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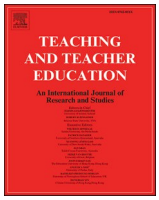

Research paper

Understanding teachers' perceptions of geomedia: Concerns about students' critical literacy

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ABSTRACT

This study examines Finnish geography teachers' (n = 16) perceptions of the significance of geomedia and geomedia teaching. Thematic analysis was applied. The findings reveal teachers' concerns about students' cursory critical geomedia literacy as well as the potential of geomedia to enhance students' management of information overflow. Teachers' perceptions of digital geomedia teaching were diverse. The significance teachers associated with geomedia was not aligned with their perceptions of digital geomedia teaching. This study suggests that diversity and incoherence regarding teachers' perceptions of geomedia should be addressed in teaching and teacher education research internationally.

1. Introduction

The ubiquitous digitalization of teaching in the past few decades has facilitated a global change in how teachers perceive and implement teaching in various subjects (Admiraal et al., 2017; Osborne et al., 2020; Walan, 2020). Web 2.0, in the form of digital technologies and information and communication technology (ICT), has increased international interest in how digitalization and technology can facilitate teaching in various subjects, including geography (Nagel et al., 2023; Osborne et al., 2020; Puttick, 2021). Concurrently, the rapid development and increased public use of geospatial technology (i.e., global positioning systems (GPSs), geographic information system (GIS), and remote sensing) have brought together the media, communication, and geography (Lapenta, 2011; Wilken, 2018). For example, social media posts include written or visual content for which the location is known. And for this reason, digital communication processes contain geospatial technology in the form of the geomedia produced by the public (Vogler et al., 2012). Similarly, it has been argued that successful teaching in the twenty-first century requires implementing instructional technology to provide today's and future learners with the competences they will need to succeed in a high-tech, interdependent, and connected world (Curtis, 2019; Fraillon et al., 2020; Sailer et al., 2021). However, international concerns about the digital competences of teachers and students in the school context have led to recommendations on the part of organisations and authorities (see e.g., European Commission, 2019; OECD, 2023; Vuorikari et al., 2022), as well as researchers (e.g., Falloon, 2020; Hatlevik et al., 2015), to facilitate teachers' and students' digital competences.

Undoubtedly, digitalization has changed teaching at global, national, and local levels. Digitalization has also allowed the benefits of geomedia use in geography education (Anunti, 2020; Anunti et al., 2023; Nilsson & Bladh, 2020), as well as in other subjects and multidisciplinary education (Atteneder & Herdin, 2020; González, 2012). However, geomedia is a relatively new concept, and therefore, it has not yet been completely defined (Hilander, 2016, 2017; Hynynen et al., 2022; Lapenta, 2011). Some researchers suggest that the term "geomedia" refers only to digital tools, applications, software, and information with a geographic reference, that is, a location- and/or spatially based reference (Lapenta, 2011; Vogler & Henning, 2013). Other researchers advocate for a more extensive definition of "geomedia", one that includes all types of written

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and visual media that are connected to a certain place or location, including maps, statistics, charts, photos, pictures, and videos (Fast et al., 2018; Gryl et al., 2014; Gryl & Jekel, 2012). In this study, we followed the broad definition of "geomedia" mentioned above. We also rely on perhaps the most uncomplicated definition, where "geomedia" is considered as the integration of a spatial reference and information (Vogler et al., 2012). Regardless of how "geomedia" is defined, it requires gathering and presenting geographically referenced information and data, which now often concern global phenomena and exist in a digital form (Anunti, 2020; Anunti et al., 2023;Schulze et al., 2015). Accordingly, the digital competences of both teachers and students are crucial (Hatlevik et al., 2015; Sailer et al., 2021; Vajen et al., 2023).

Because the concept of geomedia is still under debate in educational contexts internationally and very few studies address the significance of geomedia in education (see Wolff-Seidel & Budke, 2022), we explore geography teachers' perceptions of the significance of geomedia and digital geomedia teaching. Teachers' perceptions regarding the significance of geomedia and digital geomedia teaching are essential for international teaching and teacher education research because ubiquitous digitalization and information overflow require diverse interpretations of media sources, including location-based media. In using the term "digital geomedia teaching", we refer to both teaching with digital geomedia and teaching about digital geomedia. We focus on digital geomedia, as digital competences are crucial for contemporary and future teaching and learning in schools, including teacher education, internationally (Curtis, 2019; Nagel et al., 2023; Sailer et al., 2021). We chose this focus because gathering, analysing, and critically evaluating online information can be challenging for young people (Anunti et al., 2023;Fraillon et al., 2020). Therefore, our guiding research questions are as follows: "What are teachers' perceptions of the significance of geomedia?" and "What are teachers' perceptions of digital geomedia teaching?"

In the following sections, we will first provide the conceptual grounding for our study to better introduce the novel concept of geomedia and then show how geomedia has been applied in education. We will then briefly introduce the context of the study, that is, the Finnish educational context. This is then followed by a thorough introduction of the participants and data-gathering process. In explaining our findings, we focus on teachers' diverse perceptions of the significance of geomedia and teaching with digital geomedia. Finally, we provide a discussion, consideration of the limitations of our study, and concluding remarks about geomedia. By these means, we wish to contribute to the international discussion of how location-based media can be utilized in teaching and teacher education in various contexts globally.

