Evaluating climate change fake news in German primary education: the role of students'conceptions

Sabine Lämmer, Ulrike Ohl

Angaben zur Veröffentlichung / Publication details:

Lämmer, Sabine, and Ulrike Ohl. 2026. "Evaluating climate change fake news in German primary education: the role of students'conceptions." *European Journal of Geography* 17 (2): 16–33. https://doi.org/10.48088/ejg.s.lam.17.2.016.033.

European Journal of Geography

The publication of the European Journal of Geography (EJG) is based on the European Association of Geographers' goal to make European Geography a worldwide reference and standard. Thus, the scope of the EJG is to publish original and innovative papers that will substantially improve, in a theoretical, conceptual, or empirical way the quality of research, learning, teaching, and applying geography, as well as in promoting the significance of geography as a discipline. Submissions are encouraged to have a European dimension. The European Journal of Geography is a peer-reviewed open access journal and is published quarterly.

Received: 22/12/2025
Revised: 23/02/2026
Accepted: 28/02/2026
Published: 06/03/2026

Special Issue:
Teaching Geography for a World in Transition - Powerful Teaching in Uncertain Times

Guest Editors:
Dr. Neli Heidari
Dr. Uwe Krause
Dr. Susan Caldis
Prof. dr. Tine Beneker

EJG Editor:
Dr. Alexandros Bartzokas-Tsiompras

DOI: 10.48088/ejg.s.lam.17.2.016.033
ISSN: 1792-1341
E-ISSN: 2410-7433

Research Article

Evaluating Climate Change Fake News in German Primary Education: The Role of Students' Conceptions

Sabine Lämmer [1]✉ **& Ulrike Ohl** [1]

[1] Institute of Geography, University of Augsburg, Augsburg, Germany

✉ Correspondence: sabine.laemmer@geo.uni-augsburg.de

Abstract: The ability to critically evaluate information related to climate change and to recognise fake news is highly relevant even at primary school age, as children increasingly encounter digital media and climate-related discourses. The aim of this study is to explore primary school students' conceptions of climate change as well as of fake news and their abilities to evaluate climate change related information, with a focus on the role of the conceptions of climate change in evaluating fake news. A qualitative cross-sectional study was conducted with 28 Year 3 and Year 4 students in Germany using problem-centred interviews and evaluation tasks in June 2025. Almost half of the students were able to describe characteristics of fake news such as manipulative intent or their lack of evidence. However, students' conceptions of climate change varied considerably in depth and accuracy. Different types of evaluators can be identified, which vary in terms of how differentiated students' conceptions of climate change are, how they approach the evaluation process, how many decision criteria they apply, whether or not they draw on their conceptions, and the amount of correctly identified news. The study highlights the need for targeted educational strategies to foster climate-related conceptions and evaluation skills at an early age.

Keywords: geography education; fake news; disinformation; misinformation; primary school; conceptions

Highlights:

- Most students viewed fake news as false or misleading online content.
- Five evaluator types with differing evaluation approaches emerged.
- Climate conceptions influenced how students evaluated climate fake news.
- Students applied diverse criteria when evaluating fake news.
- Findings support fostering evaluation skills in primary education.

1. Introduction

Many topics in geographical education, including climate change, can be classified as socio-scientific issues (SSI). SSIs are controversial scientific topics that engage students in evidence-based reasoning, ethical reflection, and meaningful dialogue to support informed decision-making (Zeidler & Nichols, 2009). Climate change, as one of the most pressing global challenges, is therefore not only a central content of geography education but also a key topic for developing students' critical thinking and decision-making skills (Cambridge International Education, 2025; Hague & Bouckaert, 2022).

The topic of climate change is already relevant for primary school students, as they are increasingly confronted with climate-related information in their everyday lives, through media, family conversations, and school contexts. At the same time, children encounter these pieces of information in a media environment characterised by uncertainty,

inconsistency, and the coexistence of reliable and unreliable sources, making it increasingly difficult for them to judge the trustworthiness of climate-related claims. Early engagement with the topic can help them build interconnected and sophisticated conceptions of climate processes and human–environment interactions (Shepardson et al., 2017), as well as foster an understanding of the social and ethical dimensions of environmental change (Trott et al., 2023). Moreover, previous research suggests that primary school students already have a wide range of conceptions about causes, characteristics, consequences and possible actions of climate change (Lämmer et al., 2026, i.p.). Thus, introducing climate change as a SSI at the primary level is both meaningful and necessary.

At the same time, SSIs such as climate change are particularly vulnerable to fake news. Their complexity, uncertainty, and societal relevance make them a target for fake news (Cook et al., 2018; Scheufele & Krause, 2019). The term fake news is used as an umbrella term encompassing a range of related concepts, such as misinformation, disinformation, and misleading or deceptive content: "*Fake news is information that lacks reliability and is characterised by a false claim to authenticity, including the communication of empirically false information. It can take different forms, varying in intention, degree of truthfulness or facticity, and content*" (Lämmer and Ohl (2024, p. 3), based on Aïmeur et al. (2023; Paskin, 2018; van Helvoort & Hermans, 2020; Zimmermann & Kohring, 2018)).

Fake news about climate change often deny its anthropogenic causes, exaggerate uncertainties, or question the credibility of scientific consensus (Ecker et al., 2022; Lewandowsky et al., 2017). Such misleading claims may influence how even young students perceive and evaluate climate-related information. However, there is a growing body of research on how adolescents and adults identify and evaluate fake news (Aïmeur et al., 2023; Beer & Matthee, 2021; Machete & Turpin, 2020; O'Mahony et al., 2023; Valverde-Berrocoso et al., 2022). Little is known about how primary school students recognise fake news on climate change, what criteria they use to evaluate such information, and which factors influence their judgments (Lämmer & Ohl, 2024).

The study therefore aims to explore how primary school students identify and evaluate fake news related to climate change. It examines their conceptions of fake news and their evaluation process. Particular attention is given to how students draw on their conceptions of climate change, which were also surveyed, when evaluating information. The findings contribute to geography education research by providing insights into children's information evaluation skills in the context of an SSI and by identifying implications for fostering evaluation skills for dealing with climate-related fake news.

2. Theoretical Background: Students' Conceptions of Climate Change and Fake News Evaluation in Primary Geography Education

2.1. Students' Conceptions of Climate Change and Fake News

Understanding how students conceptualise complex SSIs such as climate change and fake news is essential for fostering critical thinking (Zeidler & Nichols, 2009). Building on the work of Niedderer (1988), Girg (1994), Einsiedler (1997), Kaiser (1997), Möller (1999), and Duit (1997, 2002), Adamina (2008) defines conceptions as students' personal, often experience-based understandings of phenomena, which may diverge from scientific explanations and influence how new information is processed. These "mental conglomerates" (Adamina, 2008, p. 19) comprise various elements, including knowledge components, experiences, perceptions, attitudes, interests, and values (Adamina, 2008).These conceptions are particularly relevant in the context of SSIs, where scientific knowledge intersects with ethical, social and political dimensions (Zeidler & Nichols, 2009).

Research has shown that children have a wide range of conceptions about climate change, including its causes, characteristics, consequences and possible actions (Akaygun & Adadan, 2021; Niusulu et al., 2024; Ramos et al., 2022; Sjöblom et al., 2022; Spiteri & Pace, 2023). For a comprehensive overview of the research landscape, see Lämmer et al., i. p. (2026). These conceptions are shaped by various influences such as media exposure, family discussions and school experiences, and often reflect a mix of scientific ideas and everyday reasoning (Lämmer et al., 2026, i.p.). In contrast, there is substantially more research on adolescents' and adults' conceptions of climate change, which has been examined far more extensively than the conceptions of younger learners (Wildbichler et al., 2025). Research consistently highlights generational differences, with younger individuals showing greater concern, emotional involvement, and urgency (Divasson-J et al., 2025; Poortinga et al., 2023; Skeirytė et al., 2022; Swim et al., 2022).

https://doi.org/10.48088/ejg.s.lam.17.2.016.033

Empirical research on children's conceptions of fake news is still in its infancy. While primary school students are familiar with the term "fake news", their understanding is often limited to general notions of falsehood of online information (Lämmer & Ohl, 2024). In contrast, adolescents and adults often conceptualise fake news as a multifaceted communicative phenomenon involving deliberate deception, manipulative intent and the way media shape the presentation of information. Research indicates that adolescents increasingly demonstrate the ability to identify the intentions behind fake news, critically assess sources and reflect on media strategies (Kahne & Bowyer, 2017; McGrew et al., 2018).

