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Pre-service teachers' search strategies when sourcing educational information on the Internet

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Teachers need to be able to inform and justify their teaching practice based on available research knowledge. When searching for research knowledge, the Internet plays a crucial role as it allows teachers to search for and access evidence long after their own education at university. On the Internet, however, educational information can have varying levels of scientific groundedness (e.g., science articles or blogs from colleagues), and research indicates that (pre-service) teachers struggle to find, select, and evaluate online educational information. It is precisely for this reason that it is important to educate (pre-service) teachers on how to competently source online information. This study describes pre-service teachers' search strategies when sourcing online educational information about the topic "students' use of mobile phones in class." It sheds light on their use of (1) basic or advanced search strategies and (2) the role of Internet-specific epistemological beliefs (ISEBs). *N* = 77 pre-service teachers conducted a realistic search on the Internet and selected those web items (WI) that they perceived relevant for justifying whether mobile phones should be used in class. Their sourcing behavior was screen-recorded and analyzed. Most selected WI were found via search engines of Google LLC (91.4%). Advanced search strategies were defined as (1) using two or more search engines (performed by 62.3% of participants), (2) adapting search terms and/or formulating new search terms (90.9%), (3) selecting at least one WI that was not listed among the first four ranks on the first search engine results page (54.7%), and (4) checking for the trustworthiness of the author/source (14.3%) or the quality of the content (13%). Binary logistic regressions were used to analyze the relationship between ISEBs and (1) search strategies and (2) science-relatedness of WI as dependent variables. The predictor ISEB did not contribute to the models,

meaning that differences in participants' ISEBs did not significantly relate to their search strategies nor to the science-relatedness of WI, all $\beta \leq |0.36|$, $Wald \leq 0.64$, $p \geq 0.43$. The role of pre-service teachers' search strategies is discussed with respect to teachers' evidence-informed reasoning and its implications for teacher education.

KEYWORDS

pre-service teachers, evidence, search strategies online, sourcing competencies online, Internet-specific epistemological beliefs

Introduction

During their professional lives, teachers are confronted with a broad range of pedagogical questions and problems, such as questions like, "Should I allow my students to use their mobile phones in classes?" "What's best for their learning, to allow mobile phones or to ban them from classes?" Teachers, like many other practitioners, need to deal with such questions and problems in an evidence-informed manner. This means that they need to justify their answers, decisions, and practices professionally by engaging in complex epistemic processes, including searching for, interpreting, and using the evidence that is "(a) most relevant to the [pedagogical] decision and (b) has the highest degree of certainty" (Spencer et al., 2012, p. 133) (Fischer et al., 2014). Accordingly, educational research and policy standards of teacher education demand pre-service teachers to ground their decisions and actions in evidence from educational research rather than base them on gut feelings (e.g., Bauer and Prenzel, 2012; Bromme et al., 2014; Häkkinen et al., 2017; Thomm et al., 2021b). In this sense, sourcing relevant evidence is a crucial part of (pre-service) teachers' evidence-informed practices.

In this endeavor, the Internet plays a crucial role as it allows pre-service and in-service teachers to search for up-to-date educational information and access evidence easily, long after they have left university (Williams and Coles, 2007; Bromme et al., 2014; Caena and Redecker, 2019). For example, during their entire professional lives, teachers have to decide which teaching methods are best suited to achieve newly defined learning goals, such as helping their students develop media skills. This was particularly evident under the specific circumstances of the COVID-19 Pandemic when teachers around the world had to teach at a distance and therefore had to adapt their regular practices to the opportunities and challenges of the new online (or hybrid) teaching methods. In addition to these society developments which require new forms of teaching and learning, scientific evidence on teaching and learning are also constantly changing (Bromme and Goldman, 2014), and teachers can use the Internet to become informed about the current educational scientific findings on a particular topic.