2. Context of the study

For this study, which is situated in the context of Finnish geography teaching and teacher education, the broader definition of "geomedia" is significant because it corresponds with the references to geomedia in the Finnish National core curriculum for basic education (FNBE, 2016a) and upper-secondary school (FNAE, 2020). In the Finnish educational context, subject teachers are required to complete a master's-level degree in their respective major subjects, including teacher education studies. In lower-secondary schools, they teach grades 7–9, the final grades of basic education, in which the students are between 13 and 15 years old. Subject teachers also teach in upper-secondary schools (students are ages 16–19), which typically lasts 3 years and concludes with the completion of the Finnish Matriculation Examination, the dominant large-scale summative assessment of learning outcomes.

The geomedia concept was introduced in the curriculum for basic education in 2014 (FNBE, 2016a) and for upper-secondary schools in 2016 (FNBE, 2016b). It is important to note that in Finland, the introduction of the concept of geomedia to both the basic education curriculum (FNBE, 2016a) and the upper-secondary school curriculum (FNBE, 2016b) was unforeseen and confusing for teachers, leaving them to define "geomedia" (Hilander, 2017). For example, Hilander (2016) points out that most teachers thought geomedia referred only to digital sources. Also, Hynynen et al. (2022) reveal that for teachers, the definition of geomedia is not straightforward. Only about one-quarter of teachers in their study (n = 20) used the concept in teaching.

The current curriculum for upper-secondary schools describes geomedia as geographic ways of gathering and presenting information, such as maps, geographic information, diagrams, pictures, videos, written sources, media, and oral presentations (FNAE, 2020). In contrast, the curriculum for basic education (FNBE, 2016a) only describes geomedia as content, sources, and skills, though it does not provide a definition. In the curriculum for upper-secondary school (FNAE, 2019), the gathering of information refers to students' use of critical literacy skills in interpreting, analyzing, and evaluating geomedia content related to various geographical phenomena, such as population growth, climate change, agricultural issues, the scarcity of natural resources, and conflicts. The presentation of information refers, for example, to producing maps using geospatial technology or producing charts using statistical programmes, such as Microsoft Excel. However, the information may be presented on paper maps and charts as well. Thus, the curricula point towards the wider definition of geomedia, one in which the skills and competences include critical geomedia literacy, as well as producing and presenting information with geographic references (see also, Anunti et al., 2018; Muukkonen et al., 2022; Nilsson & Bladh, 2020).

3. Conceptual framework

3.1. The concept of geomedia

As a broad concept that includes digital tools, applications, information, and data, as well as other written, visual, and audio information with geographic references (Anunti, 2023; Atteneder & Herdin, 2020; Fast et al., 2018), the concept of geomedia provides a multidimensional approach for teaching. It can serve as a method of producing location-based information, such as maps, statistics, and charts (Fast et al., 2018; Gryl et al., 2014; Gryl & Jekel, 2012). At the same time, geomedia can serve as content (e.g., maps, statistics, charts) of teaching (Gryl et al., 2014; Vogler et al., 2012). The broadness and versatile possibilities of implementing geomedia in teaching can thus explain, to some extent, the ongoing debate over the concept of geomedia (cf. Gryl & Jekel, 2012; Lapenta, 2011; Vogler & Henning, 2013). Furthermore, as a broad concept, geomedia is aligned with geospatial technology, which includes additional teaching tools, applications, and software, such as GPS, GIS, remote sensing, and Google Earth (see, e.g., Collins, 2018; Curtis, 2019, 2020; Nilsson & Bladh, 2020). However, because it is based on technology, geospatial technology may have narrower possibilities for educational use. In contrast, geomedia allows teachers to navigate towards the most relevant sources of either digital or other location-based media (Nilsson & Bladh, 2020). For this reason, geomedia is substantially helpful in teaching not only geography but also for other subjects, such as history (e.g., historical maps), biology (e.g., thematic maps of vegetation cover), health education (e.g., statistics on obesity or malnutrition in a population), or literature (e.g., a novel with location-based references; Gryl et al., 2014; Vogler et al., 2012).

Due to the potential to apply geomedia in teaching various subjects and the broadness of the information and the methods it includes, Anunti (2023) and Hintermann et al. (2020) have proposed that geomedia is particularly suitable for supporting students' critical literacy.

Similarly, Schulze et al. (2015) emphasize that digital geomedia should be taught within a multidisciplinary framework to encourage the development of competences in critical literacy. In this study critical literacy concerns enabling students to read and interpret printed and digital sources of information in relation to the exercise of power, the practices governing the everyday life of societies, and access to knowledge (Janks, 2013; Luke, 2012, 2013). Due to the broadness of what geomedia is, it can also be seen as providing a gateway to students' critical literacy in their encounters with location-based information. Furthermore, critical geomedia literacy can thus be conceptualized as students' ability to critically analyse and evaluate various kinds of geomedia (Dando & Chadwick, 2014). Finally, a more pragmatic perspective on how we conceptualize critical literacy and critical geomedia literacy in our study is derived from the European Union DigComp framework (Vuorikari et al., 2022). It states that digital information and data literacy include the ability to critically evaluate the credibility and reliability of sources of data, information, and digital content.