Students' conceptions of climate change and fake news have significant implications for how information is evaluated and decisions are made. The conceptions may shape students' perceptions of credibility, bias and truthfulness (Garrett & Weeks, 2017; Rijo & Waldzus, 2023; Wang & Akin, 2025). Existing studies offer preliminary evidence suggesting potential links between students' conceptions (including knowledge, beliefs, and ideas) of climate change and their ability to critically evaluate climate-related information (Lutzke et al., 2019; Morote & Hernández, 2024). The following section outlines the evaluation process in more detail. This theoretical foundation is essential for understanding how students engage with fake news and for exploring the potential interplay between their conceptions and evaluation in section 2.3.

2.2. Evaluation Process and Evaluation Skills for Dealing with Fake News

In this section, a closer look is taken at the evaluation process and skills relevant to how primary school students assess climate-related information. To explain how individuals recognise and respond to fake news, Amazeen (2024) proposes the Misinformation Recognition and Response Model (MRRM) (Figure 1).

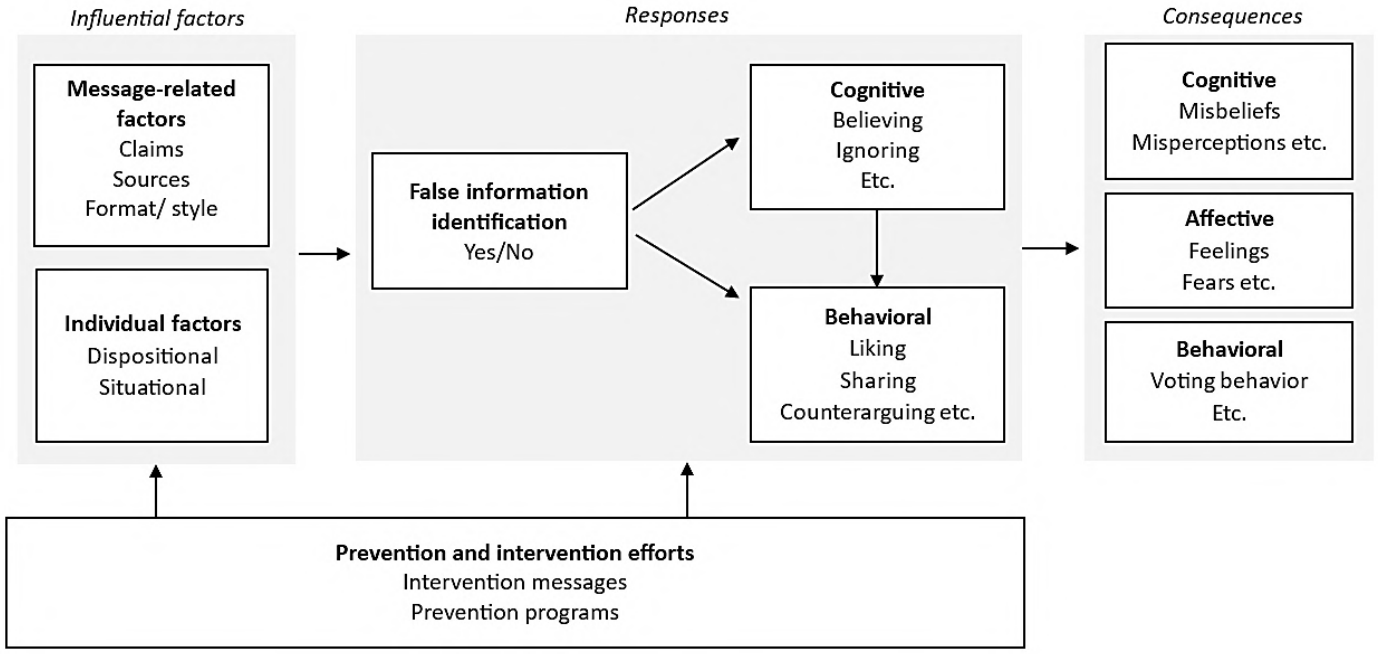

Figure 1. Misinformation recognition and response model (adapted from Amazeen (2024))

The model distinguishes three interconnected domains: influential factors that shape beliefs and processing, individual responses to misinformation, and consequences these responses have on beliefs, emotions and behaviour (Amazeen, 2024).

Since the model highlights recognition and response as core processes in dealing with misinformation, it is essential to clarify what evaluation entails and which skills are required to assess the credibility of information. This provides the conceptual foundation for understanding how students engage in these processes.

In education, evaluation is increasingly recognised as a key dimension of critical thinking (Babii, 2020; Facione, 1989; Lutzke et al., 2019). Gelerstein et al. (2016, p. 46) define evaluation as part of critical thinking as "*assessing the credibility of statements or other representations that are accounts or descriptions of a person's perception, experience,*

https://doi.org/10.48088/ejg.s.lam.17.2.016.033

situation, judgment, belief, or opinion; also assessing the logical strength of the actual or intended inferential relationships among statements, descriptions, questions, or other forms of representation." Gelerstein et al. (2016) outline three progressively demanding sub-skills of evaluation for primary school students: assessing claims, assessing arguments and assessing alternatives. Assessing claims involves recognising key factors that influence the credibility of a source. Assessing arguments means checking if a conclusion really follows logically from the reasons given. Finally, assessing alternatives entails weighing the advantages and disadvantages of different options (Gelerstein et al., 2016). This underscores that evaluation is not a uniform skill but a layered process that becomes more cognitively demanding as learners engage with more abstract and conflicting information.

Research suggests that adolescents and adults tend to overestimate their competence in detecting fake news, yet often struggle to evaluate information accurately (Kops et al., 2025; McGrew et al., 2018; Mendoza et al., 2024; Nygren et al., 2021). While young people are aware of the existence of fake news, they frequently lack the media literacy and critical thinking skills necessary to reliably assess the credibility of information. In particular, adolescents tend to rely on intuitive judgments and social cues rather than applying systematic criteria when evaluating fake news (Kops et al., 2025).

Adults, depending on their educational background and media literacy, employ more sophisticated strategies for evaluating news content (Lewandowsky et al., 2017). Targeted educational interventions that explicitly address manipulation strategies have proven effective in strengthening evaluative abilities across age groups (Kops et al., 2025). In this context, studies show that inoculation theory can help increase resilience to fake news (Cook et al., 2018). The idea is to expose people to weakened examples of fake news and explain the typical reasoning errors. This way, students learn to recognise fake news and increase resilience to fake news (Cook et al., 2018; van der Linden et al., 2017).

Looking specifically at primary school age, a systematic literature overview by Lämmer & Ohl (2024) shows how primary school students are able to evaluate fake news across a variety of topics. Studies consistently show that children are aware that fake news exists, yet they often struggle to reliably assess the credibility of online content. Recognition rates vary widely across studies, ranging from very low detection in classic hoax-based designs such as the "Pacific Northwest Tree Octopus" (Loos et al., 2018; Pilgrim et al., 2019; Dumitru, 2020) to substantially higher accuracy in tasks involving more structured prompts or familiar content (Einav et al., 2020; Paul et al., 2019). These differences can be attributed to the nature of the fake news presented, children's conceptions of the topic, and the degree of scaffolding provided. Earlier studies also reveal that children rely on a limited set of cues, such as plausibility, source or visual realism, while rarely engaging in systematic cross-checking or critical sourcing strategies (Pilgrim & Vasinda, 2021; Xu et al., 2018). Intervention studies indicate that explicit instruction can improve evaluative abilities: both structured credibility frameworks (Zhang & Duke, 2011) and media literacy or critical-thinking approaches (Housand, 2021; van Helvoort & Hermans, 2020) show positive effects. More recent work on pre- and debunking with primary school children suggests that even at this age, inoculation-based strategies can strengthen resistance to misinformation (Verhalle & Loos, 2025). Taken together, earlier research highlights the importance of fostering evaluation skills in primary school, while the specific role of students' conceptions remains an open question.

2.3. The Role of Conceptions in the Evaluation of Fake News

Amazeen (2024) explicitly emphasises that beliefs, expectations and topic-specific knowledge play a central role in the evaluation process. We position this within our broader construct of conceptions defined in section 2.1. The conceptions can be situated within Amazeen's model (Figure 1) as part of the individual factors, more specifically among the dispositional factors. Conceptions are not explicitly mentioned in the model, except for misconceptions as a response.