Pre-service and in-service teachers seem to use the Internet frequently to extract educational information related to pedagogical problems (Williams and Coles, 2007; Bougatzeli et al., 2017), but sourcing relevant evidence from the Internet can come with several hurdles: Teachers can access a variety of information easily, but this information may have varying levels of scientific groundedness (e.g., open access education science journals, open educational resources, science-related blogs, or blogs from colleagues) and may be inaccurate due to unavailable gatekeeping mechanisms (Metzger and Flanagin, 2013; Hendriks et al., 2015). Thus, (pre-service) teachers have to evaluate the relevance and quality of a considerable amount of educational information. In this context, (pre-service) teachers report frustration and worry about being unable to find accurate information or evaluate it appropriately—even if they are intrinsically motivated to explore further and connect the information to other scientific sources during online searches (synthesizing evidence constitutes an appropriate scientific practice: Rousseau and Gunia, 2016) (Chen et al., 2019; Iding et al., 2009). Furthermore, when sourcing relevant educational evidence from the Internet, (pre-service) teachers need to deal with the affordances offered by the search engines and other media they are using online (e.g., blogs or video platforms). In this sense, it is becoming increasingly important to educate pre-service and in-service teachers on the skills they need to find, select, evaluate, and use science-related online information (e.g., European Digital Competence Framework for Educators [DigCompEdu]: Caena and Redecker, 2019). Often discussions on online sourcing competencies are based on the complex and interrelated constructs of information literacy (Duke and Ward, 2009; Häkkinen et al., 2017; Caena and Redecker, 2019). So, although (pre-service) teachers should be trained to be competent at sourcing evidence from the Internet—first, to keep themselves up-to-date in the sense of informal lifelong learning and, second, to teach their students how to source online information competently (e.g., Wilson et al., 2011; Caena and Redecker, 2019)—little is known about how they actually source online information and what strategies they actually use. Thus, it is important to understand how pre-service teachers source evidence from

the Internet when aiming to find a solution for a pedagogical problem. The present study aims at describing pre-service teachers' sourcing behaviors on the Internet by focusing on (1) behaviors related to basic or advanced search strategies and (2) understanding the role that pre-service teachers' epistemological beliefs about knowledge from the Internet (i.e., Internet-specific epistemological beliefs [ISEBs]) play in their searches.

Approaches to searching for information on the Internet

Several theories and approaches from diverse research fields (e.g., communication science, information science, and psychology) exist that aim to describe how individuals search for information. While some models consider information searches to be iterative, stepwise processes (e.g., Kuhlthau, 1993), empirical research supports models that consider information searches as dynamic and gradual processes with cognitive, affective, as well as behavioral dimensions (e.g., Griffin et al., 1999; for an overview of information searching models, see, e.g., Joseph et al., 2013; Ghasemaghaei and Hassanein, 2019) (e.g., Wilson et al., 2002; Hyldegård, 2006; Jiang et al., 2015; Orlu, 2016). The Risk Information Search and Processing model (RISP; Griffin et al., 1999), for instance, is based on the Heuristic-Systematic Model of information processing (HSM: Chaiken, 1980; Eagly and Chaiken, 1993) and the theory of planned behavior (Ajzen, 1991). It argues that searching for and evaluating information (e.g., the relevance and quality of information) are dependent on each other, meaning that cognitive processes related to both overlap simultaneously. Aside from the assumption that the processes of searching for and evaluating information go hand in hand, the RISP model, at its core, focuses on the psychological need for information sufficiency, which drives any search for information (Griffin et al., 2004; Yang et al., 2014). Furthermore, the model points out that personal characteristics, subjective norms, channel beliefs (i.e., beliefs about information channels, such as the Internet, which is considered a mediated information channel: Dunwoody and Griffin, 2014), and one's self-efficacy in sourcing information are important factors that drive the extent to which one performs critical elaboration while sourcing information. Similarly, many approaches on sourcing online information assume that individuals either process information in a heuristic or a systematic way depending on several factors (e.g., motivation or epistemic beliefs) (Metzger and Flanagin, 2013; Bromme and Goldman, 2014; Stadtler et al., 2017), and numerous empirical studies have found that individuals use various cues (e.g., the rank of a search result: Haas and Unkel, 2017) when selecting and evaluating online information (Sundar, 2008; Choi and Stvilia, 2015) (for an overview of discussed heuristics in evaluation of online information, see Sundar, 2008; Metzger and Flanagin, 2013). However, research about whether these cues are actually processed in a heuristic rather than a systematic way when searching for online information is still in its infancy (Schemer et al., 2008; Yang et al., 2014; Meinert and Krämer, 2022).