3.2. Geomedia and its use in education

Wolff-Seidel and Budke (2022) discovered that student-produced digital geomedia supported students in making their points more clearly, for example, by developing their argumentation skills. Geomedia technology was also found beneficial in an intercultural context because exchange students' cultural competence was supported by using geomedia (Atteneder & Herdin, 2020). Additionally, as a socio-technological affordance, geomedia allowed students to navigate various cultures and supported their independence and feeling of safety while abroad (Atteneder & Herdin, 2020). Geomedia has also been found to be beneficial for both students and teachers in terms of understanding the challenges and solutions regarding sustainability (González, 2012). Clearly, the benefits of geomedia teaching include the fact that it promotes student skills, competences, and understanding in multidisciplinary contexts. However, according to teachers, students may have deficits in technical knowledge, in presenting digital geomedia in written form as well as lack a critical approach when using digital geomedia (Wolff-Seidel & Budke, 2022). On the other hand, geography teachers prefer to use digital geomedia with themes involving the repetitive learning of the names of places, whereas geographical themes requiring deeper disciplinary content knowledge were generally taught without digital geomedia (Nilsson & Bladh, 2020).

Previously, various pedagogical methods, including the portfolio model and inquiry-based teaching, have been implemented to study the gathering and presenting of geomedia among Finnish upper-secondary school students and pre-service geography teachers (Anunti et al., 2018, 2020; Anunti et al., 2023). These studies have revealed that geomedia teaching has the potential to promote students' GIS competences (Anunti et al., 2018), sustainability competences (Anunti et al., 2023), and powerful knowledge in geography (Biddulph et al., 2020; Virranmäki et al., 2019). Anunti et al. (2018, 2020) and Anunti et al. (2023) highlight that upper-secondary school students prefer to rely on teacher-selected sources of geomedia, which emphasizes that students require teachers' support in searching for information.

In the context of teacher education, Schulze et al. (2015) recommends that teacher education should promote teachers' professional competence in digital geomedia because it can empower young people to participate in society. They also state that given the development of geospatial technology, along with the possibility of sharing location-based information online, the expert-based view of GIS currently prominent in education should be replaced with the non-expert use of digital geomedia in schools (Schulze et al., 2015). Therefore, technical skills like the ability to use certain (GIS) software are essential for learners but are not the only aim of geomedia education (Gryl et al., 2014). This notion is aligned with the findings of Fernández-Batanero et al. (2022), who specify that in attempts to develop students' digital competence, teacher education should focus on pedagogical, rather than technological, factors to promote students' meaningful learning (see also Nagel et al., 2023).

4. Methods

4.1. Participants and data gathering

The data collection followed the protocol of Finnish National Board of Ethics in Research (TENK, 2019). The consent of each participant was obtained before the interviews, and participants were informed that they could withdraw from the interview at any point. Furthermore, to build trusting relationships with the participants, the entire data-collection procedure and the questions of the interview were described to the participants beforehand. The anonymity of the participants was carefully maintained by referring to the participants only with numbers (Cohen et al., 2018).

The data consist of sixteen (n = 16) geography subject teachers' interviews. The interviewed teachers taught geography in lower-secondary schools (n = 5) or upper-secondary schools (n = 11). All teachers had more than 5 years and up to 35 years of experience in teaching geography, and some had experience spanning both educational levels. For the purposes of this study, the teachers were asked, for example, about how they understand the concept of geomedia, the significance of geomedia teaching for them, and their own digital geomedia teaching practices. The entire data collection procedure was conducted by Author 2 and Author 3, and the data collection continued until saturation was reached, meaning that new information was not obtained from additional interviews (Cohen et al., 2018; Onwuegbuzie & Leech, 2007). The data collection was initiated by personally inviting teachers we knew through personal connections and networks. In addition to personal invitations, we sent general interview invitations to teachers through various channels, including social media. There were no responses to the general invitations, and a few personally invited individuals declined to participate in the interviews.

The interviews were conducted remotely via Microsoft Teams calls in the spring of 2021. The semi-structured interview principles were applied because they allowed for variation in the order and emphasis of pre-set questions, as well as the introduction of additional questions (Atkins & Wallace, 2012; Cohen et al., 2018). This method also allowed teachers teaching at either the lower-secondary or upper-secondary level to approach geomedia education from their perspectives. The entire interview consisted of eight themes and 36 questions (Appendix 1), and the interviews lasted from 1 h 15 min to 2 h 30 min. The teachers had varying levels of geomedia proficiency, and their responses were rich and diverse. During the interviews, we acknowledged that our positions as researchers and teacher educators could constrain some teachers from sharing their perceptions. Hence, the teachers were encouraged to speak as openly as they wanted about their experiences of teaching with geomedia. This was done to maintain trustworthy relationships with the participants.

4.2. Data analysis

To analyse our data, we applied inductive thematic analysis. The chosen method offered an effective and flexible approach via which to analyse qualitative data in an intentional manner by identifying themes and patterns (Braun & Clarke, 2006, 2019, 2020). We focused on those parts of the dataset that directly related to our research questions. We will next clearly indicate which approaches were used in our inductive

thematic analysis, and then, we will reveal how we conducted the analysis.