To better understand the role of conceptions in evaluating fake news, it is helpful to take a closer look at the process of identifying informational problems. This is, according to Amazeen (2024) the initial cognitive step in which an individual determines whether something about the information appears problematic. When a person encounters information, they compare it to their prior beliefs and topic-specific knowledge. If the message aligns with their beliefs and knowledge, they are unlikely to recognise any problems, and the process will not activate the recognition. Conversely, if the message contradicts their beliefs, people are more likely to identify an informational problem, which then triggers closer inspection and the potential identification of misinformation. Messages that are congruent with existing beliefs often bypass critical evaluation, while incongruent messages prompt problem identification and further processing

https://doi.org/10.48088/ejg.s.lam.17.2.016.033

(Amazeen, 2024; Ecker et al., 2022). The identification of informational problems clearly shows how the broader construct of conceptions can influence the ability to evaluate.

Van der Linden et al. (2017) find that inoculation strategies help broaden existing prior beliefs, attitudes and perceptions and thereby increasing resistance to climate misinformation. This demonstrates the protective function of well-developed conceptions. Cook et al. (2018, p. 1) point out that "*when people lack the expertise and skill to evaluate the science behind a claim, they typically rely on heuristics such as substituting judgment about something complex (i.e. climate science) with judgment about something simple (i.e. the character of people who speak about climate science) and are therefore vulnerable to misleading information*". This reliance on heuristics makes people particularly vulnerable to misleading information that aligns with their pre-existing beliefs.

Cook et al. (2018) also describe a backfire effect: when people are given facts that contradict their strong beliefs, they may hold on to the false belief even more strongly. In this case people perceive the contradictory information as a threat to their identity or worldview, leading them to defend their original belief even more strongly (Nyhan & Reifler, 2010). This phenomenon illustrates the central role of beliefs in shaping how individuals process and accept new information. Rather than functioning as neutral recipients of facts, people interpret information through the lens of their prior beliefs, which significantly influences their susceptibility to climate misinformation (Cook et al., 2018). These findings demonstrate that conceptions are not merely a background factor, but actively influence how individuals detect and evaluate fake news. Moreover, climate-related conceptions represent an important prerequisite for learning processes (Ohl & Sprenger, 2025).

2.4. Aim of the Study and Research Questions

While existing models and studies provide valuable insights into how adolescents and adults evaluate fake news, there is a notable lack of research focusing on younger learners, particularly in the context of primary education. Conceptions have been shown to play a crucial role in shaping evaluative processes. However, the specific interplay between children's conceptions of climate change, and their ability to critically assess such information, remains largely unexplored.

This gap highlights the need for empirical research that investigates how primary school students evaluate climate-related fake news and what role their conceptions play in this process. The study addresses this by examining the evaluation skills of children in relation to their conceptions of climate change.

The study has two aims: first, to explore students' conceptions of fake news, and second, to analyse their ability to identify and evaluate fake and real news. Particular focus is given to possible connections between students' content-related conceptions and their evaluation competencies. As part of the broader research project (Lämmer et al., 2026, i.p.), students' conceptions of climate change were also examined through 28 interviews and 94 drawings.

The following research questions (RQ) are addressed in this paper:

- RQ1: What conceptions do primary school students have about fake news?
- RQ2: To what extent do primary school students recognise fake news about climate change?
- RQ3: What criteria do students use to evaluate fake news about climate change?
- RQ4: What role do primary students' conceptions of climate change assume in the process of evaluating climate change-related fake news?

3. Materials and Methods

3.1. Methodological Choice and Sample Description

The study employed a qualitative research design to gain an in-depth understanding of students' conceptions and evaluation abilities. Figure 2 provides an overview of the research design and the main steps of the study. Data were collected through problem-centred interviews, designed in accordance with Witzel (1985), Vogl (2021), Trautmann (2010), and Kurz et al. (2007). A total of 28 problem-centred interviews were conducted with students from Years 3 and 4 in Bavaria, Germany, aged between 8 and 11 years (average age: 9.4). These interviews took place at two different schools, both characterised by a heterogeneous student body that reflected a broad range of social and educational backgrounds. All required approvals were obtained, the ethical considerations were reviewed by the responsible committee, and written consent was provided by the parents or legal guardians.

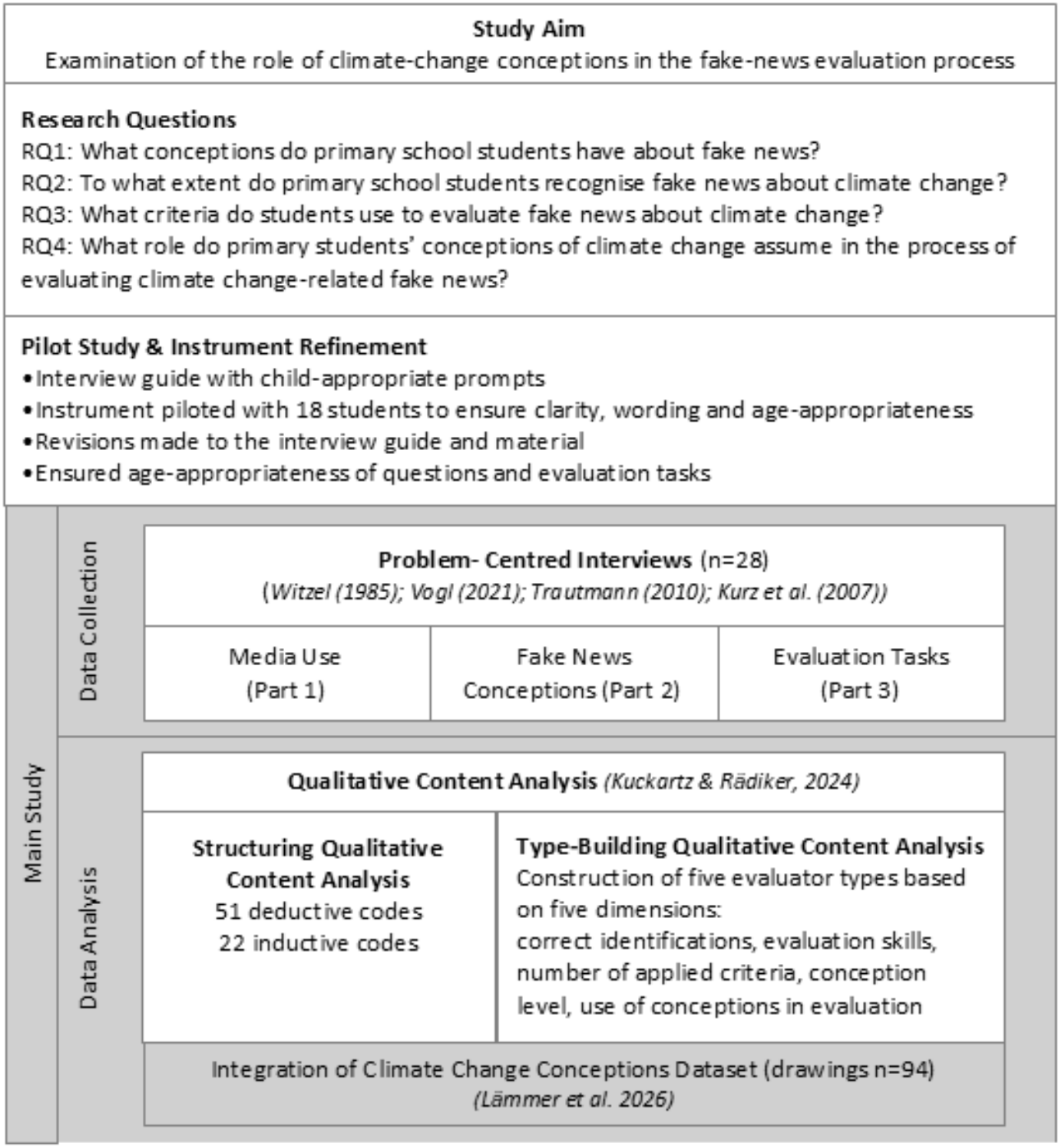

Figure 2. Research Diagram

3.2. Materials

The interview guide (see Supp. Material: Section A, Table A1) for the problem-centred interviews was divided into three sections. The first part focused on the students' media use and their sources of information related to climate change, addressing where and how they obtain information on the topic. The second part explored their conceptions of fake news, including their own explanations and prior experiences with fake news. The third part of the interview was dedicated to the evaluation of fake news. For this purpose, ten different pieces of information about climate change were used as material, comprising both true and false statements. The set included different types of news formats to reflect real-world diversity. The design was inspired by typical adult and child-oriented online environments such as

newspaper websites, Instagram posts, TikTok videos, WhatsApp chats, breaking news headlines, and online search results to ensure realism. The content of these statements covered the causes, characteristics, consequences, and possible actions related to climate change. An example of the material used is shown in Figure 3.