In addition to the RISP model, Brand-Gruwel et al. (2009) describe the processing of information when aiming to make informed decisions about scientific issues by focusing on the specific conditions of searching for information on the Internet. They describe five components for successfully solving information problems related to online searching behaviors: (1) Similar to the initial steps in the RISP model (Griffin et al., 1999), first, individuals define the information problem at hand; (2) they formulate corresponding search queries that are submitted to the search engine; (3) they evaluate search results presented on the search engine result page (SERP) to determine which information to access; (4) then, as in the RISP model, they evaluate the information provided by websites by considering aspects such as source parameters, their own prior knowledge, and information from other sources; and, finally, (5) they integrate information across multiple websites to reach a solution to the information problem (i.e., build a comprehensive mental representation of the problem and plan interventions; see also the processing of multiple documents, as considered in the Multiple Document Task-based Relevance Assessment and Content Extraction model (MD-TRACE) (Rouet and Britt, 2011). Accordingly, the model highlights the relevance of individuals' use of search engines and their formulation of search terms, which may affect the selection as well as the evaluation of online information. During web searches, for instance, selecting from the search results presented on a SERP requires choosing between a high number of alternative search results that usually only display sparse information (i.e., a title, short excerpt of the web page, and the URL). According to both models, a (pre-service) teacher's decision about which search results to click on (e.g., to check for further information) also depends on other factors, such as their prior knowledge, beliefs, or time capacities.

While pre-service teachers may use different strategies when sourcing online educational information (e.g., depending on their online sourcing competencies or on their individual epistemic beliefs, as will be outlined in 1.2 and 1.3), other factors, such as how they enter search terms, browse information, and select search results, are also impacted by media affordances. In this vein, media affordances (e.g., the algorithm a search engine uses) determine not only how specific media are used but also the ways in which individuals can engage with the technology (Evans et al., 2016). For example, when acquiring (scientific) information, (pre-service) teachers, like other information seekers, tend to use only one type of search engine (i.e., Google) (Bougatzeli et al., 2017), such that their sourcing will be limited by the default characteristics of the search engine and its SERPs,

such as the algorithm the engine uses to present search results, the interface it offers for individuals to manually filter search results, or the sparsity of information it displays. The uncritical use of only one search engine means that one risks selecting search results in a biased way, as the results are predetermined by the affordances of the search engine; Kammerer et al. (2009), for instance, investigated individuals' interaction with two different search engines, one being a traditional query-based search system and one being an exploratory tag-based search system wherein individuals could interactively tag related search results. While the findings indicated that individuals' prior knowledge affected how many keywords they used for their inquiry, the use of the tag-based search interface was found to possibly compensate for differences in prior knowledge, as individuals who used the tag-based search engine used the tagging feature to give feedback on the relevance of search results, spent more time and were more engaged with the interface, and summarized their search inquiry by giving more arguments.