Our data analysis began with transcribing the entire dataset (n = 16), which was conducted by the Author 4. Following Braun and Clarke's (2006) phases of thematic analysis, Author 1 first *familiarized* herself with the entire dataset by reading it several times. Based on this careful and repeated reading, Author 1 conducted the second phase of analysis and created the *initial codes* by systematically coding the relevant parts of the dataset. These initial codes of interest indicated the most essential information in the entire data and were relevant to the research questions (Boyatzis, 1998). At this point, researcher triangulation was conducted by Authors 2 and 6 to ensure diversified observations (Carter et al., 2014). The codes were then translated into English by Author 1, and the accuracy of this translation was then examined and approved by Authors 2 and 6. Once the translation was complete, Authors 1 and 5 conducted the third phase of the analysis, *searching for themes*. Here, Authors 1 and 5 collated all the initial coded data extracts to themes by creating two tables, which ultimately became the tables that we presented as part of our findings. Subsequently, the two main themes were created, namely the teachers' perceptions of the significance of geomedia and teachers' perceptions of teaching with digital geomedia. In the fourth phase of analysis, *the reviewing of the themes*, we discovered that the data extracts within both main themes formed coherent patterns (Level 1, see Braun & Clarke, 2006), and we were able to create sub-themes. While reviewing these sub-themes in relation to the entire dataset (Level 2, see Braun & Clarke, 2006), we discovered that they comprehensively reflected the entire dataset. To ensure the accuracy of our analysis in the fourth phase, we again conducted the researcher triangulation by Authors 1, 2, 4, 5, and 6. From here, Author 1 proceeded to the fifth phase, *defining and naming themes* and subthemes. The sixth phase, *producing the findings*, was conducted by Authors 1, 2, 5, and 6. To ensure the transferability of our findings, thick descriptions of teachers' perceptions were included. Moreover, to ensure the credibility and validity of the data analysis, we have presented the phases of our analysis in which researcher triangulation was conducted. Finally, the confirmability of our analysis was addressed by transparently describing the phases of the analysis.

5. Findings

In what follows, we will present the teachers' perceptions, firstly, those related to the significance of geomedia (Table 1) and, secondly, those related to digital geomedia teaching (Table 2). These two main themes include sub-themes, and we present the most informative and detailed data excerpts from each sub-theme to enable us to further discuss the matter in the light of in- and pre-service teacher education.

5.1. Teachers' perceptions of the significance of geomedia

We discovered three sub-themes that represent the teachers' perceptions of the significance of geomedia (Table 1). These sub-themes reveal that teachers perceive the significance of geomedia from diverse viewpoints, including conceptualizing and interpreting information overflow and reinforcing the knowledge base.

5.1.1. Significance of geomedia as a multidisciplinary conceptual tool

The significance of geomedia as a multidisciplinary conceptual tool was highlighted by the all-encompassing nature of geographic and location-based information currently, as demonstrated by Teachers 3 and 8:

> *It (geomedia) is a good concept, kind of an umbrella concept for all geographical data … One has surely witnessed the significance of the geographic information during the last few decades, merely [based on] the growth of the significance of cartographic information … How it is ubiquitous in all fields of society and everyday life, in all applications you open, and in different fields of professions and how significant it has become. So, surely, it is significant that you create the basis for it in the school world.* (Teacher 3, Upper-Secondary School [USS] and Lower Secondary School [LSS])

> *It (geomedia) is essential since location-based information has increased tremendously over the past two decades. [Consider] all these applications and visualizations and how the concept of visual information has expanded over the past decades. All the graphs and visual elements, animations, and interactive maps have increased tremendously, so one must know how to use them …* (Teacher 8, USS)

Because of the increase in geographic and location-based information, Teachers 3 and 8 value geomedia because it provides the students with a means of considering and using this multidisciplinary information and related applications. Teachers 3 and 8's perceptions reveal that the noticeable growth of location-based information and related digital technology advances require that they should be considered in schools to provide students with the basic understanding and competences needed to use them. Here, the significance of geomedia stems from the demands of societal changes, not the demands of the geography discipline.

5.1.2. Significance of geomedia in enhancing critical literacy and interpretation

Geomedia was seen as crucial to students' interpretation skills and critical literacy. For example, Teachers 2 and 5 emphasized this by contrasting interpretation skills with the digital production of geomedia.

> *I think the most important thing in it (geomedia) is to interpret different kinds of data and material so that one can interpret things because they (students) face that all the time no matter what media service they open. […] I think making those charts (digitally) is not as important. I mean it is a skill* per se*, but I think interpreting means that one can make conclusions (about charts) and critically evaluate those conclusions.* (Teacher 2, LSS)

> *[…] I think it (interpreting) is the most important thing and, also, to separate good and truthful information from nonsense kind of information when interpreting, for example, maps or charts. That is why critical media literacy will kind of make them (students) see the forest (and not*

Table 1
Teachers' perceptions of the significance of geomedia.

Main theme	Sub-theme	Descriptor	n = 16
Significance of geomedia	Multidisciplinary conceptual tool	Increase in location-based and multidisciplinary information in school and life requires an umbrella concept, such as geomedia.	9
	Critical literacy and interpretation	Information and multimedia content overflow, including for geomedia, requires critical literacy and interpretation skills	4
	Common knowledge	Geomedia reinforces common knowledge in times of information and multimedia content overflow	3

the trees). So, it is not always the technical implementation but more about the interpretation. (Teacher 5, USS)

The examples above clearly show that Teachers 2 and 5 value the students' ability to interpret various kinds of data and information in their daily encounters with geomedia and other kinds of media over technical performance. The excerpts also reveal that Teachers 2 and 5 are concerned about their students' ability to critically evaluate information and, thus, their critical geomedia literacy. The current technology-driven way of life demands technological competences, but the current information-intensive society also profoundly influences what teachers see as significant in geomedia teaching.