Figure 3. Example of stimulus material used in the interview: Fake News on climate change (self-created); created with Canva Pro. Image sourced from Unsplash (royalty-free)

https://doi.org/10.48088/ejg.s.lam.17.2.016.033

The true and false statements were based on typical examples of news circulating on social media as well as on scientifically verified facts. The true statements were based on actual events, but have been reconstructed and simplified slightly to make them age-appropriate while retaining their original character. The fake news items were constructed using weakened examples of fake news and manipulated according to two main dimensions: (a) content-based manipulations (e.g., false claims, sensationalized headlines, misleading images, spelling mistakes) and (b) intent-based manipulations (e.g., hoaxes, conspiracy theories, clickbait strategies) (Aïmeur et al., 2023). The tablet-supported presentation allowed the students to interactively and playfully assess the news items by pressing "True" or "Fake" buttons. The interviews were audio recorded.

3.3. Data Analysis

A qualitative content analysis according to Kuckartz and Rädiker (2024) was used to analyse the data. This included both structuring qualitative content analysis, which organises the material through a systematically developed category system to identify central themes in students' conceptions and evaluation processes, and type-building qualitative content analysis, which uses the coded material to identify recurring cross-case patterns and to derive characteristic types of how students assess climate-related fake news (Kuckartz & Rädiker, 2024).

The analysis software employed was MaxQDA (VERBI Software, 2024). Categories were developed using a hybrid approach, combining both deductive and inductive coding (see Supp. Material Section B). Deductive codes were derived from theory and resulted in 51 codes (e.g., dealing with fake news, decision criteria and evaluation strategies), while inductive codes emerged from the data and resulted in 22 codes (e.g., uncertainty of [regarding credibility of news] and date of publication).

The empirical approach was closely aligned with the theoretical models outlined above. The evaluation skills according to Gelerstein et al. (2016) served as the coding framework to systematically capture the depth of evaluation in students' responses. This allowed the different levels of information assessment to be represented in accordance with the model. Amazeen's model (2024) was used to provide the theoretical framework for understanding the relationship between evaluation processes and conceptions, and to embed the study within the broader context of evaluation. However, it is important to emphasize that the specific dimensions of Amazeen's model (2024) were not directly measured but rather served as a conceptual reference point.

Findings from a related study on primary students' conceptions of climate change (Lämmer et al., 2026, i.p.) were also incorporated into the analysis to provide context and inform interpretation of the data.To enhance reliability, intercoder reliability was calculated using Cohen's kappa with two independent raters, achieving 85% agreement across 10% of the dataset. This corresponds to an "almost perfect" level of concordance (Brennan & Prediger, 1981).

During the qualitative analysis, it became evident that students' conceptions of climate change and their abilities to evaluate climate-related fake news varied considerably, yet also revealed recurring patterns. In order to systematically capture and interpret these differences, a typology was developed following Kuckartz's approach to qualitative content analysis, with a focus on constructing empirically grounded real types. These real types represent groups of cases that share similar combinations of characteristics across the relevant categories; however, these similarities do not necessarily imply causal relationships Kuckartz & Rädiker, 2024). The typology was based on five key dimensions: the level of climate-related conceptions according to Lämmer et al., i. p. (2026), the extent to which these conceptions were actively used during evaluation, the overall evaluation performance, the number of criteria applied, and the number of fake news correctly identified. Through comparative analysis, students with similar combinations of these features were grouped into distinct types that reflect typical evaluation strategies and levels of conceptual understanding. The types were determined and named in a theory-informed manner and complemented by an additional category for non-typifiable cases, ensuring transparency and accounting for the complexity of the data.

4. Results

4.1. What conceptions do primary school students have about fake news?

Across the interviews, 11 out of 28 students were able to describe characteristics of fake news. Most of these descriptions referred to false information found on the internet and were generally brief and descriptive. A consistent theme across responses was the emphasis on falsity as the core characteristic. For example, student 15 described fake

news as “news that are not true,” while student 2 explained it as “something that is made up or something like that”. A more detailed explanation was provided by student 28: “People go on the internet and pretend to be people who are researching something. Then they create a website and put false information on it”.

While most students focused on written content, a few also mentioned that images and videos can be manipulated, suggesting an emerging awareness of fake news presented in different formats. Only a small number of students referred to artificial intelligence in connection with fake news.

When asked to provide examples of fake news, students named a wide range of topics. To illustrate the conceptual ambiguities in their understanding, these examples can be grouped according to whether they actually qualify as fake news or not. Several responses referred to cases that fit the definition of fake news as they involve unreliable information presented with a false claim to authenticity or fabricated content. These include political rumours, celebrity gossip and made-up stories about people, false claims (in sports contexts), as well as fake news on geographical topics such as misleading reports about wildfires or aircraft sightings. For instance, one student referred to a rumour about a famous football player, stating: “I once heard a fake news that Manuel Neuer was somehow dead. I think that was a fake news on the internet” (student 27). Another student described misleading reports about environmental events and questioned the authenticity of visual material regarding forest fires in Russia. Other examples indicate that students associate fake news with broader forms of deception, particularly in commercial and digital contexts. These involve misleading practices rather than fabricated news stories. For instance, student 14 referred to an ice cream that “looks super awesome in the ad, but isn’t really that great”. Similarly, students mentioned fraudulent online purchases, apps perceived as misleading due to hidden costs or deceptive advertising (e.g., Temu), and digital risks such as financial scams or deceptive messages like the so-called grandchild scam.

One student explained this type of deception as follows: “This also happens, for example, to my mum. They look in the phone book, find some number, and then they just write, ‘Hello Grandpa, I need you, I really need money.’ But you also have to be really lucky to actually reach a grandpa whose child is already grown up and has a grandchild” (student 27). Another student referred to fraudulent messages that imitate official companies, noting: “Your DHL account has been blocked. You have to transfer something important, and it also says, like, quickly. And they also said that it sounds real, and the logo is down in the corner, and it looks real. But it is not real” (student 28).

Some students confused fake news with incorrect information or simple lies. Incorrect weather forecasts were frequently cited, although these do not qualify as fake news because they usually result from prediction errors rather than intentional deception. In addition, a few students referred to everyday lives. For example, student 11 mentioned “claiming to be the best player in a game in the world”, which again illustrates the tendency to conflate fake news with general untruthfulness.

In terms of perceived intentions and motives behind fake news, students offered a range of explanations. Economic motives were frequently mentioned, such as earning money through clicks or online success. As student 20 noted “They earn money, and they think […] they get so many views because so many people believe it. And then they earn money, and keep going and going, although they do not think about the chaos they are causing.” Political motives were also identified, including influencing elections or promoting hostility between countries. Social and psychological reasons such as boredom, fun, provocation, or damaging someone’s reputation were commonly cited by the students, for example, one student said, “just for fun and on purpose” (student 9). Some students recognised the intent to harm individuals or the environment, for example, one student stated, “because they want to mess with people. Because they don’t have anything else as a hobby” (student 22), and another said, “to harm the environment” (student 3). Notably, one student distinguished between intentional and accidental fake news, indicating that even unintentional false information was perceived as fake news.

4.2. To what extent do primary school students recognise fake news about climate change?

The study reveals that primary school students are capable of identifying fake news related to climate change to a considerable extent: approximately 70% of the assessments made by students were correct. Notably, no significant differences were observed in recognition rates across different content categories of climate change (characteristics, causes, consequences, possible actions).

However, a closer qualitative analysis shows that recognition varied substantially between individual items. Strongly simplified or obviously false statements, such as “climate change does not exist”, were identified as fake news by most of the participants. In contrast, items that appeared plausible or were linked to everyday experiences, such as

"cold winter proof - climate change is fake", were much more difficult to evaluate correctly and were often accepted as true. Content-based manipulations (e.g., false claims, sensationalised headlines) were generally easier for participants to detect than intent-based manipulations such as conspiracy framing or clickbait strategies.

The study provides indications that media use emerges as another relevant factor. Children who reported controlled and limited media use demonstrated a more critical stance toward online information, while those with intensive media exposure were more likely to accept familiar claims without questioning their accuracy. Approximately half of the respondents stated that they had previously read about climate change online.

4.3. What criteria do students use to evaluate fake news about climate change?

Table 1 summarises the main decision criteria applied by primary school students when evaluating fake news. These criteria can be grouped into six categories, ranging from conceptual alignment and linguistic indicators to source credibility. The examples illustrate how students justified their decisions during the interviews, revealing a mix of analytical checks and intuitive judgements.