Furthermore, the algorithm a search engine uses to determine the order of results may influence whether a (pre-service) teacher selects any of the search results and whether they perform any further search queries. Research indicates that individuals would rather view/select the highest-ranked search results on a SERP (e.g., Eysenbach and Köhler, 2002; Pan et al., 2007; Wirth et al., 2007; Salmerón et al., 2013; Haas and Unkel, 2017). However, by selecting information only because of its rank on the SERP, one risks choosing information of low relevance or even low quality. In two experiments, Kammerer and Gerjets (2014) varied not only the trustworthiness and rank of the search results that were displayed on the SERP but also the interface of the search engine; they did this to investigate whether and how individuals select higher-ranked results even when they are less trustworthy. The students in the first experiment were highly impacted by the rank of the search results: when the search results on the top of the page were the less trustworthy ones, the students selected more of the least trustworthy search results and spent more time on them, and, vice versa, students selected fewer of the most trustworthy results and spent less time on them, which led students to list fewer arguments from the most trustworthy sources. In a follow-up experiment, this effect (namely, that individuals selected and viewed search results according to their ranking by the search engine, not their relevance) were highly decreased when the search engine's interface displayed the results in a three-by-three grid; thus, the affordances offered by the search engine matter.

Thus, it is reasonable that different search engine affordances not only lead to different search results but also impact how individuals conduct their search queries. Likewise, pre-service teachers' selection and evaluation of information depend both on how they conduct their searches (e.g., formulation of search keywords) (e.g., Hinostroza et al., 2018) and on personal factors (e.g., epistemic beliefs) (Kammerer and Gerjets, 2012).

Basic vs. advanced strategies of sourcing online information

We conclude that a variety of media affordances play a crucial role when sourcing online information. Furthermore, searching for information on the Internet is considered a complex process involving several searching behaviors (e.g., formulating search terms, evaluating search results presented on the SERP) (Brand-Gruwel et al., 2009). In this context, (pre-service) teachers can use several strategies to achieve a search task, e.g., search for relevant, appropriate, complete, and correct information on the Internet to ground an evidence-informed decision about an educational issue. However, defining which search strategies reflect competency (and which do not) is challenging, as defining the success of online information sourcing may differ depending on personal desires (e.g., one's epistemic aim in relieving uncertainty about a topic) or normative standards (e.g., achieving understanding about a topic in alignment with the requirement of a search task) (Hendriks et al., 2020).

While standards and policies for teacher education in general demand that (pre-service) teachers ground their decisions and actions in science-related evidence (e.g., Bauer and Prenzel, 2012), teacher competence frameworks also exist that aim to describe (pre-service) teachers' competencies in sourcing online information. For instance, the European Framework for the Digital Competencies of Educators uses a progress scale to define levels of searching strategies (i.e., Newcomer, Explorer, Integrator, Expert, Leader, Pioneer); it considers the use of other sources (e.g., official repositorium) in addition to a search engine as a very advanced strategy (i.e., Leader) for identifying and assessing relevant information and resources (Redecker and Punie, 2017). Similarly, the framework considers that evaluating the reliability of online information and resources and their suitability for an educational issue is an Expert-level search strategy.

Furthermore, research so far has used several indicators to describe behaviors related to searching strategies that likely lead to more relevant and appropriate search results and, thus, are considered more advanced search strategies. In this sense, the aspects of advanced search strategies most often focused on by researchers include the decision to use a certain search engine, the formulation of keywords to find, scan, evaluate, and select relevant search engine results, and the selection of the most relevant information (Hinostroza et al., 2018).

As described above, the affordances of media may crucially impact the results of one's search task. In this sense, it seems in particularly alarming that for any decision about what type of search engine to use, Google has the strongest dominance, with a global market proportion of over 92% (StatCounter, 2022). At the same time, different studies highlight the potential threat of search engines' biases, especially in terms how they may shape

people's opinions, as individuals seem to over-rely on Google search results (Ballatore, 2015; Salehi et al., 2018). Hence, a skilled search strategy that limits the risk of search engines' biases might entail using multiple search engines, as this might decrease the outsized effects that one search engine's algorithm can have when pre-selecting and ranking search results.

Similarly, another crucial aspect of one's search strategy is selecting relevant search results. Again, several studies indicate that individuals have problems critically reading and scanning the lists of results on a SERP and tend to simply select the search results at the top of the list (e.g., Salmerón et al., 2013; Rieh et al., 2016). This means that selecting lower-ranked links on a SERP or links that are not on the first SERP might indicate a more critical consideration of more search results and, thus, might indicate advanced search strategies.