5.1.3. Significance of geomedia in enhancing common knowledge

Finally, the teachers highlighted the significance of geomedia because it provides students with common knowledge. However, common knowledge was seen as significant within different perspectives, as seen in the excerpts below.

It (geomedia) is very important because we need to get the common knowledge back, which does not happen only through social media and the yellow press (tabloid), but we should get the facts-based interpreting back. One cannot only shout some half-truths behind fake news. So, I think it (geomedia) is the most important thing regarding common knowledge, and that is why I invest so much in geomedia and interpreting and producing it. (Teacher 12, USS)

It (geomedia) would probably broaden students' understanding and ability, for example, to apply information from the news and from what they learn to history and social studies. It (geomedia) is a kind of compiling and brings common knowledge and broad-mindedness so that one can connect things with one another. (Teacher 6, LSS)

As seen from the excerpts above, for Teacher 12, the common knowledge gained through geomedia is significant because it helps in distinguishing between facts and fiction. Whereas Teacher 6 values this common knowledge because it is beneficial for students' understanding of the interconnectedness of things.

Altogether, the teachers' (3 and 8, 2 and 5, and 12 and 6) perceptions reveal how they justify the significance of geomedia from various viewpoints. However, all the perceptions above seem to relate to how students currently face unprecedented amounts of multidisciplinary information. Teachers have concerns about students' competences in managing this and simultaneously maintaining a critical viewpoint. Hence, the significance of geomedia for teachers manifests in developing students' critical multimedia, including geomedia, literacy and in enhancing students' potential to face information overflow.

5.2. Teachers' perceptions of digital geomedia teaching

Teachers' perceptions of digital geomedia teaching were often closely related to the student perspective. The perceptions fell into two subcategories: those related to student comprehension and those related to students' digital competences.

5.2.1. Perceptions related to student comprehension

The teachers' perceptions related to student comprehension during digital geomedia teaching displayed, foremost, the need to understand the logic behind digital tools, applications, and software. The teachers' descriptions also included the measures they had taken to promote student comprehension.

We start with (for 7th graders, the first grade in LSS) the making of charts with paper (and pen) so that they (students) begin to understand the axes and other elements (of charts), and then, we move on to easy digital charts. And with students in the 8th grade, I have the first easy pie chart done, and that begins their learning about how to double-click. (Teacher 3, USS/LSS)

Teacher 3's perception above reveals that students should begin the production of geomedia on paper and only move forward to digital production after understanding the elements of charts. The exercises performed on paper are seen as more supportive of students' deep understanding than digital geomedia tools as students begin to learn to produce and present digital geomedia.

Teacher 6, who has a great deal of experience with having students complete exercises with digital geomedia, had also turned back on having students complete exercises on paper to better promote student comprehension.

[…] for many years now, we did everything digitally. For example, we named ready colored agriculture areas, drew ocean currents, and colored the fishing grounds (on computer), but they did not get the connection to it. The problem was that it was also quite hectic, that you have many tabs open, and you must surf between them, so you do not get the big picture there, and that is a minus. […] I have returned to the paper version. I gave them a paper version of a world map, and they located the agricultural areas, ocean currents, and fishing grounds. They did all that on the same map, and they performed in a totally different way (better than earlier) on the exam. (Teacher 6, USS)

Teacher's 6 perception above reveals how having multiple tabs open on computer screen seems to lessen students' understanding of the big picture and diminish their comprehension. Therefore, the teacher's pedagogical choice in this case was to return to completing the exercise on paper. This proposes that returning to completing exercises on paper, in some cases, supports students' better understanding of subject content knowledge. In contrast, it was not revealed how this reconsideration influenced the development of the students' digital geomedia competences.

Furthermore, digital geomedia teaching was also a strong value choice, as indicated by the measures the teachers (e.g., 14) reported that they were willing to take to support students' comprehension regarding how to produce digital geomedia.

I have kind of accepted the fact that even though it would take an incredibly long time to make the students understand the secrets of Excel. I have had the hidden agenda that we, at least once in our lifetimes, use Excel, which is, anyway, still a basic tool. Somehow beginning to understand it is kind of essential. So, in a way, you must make quite a big value choice there. (Teacher 14, LSS)

Table 2
Teachers' perceptions of digital geomedia teaching.

Main theme	Sub-theme	Descriptor	n = 16
Digital geomedia teaching	Perceptions related to student comprehension	Comprehending the use of digital geomedia requires practice in digital program management	7
	Perceptions related to students' digital competence	Students' diverse digital competence levels complicate teachers' work allocation and time management	9

The example emphasizes how teachers (3, 6, and 14) value student comprehension as the most elementary part of using and producing digital geomedia. In reflecting on what measures they had taken, some teachers reveal that they feel accountable for making students understand how digital geomedia can be used and produced. The efforts teachers were willing to make also reveal that learning how to use some digital tools is seen as essential for students' everyday lives in the future.