When considering the frequencies of these decision criteria and the associated reasoning processes, several patterns become evident. Logical inconsistencies were identified most frequently, followed by references to the source, with some students explicitly associating the researcher with trustworthy information. A similar number of students relied on features of the photograph in their justifications, and advertising cues also played a particularly prominent role in their reasoning. Overall, the findings indicate that the category of conceptual alignment was especially influential in students' evaluations of (fake) news. Further connections between students' conceptions and the decision criteria they applied become particularly evident in Section 4.4.

Table 1. Criteria Used by Primary Students to Evaluate (Fake) News about Climate Change

Category	Typical Criteria	Example quote from the interviews
Conceptual Alignment	Plausibility check ("Could this be true?"); unrealistic details; logical consistency; strength of claims (extreme vs. subtle)	*"I think it's fake because polar bears live where there's loads of snow." (student 24)*
Linguistic and Stylistic Indicators	Spelling or grammar mistakes; exaggerated statements; unusually fast publication	*"Whoever wrote this spelt 'cows' wrong, and 'them' too. […] No, I don't believe that!" (student 15)*
Source Credibility	Trustworthiness of source; reference to experts; presence of advertising; suspicion of AI-generated content	*"That's true because scientists don't lie." (student 2)*
Media Features	Authenticity of images or videos; mismatch between visuals and text	*"The picture doesn't look like it was edited by AI. So I think it's true." (student 20)*
Emotional and Intuitive Judgement	Reliance on gut feeling; personality-driven decisions; lack of systematic re-reading	*"I've got a feeling it's wrong." (student 26)*
Handling Uncertainty and Social Behaviour	Cross-checking with other sources; asking trusted persons; confusion caused by the term "fact", as it usually signals truth; decision not to forward fake news	*"No I would not share that message, because that would be really silly, because then everyone would get scared." (student 8)*

https://doi.org/10.48088/ejg.s.lam.17.2.016.033

4.4. What role do primary students' conceptions of climate change assume in the process of evaluating climate change-related fake news?

To explore potential connections between students' conceptions of climate change and their ability to evaluate climate change-related fake news, five types were derived from the data (see Table 2). These types combine the dimensions described in section 3.3 and represent characteristic patterns of conceptions and evaluation ability.

Table 2. Types of Primary School Students in Evaluating Climate Change (Fake) News Derived from Five Dimensions

	Five Key Dimensions					
Type	**Amount of correctly identified news (0-10)**	**Evaluation Skills (1-3) assessed according to Gelerstein et al. (2016)***	**Amount of Evaluation Criteria**	**Conceptions of climate change (learning progression level) according to Lämmer et al. (2026, i. p.)**	**Recourse to Conceptions**	**Number of Students**
Type 1: Uncritical acceptors	0-2	1	1-3	No conceptions**	No	2
Type 2: Intuitive evaluators	6-9	1;2	3-8	No, naive or pre-structured conceptions	No	9
Type 3: Emerging reflective evaluators	6-10	1;2	4-9	No, naive or pre-structured conceptions	Yes	4
Type 4: Strategic evaluators	6-10	1;2	9-12	Naive conceptions	Yes	4
Type 5: Conceptions-based evaluator	6-10	2;3	6-10	Initial subject-specific frameworks or interconnected and sophisticated conceptions	Yes	7
Non-classifiable special cases						2

*Evaluation skills (1–3) assessed according to Gelerstein et al. (2016): 1 = assessing claims, 2 = assessing arguments, 3 = assessing alternatives; these levels are explained in more detail in Section 2.2.
**"No conceptions" refers to cases in which students provided no statements or drawings related to climate change, even after prompting, making it impossible to identify any coherent or interpretable conception; for further details see (Lämmer et al., 2026, i.p.).

Across all types, evaluation behaviour appears to be influenced by conceptions to varying degrees.

Type 1: Uncritical acceptors correctly identify almost no news items and accept information without applying explicit evaluative criteria. Student 1, for example, says during the evaluation, "I've never heard of that. I don't know". This is interpreted as an indication that no further reasoning or concrete evaluation criteria (e.g., source credibility, plausibility, evidence) are actively applied in the decision-making process.

Type 2: Intuitive evaluators represent students who evaluate highly intuitively, often guided by personal feelings rather than conceptions. They rarely draw on conceptions and apply only a few decision criteria, which limits the depth of their evaluation; for example, student 26 says during the evaluation, "I have a feeling that's wrong".

Type 3: Emerging reflective evaluators show emerging reflective tendencies: these students possess only limited conceptions of climate change but actively draw on them and apply a medium number of decision criteria. Student 10 explained "A harsh winter with lots of snow. That shows that the Earth isn't warming. But the Earth can still warm up

even when there is snow and sometimes the sun comes out". This group appears to be in a transitional stage toward more sophisticated evaluation behaviour, potentially evolving into type 4 or type 5.

Type 4: Strategic evaluators demonstrate that strong evaluation skills can occur even with limited conceptions, suggesting that strategic approaches may compensate for conceptual gaps. Student 8 said, "I know the website, and there aren't any spelling mistakes. So that's true".

Type 5: Conceptions-based evaluators: Students with interconnected and sophisticated conceptions tend to apply more criteria and reference sources, which supports accurate evaluation of fake news; for example, student 23 noted, "I know that chimneys make the air dirty, and that also makes it get warmer. That's why that's fake". Notably, this was the only type that reached level 3 ("assessing alternatives") according to Gelerstein et al. (2016).

Across all types, signs of uncertainty showed during the interviews, such as hesitation or comments. When uncertain, most students preferred to ask a trusted person for help, while only a few attempted to cross-check information online. It can be assumed that when students lack the ability to identify information problems based on their conceptions due to language or reading limitations, they tend to adopt one of two approaches: either a criterial evaluation strategy or an intuitive, feeling-based evaluation.

5. Discussion

The findings provide important insights into how primary school students evaluate climate-related fake news and the role of their conceptions in this process.

With regard to children's conceptions of fake news (RQ1), our results confirm earlier research showing that primary school students typically understand fake news mainly as "false information" (Lämmer & Ohl, 2024). The broad range of examples students cited, from political rumours to commercial deception, also indicates a more differentiated and multifaceted conception of fake news than commonly assumed in literature. At the same time, the data reveal new aspects: unlike most previous studies, several students in our sample articulated motives behind fake news (e.g., economic gain, manipulation), and a few even referred to AI-generated content, an emerging awareness not yet documented for this age group.

With regard to students' ability to identify fake news (RQ2), our findings largely align with earlier research (Pilgrim et al., 2019; Einav et al., 2020) primary school children were able to recognise a substantial proportion of false information, yet struggled particularly with items that appeared plausible or were closely linked to everyday experiences (Paul et al., 2019).

With regard to the criteria students use when evaluating fake news (RQ3), our findings support earlier studies indicating that children rely primarily on simple, surface-level indicators such as implausibility, stylistic errors, or exaggeration (Pilgrim & Vasinda, 2021; Xu et al., 2018). However, our results also show that intuitive judgments, often described as a limiting factor, can, in some cases, function as effective heuristics, enabling accurate evaluations even when conceptual knowledge is limited. This highlights both continuity with previous findings and a more nuanced understanding of how decision criteria operate in primary school contexts.

Overall, the evaluation strategies observed align with Amazeen's (2024) Misinformation Recognition and Response Model, but not all elements of the model could be considered in the study. With regard to the role of conceptions (RQ4), the initial step of informational problem identification proved particularly relevant. Students frequently compared presented information with their prior conceptions of climate change to varying degrees. When inconsistencies were detected, they engaged in deeper evaluation with more criteria, which confirms Amazeen's model assumption that recognition occurs as a result of perceived contradictions. Importantly, due to the methodological design of this study, we did not observe any evidence of a backfire effect. However, the results suggest that conceptions should be considered as a distinct and influential factor within the model, rather than being implicitly included within dispositional variables which include age, education, ideology, need for cognition, and motivational goals.

The evaluation types identified in this study further illustrate the heterogeneity of the evaluation approaches. For instance, type 5 (conceptions-based evaluators) demonstrates sophisticated conceptions and applies multiple criteria, whereas type 1 (uncritical acceptors) lacks conceptions and hardly recognises any news correctly. Interestingly, type 4 (strategic evaluators) identifies many news items correctly despite limited conceptions, indicating that strategic approaches can compensate for conceptual gaps. This finding underscores the significant role of the heuristics discussed in chapters 2.2 and 2.3, as they appear to function as compensatory mechanisms that enable effective information evaluation even in the absence of comprehensive conceptions.

https://doi.org/10.48088/ejg.s.lam.17.2.016.033

The assumption that well-developed conceptions alone guarantee effective evaluation can be questioned. Instead, it points to a more complex interaction between conceptions and strategic reasoning, where heuristics play a key role. These heuristics act as mental shortcuts that help learners bridge gaps in their understanding and still make plausible judgments.