Furthermore, formulating search terms plays an important role in the search strategy, as writing complete sentences or using very few different search terms and synonyms could lead to results that are too general and irrelevant (Hinostroza et al., 2018). Accordingly, adapting and using new search terms is considered an advanced search strategy that might help (pre-service) teachers retrieve more relevant search results regarding their search task.

Finally, another important aspect of search strategies is evaluating the information and source quality (e.g., Bromme and Goldman, 2014; Redecker and Punie, 2017). Research indicates that selecting information is often influenced by criteria that are less relevant for actually evaluating the quality and relevance of information (e.g., design and usability; Hinostroza et al., 2018; rank on SERP; Haas and Unkel, 2017) than by criteria being more relevant for evaluating the information quality itself or the trustworthiness of the authors/sources [e.g., authors'/sources' expertise that may at least help pre-service teachers decide whether they can rely on the information provider, especially when they are not able to critically elaborate the quality of information, such as when they do not have enough time to do so (Bromme and Goldman, 2014)]. Thus, checking for the quality of information and for the trustworthiness of its authors/sources is considered an advanced strategy that likely helps pre-service teachers to retrieve relevant, appropriate, correct, and complete information (e.g., Bromme and Goldman, 2014).

(Internet-specific) epistemological beliefs and their role for pre-service teachers' searching behavior and selection of scientific evidence

According to Schommer (1990), epistemic beliefs consist of several dimensions that are relatively independent of each other and are conceptualized as beliefs about knowledge and how knowledge emerges. In general, one's beliefs about the nature of scientific knowledge—as part of epistemic cognition (Chinn et al., 2014)—may directly influence which strategies and practices they employ during online sourcing (Muis, 2007; Barzilai and Zohar, 2016; Hendriks et al., 2020). Bråten et al. (2005) were the first to investigate special aspects of epistemic beliefs regarding the Internet (which is considered an information channel in the RISP model: Dunwoody and Griffin, 2014). They argue that because "hypermedia technologies such as the Internet allow for new ways of presenting knowledge and new ways of knowing, measures of personal epistemology should probably focus specifically on beliefs about the nature of knowledge and knowing in such technological environments" (Bråten et al., 2005, p. 147). As such, they invented a measurement of epistemic beliefs that focuses specifically on beliefs about the nature of knowledge and knowing in Internet-based environments (i.e., ISEBs).

Like epistemic beliefs in general, an individual's ISEBs may also influence how they search for information on the Internet. In this sense, one study found that students with more educational years tended to have advanced epistemic beliefs regarding the uncertainty of Internet-based knowledge (i.e., constructivist oriented), which made them more likely to suspect that the Internet is a good source containing accurate knowledge, as well as more inclined to justify and evaluate Internet-based knowledge with other sources (Chiu et al., 2016). Research on (pre-service) teachers' ISEBs and their sourcing behavior seems inconsistent, as some research indicates that in-service teachers' advanced epistemological beliefs could mean that they use more sophisticated online search strategies (i.e., selecting less irrelevant information) to filter and organize information than those with less advanced beliefs (Tsai et al., 2011); yet, other research indicates that pre-service teachers' ISEBs did not have a significant impact on their online search strategies (Yilmaz and Çakmak, 2016).

When it comes to (pre-service) teachers' preferences for scientific or anecdotal evidence (e.g., experiences of colleagues), research has indicated that (pre-service) teachers tend to prefer anecdotal evidence (e.g., Bråten and Ferguson, 2015; Kiemer and Kollar, 2021). Of course, relying on anecdotal evidence can be important in, for example, determining the practicability of certain teaching methods in specific situations. However, anecdotal evidence rarely meets the systematic standards for knowledge generation that forms of scientific evidence often do (e.g., Spencer et al., 2012). In a recent study by Hendriks et al. (2021), pre-service teachers judged the trustworthiness of a researcher vs. An experienced teacher depending on what epistemic aims the pre-service teachers held (i.e., their aims at achieving epistemic ends, such as gathering knowledge or getting practical explanations; see also Chinn et al., 2014); when

pre-service teachers aimed for a theoretical explanation about schooling, they judged the researcher to be more trustworthy. Thus, it seems as though pre-service teachers select evidence according to their epistemic beliefs, as their judgment of certain sources of information depending on their epistemic aims indicates that they have assumptions about how the source can help fulfill their epistemic aims. In this sense, pre-service teachers' epistemic beliefs about the nature of knowledge and knowing on the Internet may affect not only their actual searching behavior but also whether they select scientific vs. anecdotal evidence.