5.2.2. Perceptions related to students' digital competence

The teachers' perceptions of students' digital competence related to digital geomedia were ambiguous, suggesting that what was expected from the students was not always coherent. The following two teachers' excerpts (4 and 16) reveal students' challenges using professional digital geomedia.

> *[…] many of the upper-secondary school students find it (QGIS; free open-source map-making application) confusing that the range of possibilities is so wide. […] They do not have the patience, and they think that they can skip the interphases[…] I have said to them that all assignments must have some kind of map, and they do the maps in a variety of ways. For example, I have said that a screenshot from Google Maps is enough. You do not have to do it by yourself (with QGIS). So, in that way, I have made it easier and said that using the geographic information programs is not mandatory to lower the threshold to participate in the course.* (Teacher 4, USS)

> *I am always surprised by how weak upper-secondary school students are in using Excel and that there are such large differences between students. For others it is like, 'Yes, we did this every day in lower secondary school,' and the others are like, 'What is Excel?'* (Teacher 16. USS)

The abovementioned examples reveal how the use of professional map-making applications is considered difficult and confusing from the students' point of view. For this reason, Teacher 4 had decided to moderate the requirements. Teacher 16, taking the teacher's point of view, is confused by students' lack of digital competence (in Excel). These perceptions, followed by concerns about students lacking patience, as well as the varying levels of student digital competence, revealed the complexity of digital geomedia teaching. Teachers must adapt to the student and teacher perspectives and the difficulties faced by students as well as their weaknesses. Finally, teachers must adapt by moderating requirements to students' varied levels of digital competence during geomedia teaching.

On the other hand, the following excerpt reveals a perception of students' digital competence that was more confident in that Teacher 5 claims that students could produce digital geomedia (here, charts).

> *I have noticed that the students can do [things] digitally. They master the drawing of charts, but they cannot interpret those charts. So, in a way, things have moved ahead with digital, but when one must interpret the charts, which they can find from different media, they will just have a look and say it looks nice, and they know the different elements, like the title and x- and y-axes, but they cannot interpret it.* (Teacher 5, USS)

However, Teacher 5's concern over students' lack of interpretation skills brings forth that students have only cursory critical geomedia literacy skills. According to Teacher 5, the students may assume that technical performance is sufficient in producing and presenting digital geomedia, leaving the students without the skills needed to critically interpret either self-generated or other digital geomedia.

According to the teachers 4, 16, and 5, students' digital competence is challenged by the plurality of digital geomedia. Professional digital geomedia tools and applications (e.g., QGIS and Excel) may be too difficult for some students. However, in the case of some teachers, the moderation of requirements showed how teachers' pedagogical choices may be beneficial for students' use of digital geomedia. On the other hand, some teachers are more concerned about students' lack of interpretation skills regarding student-generated presentations of digital geomedia.

6. Discussion

In this study, we examined geography teachers' perceptions of the significance of geomedia and digital geomedia teaching. Despite the national context of our study, we believe that our results will resonate with and contribute to the wide international audience for teaching and teacher education research. Our findings revealed an inconsistency in teachers' perceptions of what geomedia teaching is (see also Nilsson & Bladh, 2020). To a degree, this coheres with previously raised concerns (see Hilander, 2017) that the introduction of the concept of geomedia into the curricula for basic education (FNBE, 2016a) and upper-secondary school (FNAE, 2020; FNBE, 2016b) did not provide a sufficiently clear explanation of what geomedia is. For this reason, teachers are still, to some extent, struggling with making sense of what geomedia is and how to teach with it. In what follows, we discuss some of the observations stemming from teachers' perceptions in terms of the implications for geomedia in teacher education.

First, the teachers' perceptions revealed that conceptually apprehending the growth of location-based information requires geomedia. Previous studies (Atteneder & Herdin, 2020; González, 2012) have shown that geomedia can be beneficial in teaching multidisciplinary themes, whereas the teachers' perceptions in this study showed that geomedia was also appreciated as a multidisciplinary tool that can help students conceptualize a plethora of location-based information. Furthermore, the perceptions of significance attached to critical literacy and interpretation revealed teachers' concerns about students' critical geomedia literacy competences. Teachers valued the interpretation skills of geomedia in critically evaluating the flow of constant information, data, and digital content. As in previous studies (see Fernández-Batanero et al., 2022; Gryl et al., 2014; Schulze et al., 2015), the teachers in this study also regarded technical skills and performance as secondary as compared to interpretation skills. Lastly, the teachers valued geomedia, as it provides common knowledge, which was seen as essential in distinguishing facts from fiction and understanding how things are interconnected.

Interestingly, the findings reveal how all the perceptions of the significance of geomedia arose from concerns over students' critical management of geographic information overflow. Therefore, it can be assumed that the meaning of geomedia for teachers is deeply embedded in the way in which it helps students critically confront an information-intensive world. This finding is significant for teachers and teacher education internationally because it clearly shows how geomedia can be implemented in geography teaching to enhance students' critical literacy (see Gryl et al., 2014; Vogler et al., 2012). Additionally, what is substantial in teachers' perceptions about the significance of geomedia is that none of the subcategories found or the teachers' perceptions revealed meanings attached to using, producing, or presenting digital geomedia. Digital geomedia competences were referred to only to note that they are not as important as interpretation skills. However, the Finnish curricula (FNBE, 2016a; FNAE, 2020; see also Vuorikari et al., 2022) expect both elements: critical evaluation when *gathering* information and the skills needed to use and produce geomedia when *presenting* information. Thus, teachers' perceptions of the significance of geomedia reflect incongruities with the expectations of the curricula.