Previous research has primarily highlighted the importance of media literacy and critical thinking skills for detecting fake news (Hintermann et al., 2020; Lutzke et al., 2019; Pilgrim et al., 2019). Our study extends this perspective by providing empirical evidence on the role of primary school students' conceptions of climate change in the evaluation process. The findings show that these conceptions play a significant role, particularly in guiding plausibility checks and logical reasoning during the assessment of information. At the same time, the finding that some students rely heavily on intuitive judgments echoes earlier studies on adolescents' heuristic-based evaluation (Lewandowsky et al., 2017).

The results suggest that existing theoretical models should integrate conceptions more explicitly as a factor influencing evaluation. While Amazeen's model (2024) provides a valuable framework, our data indicate that conceptions not only shape recognition but also affect the depth and quality of subsequent evaluation steps. Furthermore, the five evaluation types point to potential developmental trajectories. The study showed this for type 3. Students of type 3 (Emerging reflective evaluators) appear to be in a transitional phase toward more advanced evaluation skills. This suggests that their development could provide valuable insights for future research on how evaluation abilities progress over time.

6. Conclusions

6.1. Limitations and Future Directions

Several limitations need to be considered when interpreting the findings. First, the methodological design was strongly oriented toward students' conceptions, which may have influenced the students' evaluation process. By explicitly asking students to justify their decisions, the interviews might have prompted them to draw more heavily on their conceptions than they would in spontaneous online contexts.

Second, as the data analysis showed in retrospect, the extent to which the interviewer followed up on students' statements varied across interviews, which may have influenced the depth of their responses. Some students were encouraged to elaborate more than others, which could have introduced variability in the data.

Third, individual differences in personality and decision-making speed may have influenced the evaluation process. Fourth, the stimulus material was designed to appear highly authentic, which may explain why visual features such as image manipulation were rarely mentioned as evaluation criteria. Finally, the binary judgment format ("True" vs. "Fake") does not capture the complexity of real-world evaluation, where credibility often exists on a continuum. Future research could consider more nuanced assessment formats to better reflect authentic decision-making processes.

Fourth, the evaluation task was administered after the interviewees had already discussed fake news in detail, which likely made them more attentive and critical than they would be in everyday encounters with fake news; this sequencing should therefore be considered a limitation of the study.

Fifth, we were not permitted to collect any additional demographic data in this study and were therefore unable to consider such variables in the data analysis.

Further studies should employ larger samples to enable quantitative analyses of the relationship between conceptions and evaluation skills. Future research could also examine the specific role of climate-related misconceptions in evaluation processes, given their documented prevalence and influence on students' geographical understanding (Škodová et al., 2025). Expanding the focus beyond climate change to other geography-related topics could reveal whether the observed patterns are topic-specific or more widely applicable. Longitudinal designs could clarify whether the identified types represent developmental stages. Additionally, exploring correlations between fake news evaluation and other cognitive abilities would provide valuable insights into underlying competencies.

6.2. Implications of the Results for Geography Teaching Practice

The findings have implications not only for geography education, but also for climate change education, education for sustainable development, and for teaching contexts that address SSI. First, the observed diversity of evaluation types indicates that students do not approach information in a uniform way; rather, they employ strategies ranging from

https://doi.org/10.48088/ejg.s.lam.17.2.016.033

intuitive judgments to systematic reasoning. This variability means that a one-size-fits-all approach in teaching evaluation skills is insufficient. Teachers should therefore recognise that students differ not only in their conceptual understanding of climate change but also in how they assess the credibility and plausibility of information. It is essential to make students aware of why evaluating information matters.

To address this, instructional design should integrate two complementary components: (1) conceptual development, ensuring that students build scientifically accurate and interconnected conceptions about climate change, and

(2) explicit training in critical evaluation skills, such as checking source credibility, identifying reasoning errors, and applying plausibility checks. These components should not be taught in isolation; rather, they need to be integrated so that students learn to use their conceptions as a resource when evaluating information.

Teachers may need to provide varied scaffolds and tasks that address different levels of evaluation abilities. For example, some students might benefit from guided discussions using structured criteria, while others could engage in more autonomous analysis of information sources. This approach ensures that all learners, regardless of their starting point, develop both robust conceptions and the ability to critically engage with socio-scientific issues such as climate change.

Evidence-based strategies can further strengthen these efforts. According to Ecker et al. (2022), two approaches are particularly promising even at the primary school level: prebunking (pre-emptive intervention) and debunking (reactive intervention). Prebunking involves exposing students to weakened examples of fake news and explaining typical reasoning errors before they encounter false information in real contexts. This approach, grounded in inoculation theory, has proven effective in increasing resilience to fake news (van der Linden et al., 2017; Cook et al., 2018). In primary education, such interventions can be implemented through playful activities, such as evaluating age-appropriate fake news examples on climate change, expressing assumptions, and discussing why they are misleading.

Since many students rely on intuitive judgments, explicit instruction in systematic evaluation criteria (e.g., source credibility, plausibility checks) is essential. Finally, the strong link between conceptions and evaluation observed in this study highlights the importance of developing scientifically accurate and interconnected conceptions of climate change. Lessons should therefore integrate content learning with evaluation training, enabling students to use their conceptions as a resource for evaluating information.

In our study, the fake news examples used were deliberately designed as weakened examples. The findings indicate that these examples were highly effective in initiating reflection processes: they provided a coherent anchor for students to think about the phenomenon of fake news and enabled them to identify criteria that are helpful for evaluation. Consequently, weakened examples appear particularly suitable for training these evaluation skills in geography education. In addition, action-oriented approaches could further support this learning process. For instance, having students create their own fake news could prompt them to apply evaluation criteria and draw on their conceptions, thereby offering an action-oriented opportunity to foster relevant skills.

Teaching practice should also consider the role of artificial intelligence (AI). AI-based tools can support students in evaluating fake news. Integrating such technologies can make evaluation training more authentic and prepare learners for digital information environments. This is particularly relevant as current AI applications in geography focus predominantly on physical and technical analyses, while evaluative and cognitively oriented processes remain largely unexplored (Oğlakcı & Uzun, 2025).

In a broader perspective, the ability to detect fake news can be seen as a preparatory step toward more advanced competencies required in secondary education and beyond, where students must deal with SSI and therefore not only distinguish between true and false information but also evaluate the quality of sources on a continuous scale.

Overall, these results underline that geography teaching must respond to the increasing uncertainty that characterises today's information environments. Students are confronted not only with incomplete or contradictory explanations but also with fake news that deliberately distort climate-related evidence. Preparing learners for these conditions is essential for powerful teaching in a world in transition: students need opportunities to practise navigating ambiguity, identifying misleading claims, and grounding their judgments in scientifically accurate conceptions.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

https://doi.org/10.48088/ejg.s.lam.17.2.016.033

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: During the preparation of this work, the author(s) used Microsoft Copilot, ChatGPT and DeepL to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article

Acknowledgments: This article forms part of the Special Issue (SI_TGEO), Teaching Geography for a World in Transition. Powerful Teaching in Uncertain Times, published in the European Journal of Geography. The Special Issue draws inspiration from the 2026 EUROGEO Conference, held in Tilburg, The Netherlands, 21 to 22 May 2026. The collection brings together research on geography education and geographical inquiry, with a focus on powerful geographical knowledge, spatial thinking, and critical, future oriented pedagogies. Contributions address key transformations shaping contemporary geography, including deglobalisation, multipolar world orders, postcolonial critique, contested knowledge and places, and the integration of artificial intelligence in educational practice and research. The Special Issue is edited by **Dr. Neli Heidari**, University of Bremen, Germany, **Dr. Uwe Krause**, Fontys University of Applied Sciences, The Netherlands, **Dr. Susan Caldis**, Macquarie University, Australia, **Prof. Tine Beneker**, Utrecht University, The Netherlands, and **Dr. Alexandros Bartzokas-Tsiompras**, National Technical University of Athens, Greece, & Associate Editor of the European Journal of Geography.

Contribution to the Special Issue Topics: This study contributes to the Special Issue by addressing how young learners navigate epistemic uncertainty and mis- and disinformation in complex socio-scientific issues. By examining primary students' conceptions and their evaluation of climate-related fake news, the paper advances understanding of teaching controversial topics and supports approaches that strengthen critical thinking and powerful geographical knowledge in times of digital disruption and societal transition.

