understood. The following quotation shows that the student did establish a spatial reference, but had not understood the core concept of the conflict at all, so the spatial reference was irrelevant to the argumentation.

> *"Many people from Lindenthal, which is the district closest to the training ground, are against it. In many other districts, however, people are in favor. It would make sense to build the training grounds in a place where people are for it. That way, both the people from Lindenthal and other people from other parts of town would be happy." 20II*

The student correctly identified the area in which the training ground is located (Lindenthal) and recognized that a survey on the expansion of the soccer field showed that many people from this district were against the expansion. Nevertheless, she obviously did not understand that the conflict is about local citizens fighting for the preservation of their recreational area and that people who are further away do not find the development so unpleasant as they are not directly affected. In this example, spatial data was read but not interpreted or meaningfully integrated into the argumentation. In addition to the challenges involved in identifying the actors, just over half of the students (55%) were unable to correctly identify at least one position of an actor in the conflict, indicating that students had difficulty understanding and filtering information from the materials, and subsequently attributing it to individual actors. In-depth text comprehension seemed to be a huge challenge for the students while working with the materials.

4.3 Material Linkage

Only a few students (16%) were able to link the materials used. In the following case, the materials M3, a map of the city of Cologne, and M4, a table showing the distribution of signatures for and against the expansion of the training grounds in the individual districts, were correctly linked:

> *"Many people from Lindenthal, i.e. the district closest to the training grounds, are against this." (20II)*

The following quote reflects the students' linguistic or logical problems: "The green belt initiative finds that the volume of traffic is increasing and accordingly damages nature." Student 3II probably wanted to link the information from the argument (higher traffic volume due to the expansion of the training ground) with information from the newspaper article (the construction of the training ground damages the environment) and therefore support the opinion that the training ground should not be expanded. However, the sentence is linguistically formulated in such a way that this link is not logical, as it sounds as if the green belt initiative would harm nature.

In total, material linking could only be identified twice in all 19 texts, which again illustrates that linking information from different materials seems to be a very challenging task for the students. This problem also occurred in thinking aloud. Individual materials were verbally linked to each other by making references between materials or referring to other materials a total of 14 times. The low level of material linking (both in writing and verbally) is probably due to the lack of a planning process.

5. Discussion

Even though this study only conducted one research survey with a small number of students, and can therefore not present representative results on a national level, the results nevertheless provide indications of problems and challenges in material-based writing within geography classes. The analysis of the survey data revealed that material-based argumentative writing seems to be a challenging task for students. Although material-based writing is supposed to help students learn to write epistemically and to better understand technical content (Feilke 2017), the side-by-side use of different materials and the gathering of information from these in the context of formulating an argument seems to overwhelm the students.

From the results it can be concluded that the students took information from the materials when formulating their own written argumentation, which was mostly reproduced correctly. Nevertheless, the amount of information taken from the materials is very low. Similar to the study by Budke and Uhlenwinkel (2011), this investigation also showed that students have problems with filtering relevant information from materials and subsequently including them in their arguments.

Geographical references were mainly ignored in the argumentation. Not one single student integrated aspects of time or space into their argumentation. This result supports the findings of the pilot study by Budke and Uhlenwinkel (2011), because it also becomes clear that selecting relevant information, in particular information with a geographical aspect, takes place rarely or not at all.

Nearly all students used the aggregative mode of production and presentation, defined according to Schüler (2017) as text production modes, as they processed the contents of the materials in a linear-sequential or list-like way, and strongly oriented themselves to the respective sources when structuring their own text (Schüler 2017). Only one student named examples in the resulting text that were not mentioned in the materials, suggesting a slightly different approach (Schüler, 2017). The number of aggregative text production modes used illustrates that thinking and referencing beyond the materials seems to be difficult for the students. There seems to be a disruption to a synthetic text production in which their own texts are created using content from the materials, as well as their own thematic aspects. A targeted use of structuring posters could support the students in the area of self- and text structuring. It was also clear that many students only read the materials selectively and chose the information according to their own judgment. For example, one student reproduced information taken from a table which shows a collection of signatures from individual city districts for and against the expansion of the training grounds, with a focus on his own place of residence. This information was irrelevant for the argumentation and instead integrated aspects from previous knowledge or the student’s own thoughts. However, this suggests that an individual's relationship to a place has a significant impact on social cognitive information elaboration, as outlined in Crick and Dodge's (1994) model. Based on this, a central challenge in material-based argumentative writing could be identified as the structured and fully comprehensive information processing of the materials by the students.