Second, teachers' perceptions of digital geomedia teaching clearly show that they express their perceptions of it from students' points of view. The findings related to student comprehension revealed that some teachers regard the students working on paper first as essential in producing digital geomedia and supporting student comprehension. Consequently, when implementing geomedia, including geospatial technologies, there is still a need for the parallel use of both digital and paper maps. Furthermore, the findings indicated that sometimes teachers were willing to push the limits of the measures they took to teach digital geomedia if they saw it as very significant for students'

comprehension. These are promising findings because they demonstrate that the teachers in this study could proficiently alternate between geomedia sources in their teaching to support student learning and comprehension. However, maintaining the balance between implementing digital and other geomedia, as well as determining how much time is devoted to teaching different digital technologies, is not necessarily clear for teachers. So, even if the teachers recognise the benefits of using geomedia for student learning (Anunti, 2020; Anunti et al., 2023; Nilsson & Bladh, 2020), they are still unaware of how to consistently implement geomedia in their teaching. This calls for a more precise definition of geomedia competences in the educational context. Thus, critical evaluation of the sources of digital geomedia and the competences needed to use digital geomedia equipment should be specified. This would allow students globally to achieve the critical geomedia literacy and the digital geomedia competences required in a digitalized and information-intensive society. Additionally, the significance of in- and pre-service teacher education in this matter is essential because the national curricula (FNAE, 2020; FNBE, 2016a) do not seem to provide sufficient guidance on this matter.

Furthermore, the teachers' perceptions related to students' digital competences were more diverse and, in some cases, even contradictory. The findings displayed how digital geomedia teaching was complex because of students' different levels of digital competence (Hatlevik et al., 2015) and because of their lack of patience when using digital geomedia. For this reason, teachers had to moderate and differentiate their digital geomedia teaching. Especially in the case of using professional map-making tools, the requirements had to be moderated. So, the use of professional tools, such as QGIS, in upper-secondary schools can be questioned. For example, what is the level of digital competence required in schools if the digital competence demanded generally only involves searching, evaluating, and managing data, information, and digital content (Vuorikari et al., 2022)? Still, the use of professional map-making tools in secondary education is strongly advocated by some researchers (Curtis, 2019; Osborne et al., 2020). Nonetheless, for teacher education, these findings clearly suggest that future teachers should be prepared to moderate and differentiate their digital geomedia teaching. According to Nagel et al. (2023), this would require that in teacher education the didactical digital, profession-oriented digital, and transformative digital competencies should be advocated. Here, didactical digital competence refers to digital competence in subject teaching, profession-oriented digital competence refers to the digital responsibility for and awareness of changes in one's subject and transformative digital competence refers to the ways needed to transform one's teaching practices by choosing appropriate digital tools.

Unlike previous research, which has revealed teachers' uncertainty in adapting or implementing digital technologies in their teaching (Curtis, 2019; Fraillon et al., 2020), the teachers in this study did not describe such experiences with digital geomedia, implying the achievement of digital-technology-related teaching skills (Sailer et al., 2021). Even though Curtis (2019) maintains that there is a gap between the desired instructional use of geospatial technology (the more technological aspect of digital geomedia) and teachers' preparation to meet these expectations, our findings did not reveal such a gap. However, this does not mean that such a gap does not exist in the Finnish context; rather, our study revealed that teachers are more concerned about students' geomedia competences related to critical geomedia literacy than their own digital competences in digital geomedia teaching.

Third, the significance teachers place on geomedia somewhat contradicts their perceptions of digital geomedia teaching. When the teachers described their perceptions of geomedia teaching, they rarely reported the aspects of geomedia that they saw as significant in their teaching. Apparently, teachers do not perceive digital geomedia as a means of advancing the significant aspects of geomedia teaching; rather, they focus on technical skills, as highlighted by Vajen et al. (2023), and making students understand how the technical side of geomedia works. Thus, even though the teachers take the learner-centred approach (Admiraal et al., 2017) in their digital geomedia teaching, the focus on technical skills may diminish digital geomedia variety and its benefits in teaching.

These incongruities demand the attention of the international teacher education community. There is clearly a need for discussion about what should be emphasized in teaching geography and other subjects with digital geomedia. Teachers seem to have many kinds of thoughts about what to teach and how to teach it, which relate to the curriculum-making discussion (cf. Curtis, 2019). To avoid too strict guidance on the part of the curricula and too loose guidance leaving teachers unaware of whether to emphasize the teaching of technical skills or the critical interpretation of multimedia content, the discussion should be directed towards what we see as significant in teaching geography. According to the geography teachers in this study, technical skills should be taught, but critically interpreting multidisciplinary geomedia content seems to be more significant. Therefore, we recommend that the incongruities mentioned above should be addressed in teacher education internationally by offering teachers examples of the appropriate implementation of geomedia, in which there is a balance between teaching technical skills and teaching critical interpretation.