Supplementary Material: Available on the journal's website.

References

Adamina, M. (2008). *Vorstellungen von Schülerinnen und Schülern zu raum-, zeit- und geschichtsbezogenen Themen: Eine explorative Studie in Klassen des 1., 3., 5. und 7. Schuljahres im Kanton Bern* [Dissertation, Universität Münster]. https://nbn-resolving.de/urn:nbn:de:hbz:6-34589370206

Aïmeur, E., Amri, S., & Brassard, G. (2023). *Fake news, disinformation and misinformation in social media: A review. Social Network Analysis and Mining*, 13(1), 1–36. https://doi.org/10.1007/s13278-023-01028-5

Amazeen, M. A. (2024). *The misinformation recognition and response model: An emerging theoretical framework for investigating antecedents to and consequences of misinformation recognition.* Human Communication Research, 50(2), 218–229. https://doi.org/10.1093/hcr/hqad040

Babii, A.-N. (2020). *The use of critical thinking against fake news.* In Proceedings of the NORDSCI Conference (pp. 127–135). http://www.nordsci.org

Beer, D. de, & Matthee, M. (2021). *Approaches to identify fake news: A systematic literature review.* In T. Antipova (Ed.), Integrated science in digital age 2020 (Lecture Notes in Networks and Systems, 136, pp. 13–22). Springer International Publishing. https://doi.org/10.1007/978-3-030-49264-9_2

Brennan, R. L., & Prediger, D. J. (1981). *Coefficient kappa: Some uses, misuses, and alternatives.* Educational and Psychological Measurement, 41, 687–699. https://doi.org/10.1177/001316448104100307

Cambridge International Education. (2025). *Developing the skills to tackle climate change.* https://www.cambridgeinternational.org/why-choose-us/benefits-of-a-cambridge-education/climate-change-education/supporting-cambridge-schools/developing-the-skills-to-tackle-climate-change/

Canva. (2025). Canva Pro [Design software]. Canva. https://www.canva.com

Cook, J., Ellerton, P., & Kinkead, D. (2018). *Deconstructing climate misinformation to identify reasoning errors.* Environmental Research Letters, 13(2), 24018. https://doi.org/10.1088/1748-9326/aaa49f

Divasson-J, A., Aguayo-Mendoza, A., Quesada, C., Casado-Mansilla, D., & Borges, C. E. (2025). *Climate change from B to Z: A cross-generational perception study in Spain.* Frontiers in Environmental Science, 13, Article 1511398. https://doi.org/10.3389/fenvs.2025.1511398

Duit, R. (1997*). Alltagsvorstellungen und Konzeptwechsel im naturwissenschaftlichen Unterricht – Forschungsstand und Perspektiven für den Sachunterricht in der Primarstufe.* In W. Köhnlein (Hrsg.), Kinder auf dem Wege zum Verstehen von Welt (S. 233–246). Klinkhardt.

Dumitru, E.-A. (2020). *Testing children and adolescents' ability to identify fake news: A combined design of quasi-experiment and group discussions.* Societies, 10(3), 71. https://doi.org/10.3390/soc10030071

Ecker, U. K. H., Lewandowsky, S., Cook, J., Schmid, P., Fazio, L. K., Brashier, N., Kendeou, P., Vraga, E. K., & Amazeen, M. A. (2022). *The psychological drivers of misinformation belief and its resistance to correction.* Nature Reviews Psychology, 1(1), 13–29. https://doi.org/10.1038/s44159-021-00006-y

Einav, S., Levey, A., Patel, P., & Westwood, A. (2020). *Epistemic vigilance online: Textual inaccuracy and children's selective trust in webpages. British Journal of Developmental Psychology*, 38(4), 566–579. https://doi.org/10.1111/bjdp.12335

Einsiedler, W. (1997). *Probleme und Ergebnisse der empirischen Sachunterrichtsforschung.* In B. Marquardt-Mau et al. (Hrsg.), Forschung zum Sachunterricht: Probleme und Perspektiven des Sachunterrichts (Bd. 7, S. 18–42). Klinkhardt.

Facione, P. (1989). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction* (The complete American Philosophical Association Delphi research report, pp. 1–21).

Garrett, R. K., & Weeks, B. E. (2017). *Epistemic beliefs' role in promoting misperceptions and conspiracist ideation.* PLOS ONE, 12(9), e0184733. https://doi.org/10.1371/journal.pone.0184733

Gelerstein, D., Del Río, R., Nussbaum, M., Chiuminatto, P., & López, X. (2016). *Designing and implementing a test for measuring critical thinking in primary school.* Thinking Skills and Creativity, 20, 40–49. https://doi.org/10.1016/j.tsc.2016.02.002

Girg, R. (1994). *Die Bedeutung des Vorverständnisses der Schüler für den Unterricht: Eine Untersuchung zur Didaktik.* Klinkhardt.

Hague, C., & Bouckaert, M. (2022). *Creativity, critical thinking & climate education for the green transition.* https://oecdedutoday.com/creativity-and-climate-education/

Hintermann, C., Bergmeister, F. M., & Kessel, V. A. (2020). *Critical geographic media literacy in geography education: Findings from the MiDENTITY project in Austria.* Journal of Geography, 119(4), 115–126. https://doi.org/10.1080/00221341.2020.1761430

Housand, B. C. (2021). *Fighting fake news! Grades 4–6: Teaching critical thinking and media literacy in a digital age.* Routledge. https://doi.org/10.4324/9781003235200

Kaiser, A., & Milhoffer, P. (1997). *Mädchen und Jungen – ihre Selbstwahrnehmung und ihr Zugang zur Welt.* In W. Köhnlein et al. (Hrsg.), Kinder auf dem Wege zum Verstehen von Welt (Forschungen zur Didaktik des Sachunterrichts, Bd. 1, S. 90–109). Klinkhardt.

Kops, M., Schittenhelm, C., & Wachs, S. (2025). *Young people and false information: A scoping review of responses, influential factors, consequences, and prevention programs.* Computers in Human Behavior, 169, 108650. https://doi.org/10.1016/j.chb.2025.108650

Kuckartz, U., & Rädiker, S. (2024). *Qualitative Inhaltsanalyse: Methoden, Praxis, Umsetzung mit Software und künstlicher Intelligenz* (6. Auflage). Juventa Verlag. https://nbn-resolving.org/urn:nbn:de:bsz:31-epflicht-3155932

Lämmer, S., & Ohl, U. (2024). *Facts and fakes – A systematic literature review on how primary school students deal with fake news from the perspective of geography education.* International Research in Geographical and Environmental Education, 1–19. https://doi.org/10.1080/10382046.2024.2438061 511

Lämmer, S., Schuster, E., & Ohl, U. (in press). *The planet is broken – A qualitative cross-sectional study on elementary school students' conceptions of climate change.* In M. Beudels & C. Henrichwark (Eds.), Vorstellungen von Kindern zu Themenfeldern der Nachhaltigkeit (pp. 1–14). Julius Klinkhardt.

Lewandowsky, S., Ecker, U. K. H., & Cook, J. (2017). *Beyond misinformation: Understanding and coping with the "post-truth" era.* Journal of Applied Research in Memory and Cognition, 6(4), 353–369. https://doi.org/10.1016/j.jarmac.2017.07.008

Loos, E., Ivan, L., & Leu, D. (2018). *"Save the Pacific Northwest tree octopus": A hoax revisited.* Information and Learning Science, 119(9/10), 514–528. https://doi.org/10.1108/ILS-04-2018-0031

Lutzke, L., Drummond, C., Slovic, P., & Árvai, J. (2019). *Priming critical thinking: Simple interventions limit the influence of fake news about climate change on Facebook.* Global Environmental Change, 58, 101964. https://doi.org/10.1016/j.gloenvcha.2019.101964

Machete, P., & Turpin, M. (2020). *The use of critical thinking to identify fake news: A systematic literature review.* In Birukou & Hattingh (Eds.), Responsible design, implementation and use of information and communication technology (Lecture Notes in Computer Science, Vol. 12067, pp. 235–246). Springer International Publishing. https://doi.org/10.1007/978-3-030-45002-1_20

McGrew, S., Breakstone, J., Ortega, T., Smith, M., & Wineburg, S. (2018). *Can students evaluate online sources? Learning from assessments of civic online reasoning.* Theory & Research in Social Education, 46(2), 165–193. https://doi.org/10.1080/00933104.2017.1416320

Mendoza, G. A. S., Ballar, K. J., Yap, J. K., & Deinla, I. B. (2024). *Accuracy or confidence? Analyzing the impact of online misinformation on Filipino youth voting likelihood.* Media Asia, 51(3), 470–488. https://doi.org/10.1080/01296612.2023.2279343

Möller, K. (1999). *Konstruktivistisch orientierte Lehr Lernprozessforschung im naturwissenschaftlich-technischen Bereich des Sachunterrichts.* In W. Köhnlein (Hrsg.), Vielperspektivisches Denken im Sachunterricht (Forschungen zur Didaktik des Sachunterrichts, Bd. 3, S. 125–191). Klinkhardt.