The skills of synthetic text production, in which students’ own texts are created on the basis of combining and relating different materials, were barely developed in the texts produced by the students examined. References to direct material, which were explicitly formulated, were undertaken by one of the nineteen students. All of the other eighteen text products referred to the information in the materials only implicitly, if at all. In general, only a small number of the available materials were used, with students, on average, using 1.9 materials. Texts were used most frequently used, reinforcing the claim that the students seem to be more familiar with continuous texts than with discontinuous texts (Schnotz, 1989). A link between the materials only occurred once in the written work. Furthermore, it became clear that the students predominantly focused on one actor and their position. The conflict, which arises through the confrontation between the positions of different actors, did not seem to have been understood at all. This shows a deficit of knowledge of multi-perspectivity and a basic understanding of the conflict. It seems to be difficult for the students to take a multi-perspective point of view and also to use the different materials and their contents in the development of a complex controversial argumentation. In future, these aspects should be further integrated into geography lessons and should be practiced through the use of specific tasks. As in the study by Sampson and Clark (2008), our students also had problems with coherence and the meaningful linking

of ideas in the context of their own argumentation. The problem of structuring argumentation, which Becker-Mrotzek (2017) already describes in his studies, was also observed in this group. Structuring the argumentation seems to overwhelm the students and to be a barrier for the writing process due to the volume of material.

The students mentioned only a small number of arguments in their written texts and were rarely able to precisely formulate the necessary evidence to support their conclusion (claim). This is indicative of the weak quality of the arguments made, and is in line with other studies on students' written argumentation in geography classes (Engelen & Budke, 2020; Budke et al., 2010, among others). These weak outcomes could possibly be explained by the fact that argumentation skills are not developed to a great enough extent in German geography classes.

Looking at Fig.1, it is clear that a major problem had already occurred in the first phase, preparation. Task-oriented filtering of relevant information out of the materials was rudimentary in this phase. It was also a great challenge to work out the different actors and positions and to sort relevant information into pros and cons in relation to the question, and then to take up one's own position by weighing up the pros and cons. None of the students seems to have worked through the materials in detail, because none of the collected text products, materials, or working papers contained references to possible writing plans or planning documents. The same applied to thinking aloud. None of the students made notes or marks on the worksheets, which suggests that all of them started the writing process without reading strategies or concrete planning and that they did not go through the essential steps of the first phase (Fig. 1). As a result, further problems occurred in Phase II, the writing of the argument. The incorrect formulation of arguments with reference to the materials was a consequence of not identifying relevant information from the materials, which also affected the use of concrete evidence in the formulation of the argumentation. Thus, in Phase II, there was no linking of the position with relevant evidence. Counterarguments, and space and time references were not formulated, or were hardly formulated. This problem was also the result of a lack of intensive preparation being carried out in Phase I. Consequently, further problems occurred in Phase III, the revision. The comparison of the information in the resulting text with the information from the materials was weak, which was also true for the examination of the students' own texts on the basis of quality criteria. Linguistically, no revision took place in any case. In general, it became evident that the third phase was often not carried out by the students. The phase model (Fig. 1) and the results of this research underline the importance of good preparation (Phase I) so that students are able to produce good texts containing material-based argumentative writing. Developing this skill would be a first starting point to support the students' learning. However, it also becomes clear that Phases II and III of the model are just as essential to good argumentation as Phase I, and that all three phases are interrelated and build on each other.

6. Conclusion

The problems identified in this work indicate that 8th grade students have not learned essential strategies for materials-based writing during their time in school and that more effort is needed to promote this form of writing, particularly in geography classes, where working with many materials and material-based writing is integral to the subject. By using this format, students will learn about socially relevant topics in geography classes, which will empower them to take a position on these subjects. They will also be encouraged to form and reflect on their own opinions. In connection with the phase model (Fig. 1), an awareness of the three phases should first be established in future teaching. In addition, each phase should then be worked through step by step with the students. For this reason, supporting materials have to be developed for each phase, which make it possible for students to practice the formulation of a material-based argumentation. According to the problems identified, these would primarily be structuring aids, such as planning posters or small-step tasks, which guide the students through the elaboration and the writing process. Whether the focused use of supporting materials can achieve a significant improvement in material-based argumentative writing would be a very interesting question for further research.

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