Furthermore, because the significance that teachers attached to geomedia suggests that teachers have concerns about the information overflow that students must cope with, we propose that the broader definition of geomedia should be used in teaching (Fast et al., 2018; Gryl et al., 2014; Gryl & Jekel, 2012). By this, we mean that in educational use, geomedia should include many kinds of geographically referenced information, tools, applications, and software to expose students to them in the early years of basic education and to increase their understanding of the possibilities of geomedia. Likewise, we propose that in international pre- and in-service teacher education, teachers should encounter and practice the use, production, and presentation of geomedia as broadly as possible to support them in choosing the most relevant sources of geomedia for their teaching (see also Curtis, 2019; Nilsson & Bladh, 2020).

Finally, we would like to address the limitations of this study. We acknowledge that this is a small-scale, qualitative, and regional research project and that the findings are not generalizable. The teachers who voluntarily participated in our study are not representative of all geography teachers in national or international contexts. For this reason, there is always a possibility that with different participants, the findings might have been different. The findings presented here, however, shed new light on teachers' perceptions of the significance of geomedia, especially teaching with digital geomedia. To ensure the validity of our study, we provided rich and descriptive data to allow readers understand the perceptions described in this study and make their own decisions about the transferability of the findings to similar contexts (Cresswell & Miller, 2000).

7. Conclusions

This study revealed that teachers associated the significance of geomedia with its potential to support students' critical literacy, especially the interpretation of information, data, and digital content. The teachers viewed geomedia as significant, as contemporary digital society presents extensive amounts of information, which students must be able to manage. For this reason, the teachers appreciated interpretation skills more than the technical management of geomedia. This implies that geomedia should be utilized in geography education to support students' critical literacy in both regional and global respects. Furthermore, teachers' perceptions related to digital geomedia teaching were firmly attached to students' points of view, including students' comprehension and digital competence. The findings showed that teachers were willing to make efforts and change their geomedia teaching to support students' comprehension of how to produce and present digital geomedia. Finally, the teachers' perceptions of students' digital competence were diverse, indicating that teachers are required to moderate and differentiate their

digital geomedia teaching. Therefore, the diversity of content and teaching methods that teachers are required to manage when teaching with digital geomedia should be also included in the geography didactics course contents of teacher education internationally.

Based on the findings presented in this study, we can conclude that the educational use of geomedia requires clear definitions and guidelines for teachers of different subjects about how to benefit from the implementation of geomedia. This conclusion relates directly to the ongoing discussion of curriculum implementation and development globally, as it calls into question whether the guidance offered is sufficient when introducing a new concept into the national curriculum. Our conclusion, thus, extends and enhances the global development of curricula in their national contexts, as well as international teacher education, because it calls attention to maintaining support for teachers when introducing new concepts into the curricula. Based on our findings, we also conclude that students, teachers, and teacher educators should be provided with clear instructions about how to use both digital and other geomedia. Finally, teachers should be allowed to make use of the pedagogical potential of digital and other geomedia to ensure the use of relevant practices that foster both teachers' professional development and student competences. Therefore, geography teacher education, internationally, should embrace the new and innovative concept of geomedia and strive to develop its use.

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CRediT authorship contribution statement

Anne Pellikka: Writing – original draft, Formal analysis, Conceptualization. **Tua Nylèn:** Writing – review & editing, Investigation. **Virpi Hirvensalo:** Investigation. **Laura Hynynen:** Investigation, Data curation. **Sonja Lutovac:** Writing – review & editing, Conceptualization. **Petteri Muukkonen:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

No potential conflict of interest was reported by the authors.

Data availability

The data that has been used is confidential.

Appendix 1

Interview

0–15 min: Background questions.

- Age levels of the students you teach
- Language of instruction
- Other subjects you teach
- Years of teaching experience
- Teaching experience at different grade levels
- Major subject in university
- Number of credits of geography studies
- Number of credits of geoinformatics studies
- Number of credits of education studies

15–30 min: the importance of geomedia teaching and the concept of geomedia

- The significance of geomedia teaching in the teacher's opinion
- Understanding the concept of geomedia (how you understand yourself)
- The usefulness of teaching the geomedia concept according to one's own understanding
- Understanding the concept of geomedia (how students understand)
- How are the following concepts used and understood in the classroom: geographic information, spatial information, data, material, map and analysis?

30–45 min: Amount of geomedia teaching, different geomedia and, digital geomedia.

- Amount of geomedia teaching
- What geomedia do pupils/students use in their studies and in their free time?
- Is there an emphasis on some form of geomedia
- Tell about your digital geomedia teaching

45–60 min: Geomedia teaching resources.

- Temporal resources for geomedia teaching
- Availability of training, availability of other support
- Device resources
- Software and tool resources
- Material resources
- Variation among colleagues (within the school/municipality, nationwide)

60-75 in: Teaching methods and materials.

- Teaching methods (what works, what doesn't work)
- Geomedia teaching context: Is geomedia taught separately or integrated into the theme? For which themes in particular?
- Learning materials (availability, quality, do you produce yourself)

75–90 min: Challenges, mistakes.

- Challenges/eases of teaching
- The most common mistakes/misconceptions

90–105 min: Skills and skill levels.

- What should you know? What is most important?
- How does the teacher separate skills (use vs. production, hierarchy of skills?)
- Students' skills? On average and differences?
- What are the reasons for the level and differences?

105-120 n: Development ideas and needs.

- What are the biggest gaps/challenges/slowdowns?
- What would a teacher need most to support geomedia teaching?
- How would the threshold be lowered?

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