Morote, Á.-F., & Hernández, M. (2024). *Knowledge and perception of Spanish school children of climate change.* Children's Geographies, 22(3), 465–479. https://doi.org/10.1080/14733285.2024.2303581

Niedderer, H. (1988). *Schülervorverständnis und historisch-genetisches Lernen.* In K. H. Wiebel (Hrsg.), Zur Didaktik der Physik und Chemie: Probleme und Perspektiven (S. 76–107). Leuchtturm.

Nygren, T., Guath, M., Axelsson, C.-A. W., & Frau Meigs, D. (2021). *Combatting visual fake news with a professional fact checking tool in education in France, Romania, Spain and Sweden.* Information, 12(5), 201. https://doi.org/10.3390/info12050201

Nyhan, B., & Reifler, J. (2010). *When corrections fail: The persistence of political misperceptions.* Political Behavior, 32(2), 303–330. https://doi.org/10.1007/s11109-010-9112-2

Oğlakcı, B., & Uzun, A. (2025). *A decade of artificial intelligence (AI) and geography: Bibliometric insights with AI-powered analysis.* European Journal of Geography, 16(2), 372–392. https://doi.org/10.48088/ejg.b.ogl.16.2.372.392

Ohl, U., & Sprenger, S. (2025). *Klimabildung im Schulfach Geographie und in der geographiedidaktischen Forschung.* In D. Höttecke, S. Heinicke, 541 H. Martens, A. Nehring, & T. Rabe (Eds.), Handbuch Klimabildung (pp. 141–164). Springer VS; Springer Fachmedien Wiesbaden GmbH. 542 https://doi.org/10.1007/978-3-658-48374-6_7

O'Mahony, C., Brassil, M., Murphy, G., & Linehan, C. (2023). *The efficacy of interventions in reducing belief in conspiracy theories: A systematic review.* PLOS ONE, 18(4), e0280902. https://doi.org/10.1371/journal.pone.0280902

Paskin, D. (2018). *Real or fake news: Who knows?* The Journal of Social Media in Society, 7, Article 2.

Paul, J., Stadtler, M., & Bromme, R. (2019). *Effects of a sourcing prompt and conflicts in reading materials on elementary students' use of source information.* Discourse Processes, 56(2), 155–169. https://doi.org/10.1080/0163853X.2017.1402165

Pilgrim, J., Vasinda, S., Bledsoe, C., & Martinez, E. (2019). *Critical thinking is critical: Octopuses, online sources, and reliability reasoning.* The Reading Teacher, 73(1), 85–93. https://doi.org/10.1002/trtr.1800

Pilgrim, J., & Vasinda, S. (2021). *Fake news and the "wild wide web": A study of elementary students' reliability reasoning.* Societies, 11(4), 121. https://doi.org/10.3390/soc11040121

Poortinga, W., Demski, C., & Steentjes, K. (2023). *Generational differences in climate-related beliefs, risk perceptions and emotions in the UK.* Communications Earth & Environment, 4(1). https://doi.org/10.1038/s43247-023-00870-x

Rijo, A., & Waldzus, S. (2023). *That's interesting! The role of epistemic emotions and perceived credibility in the relation between prior beliefs and susceptibility to fake news.* Computers in Human Behavior, 141, 107619. https://doi.org/10.1016/j.chb.2022.107619

Scheufele, D. A., & Krause, N. M. (2019). *Science audiences, misinformation, and fake news.* Proceedings of the National Academy of Sciences, 116(16), 7662–7669. https://doi.org/10.1073/pnas.1805871115

Shepardson, D. P., Roychoudhury, A., & Hirsch, A. S. (Eds.). (2017). *Teaching and learning about climate change.* Routledge. https://doi.org/10.4324/9781315629841

Sjöblom, P., Wolff, L.-A., Vuorenpää, S., & Grahn, R. (2022). *Primary school students and climate change: An interview study in Finland and Tanzania.* Journal of Cleaner Production, 380, 135099. https://doi.org/10.1016/j.jclepro.2022.135099

Skeirytė, A., Krikštolaitis, R., & Liobikienė, G. (2022). *The differences of climate change perception, responsibility and climate-friendly behavior among generations and the main determinants of youth's climate-friendly actions in the EU.* Journal of Environmental Management, 323, 116277. https://doi.org/10.1016/j.jenvman.2022.116277

Škodová, M., Madleňák, T., & Mihoková, M. (2025). *Critical spots and misconceptions in students' understanding of problems and challenges in Europe.* European Journal of Geography, 16(2), 406–418. https://doi.org/10.48088/ejg.m.sko.16.2.406.418

Swim, J. K., Aviste, R., Lengieza, M. L., & Fasano, C. J. (2022). *OK boomer: A decade of generational differences in feelings about climate change.* Global Environmental Change, 73, 102479. https://doi.org/10.1016/j.gloenvcha.2022.102479

Trott, C. D., Lam, S., Roncker, J., Gray, E.-S., Courtney, R. H., & Even, T. L. (2023). *Justice in climate change education: A systematic review.* Environmental Education Research, 29(11), 1535–1572. https://doi.org/10.1080/13504622.2023.2181265

Unsplash. (2019). Hochhäuser unter Wolken [Photograph]. https://unsplash.com/de/fotos/hochhauser-unter-wolken-vePJsyzbLwQ

Valverde Berrocoso, J., González Fernández, A., & Acevedo Borrega, J. (2022). *Disinformation and multiliteracy: A systematic review of the literature: Desinformación y multialfabetización: Una revisión sistemática de la literatura.* Comunicar, 93–105. https://doi.org/10.3916/C70-2022-08

van der Linden, S., Leiserowitz, A., Rosenthal, S., & Maibach, E. (2017). *Inoculating the public against misinformation about climate change.* Global Challenges, 1(2), 1600008. https://doi.org/10.1002/gch2.201600008

van Helvoort, J., & Hermans, M. (2020). *Effectiveness of educational approaches to elementary school pupils (11 or 12 years old) to combat fake news.* Media Literacy and Academic Research, 38–47. https://www.mlar.sk/wp-content/uploads/2020/12/3_Helvoort_Hermans.pdf

VERBI Software. (2024). *MAXQDA 2024* [Computer software]. VERBI Software. Consult. Sozialforschung GmbH. https://www.maxqda.com

Verhalle, P., & Loos, E. (2025). *Fighting disinformation: How to measure the impact of pre- and debunking on Dutch primary school children's media literacy?* Societies, 15(6), 155. https://doi.org/10.3390/soc15060155

Wang, M. B., & Akin, H. (2025). *Effects of epistemic beliefs, science populism, and social media use on climate change misperceptions.* Public Understanding of Science. Advance online publication. https://doi.org/10.1177/09636625251343510

Wildbichler, S., Haagen-Schützenhöfer, C., & Schubatzky, T. (2025). *Students' ideas about the scientific underpinnings of climate change: A systematic review of the literature.* Studies in Science Education, 61(1), 117–169. https://doi.org/10.1080/03057267.2024.2395206

Xu, S., Shtulman, A., & Young, A. (2022). *Can children detect fake news? Proceedings of the Annual Meeting of the Cognitive Science Society*, 44. Retrieved from https://escholarship.org/uc/item/9bh2z1q9

Zeidler, D. L., & Nichols, B. H. (2009). *Socioscientific issues: Theory and practice.* Journal of Elementary Science Education, 21(2), 49–58. https://doi.org/10.1007/BF03173684

Zhang, S., & Duke, N. K. (2011). *The impact of instruction in the WWWDOT framework on students' disposition and ability to evaluate web sites as sources of information.* The Elementary School Journal, 112(1), 132–154. https://doi.org/10.1086/660687

Zimmermann, F., & Kohring, M. (2018). *„Fake News" als aktuelle Desinformation: Systematische Bestimmung eines heterogenen Begriffs.* Medien & Kommunikationswissenschaft, 66(4), 526–541. https://doi.org/10.5771/1615-634X-2018-4-526