Rationale of this study

Given this theoretical and empirical background, we wanted to describe pre-service teachers' sourcing strategies by focusing on behavioral processes related to their selection as well as evaluation of online information (Griffin et al., 1999). We focused on aspects of search strategies that are considered specific to sourcing information on the Internet and play a crucial role in sourcing relevant information (e.g., use of search engines; Brand-Gruwel et al., 2009; Kammerer and Gerjets, 2014). As pre-service teachers' ISEBs may also relate to how they source information on the Internet (e.g., Tsai et al., 2011; Dunwoody and Griffin, 2014), we additionally assessed participants' ISEBs.

The goals of the present research were twofold: First, we aimed at describing pre-service teachers' searching strategies when sourcing online educational information (Research Question 1). Therefore, we investigated whether participants used basic vs. advanced search strategies and, thus, analyzed several behavioral aspects that are considered crucial for the competencies in sourcing information on the Internet; these aspects included (1) the frequencies of types of search engines used, (2) the number of used search engines, (3) the adaptation or formulation of (new) search terms, (4) the selected information's rank on SERP and the SERP page number it came from, and (5) the instance of any type of quality check (e.g., Salmerón et al., 2013; Bromme and Goldman, 2014; Hinostroza et al., 2018). Second, we investigated the relation of pre-service teachers' ISEBs to their searching strategies as well as to the science-relatedness of their selected information (Research Question 2).

> RQ1: How do pre-service teachers search for online educational information, and what strategies do they use when sourcing these?

> RQ2: Are pre-service teachers' Internet-specific epistemic beliefs related to their searching strategies and/or to their selection of evidence?

Materials and methods

Participants

Study participants included 91 pre-service teachers from three universities in Germany who were studying at the bachelor's or master's degree level to become secondary school teachers. Participation was voluntary, and participants received an allowance of 20€. Data from 12 participants were excluded (1) due to issues in recording their search behaviors via screen video, (2) due to issues with the Internet connection during the investigation, or (3) because the time they spent on conducting the experiment differed more than one standard deviation from the mean duration. This resulted in a final sample of $N = 77$ participants (51 females and 1 diverse) aged 18–41 years ($M = 25.29$, $SD = 5.06$). The participants' average length of study at the time of the survey was 4.4 semesters ($SD = 2.99$). The time spent on conducting the search task was $M = 15.76$ min ($SD = 8.64$). Of the sample, $n = 27$ participants were studying at the master's level and $n = 50$ were at the bachelor's level.

Participants reported that they used a computer, notebook, or et for an average of $M = 4.01$ ($SD = 2.51$) hours per week. The average time spent on the Internet was reported to be $M = 5.01$ ($SD = 3.05$) hours per week. The weekly time for information seeking on the Internet was reported to be $M = 1.99$ ($SD = 1.55$) hours per week, and for online information seeking about educational topics they reported to invest an average of $M = 1.56$ ($SD = 1.22$) hours per week. Participants rated their self-perceived prior knowledge about the topic "students' use of mobile phones in class," as neither very low nor very high (i.e., based on four items: $M = 2.48$; $SD = 0.82$). Participants' attitudes toward banning mobile phones was balanced (i.e., based on four items: $M = 2.96$; $SD = 1.04$).

Procedure

The investigation was conducted from November 2019 to January 2020. As the investigation was performed on-site at the university, participants had access to the network and freely accessible licensed scientific books and sources of the university. Each participant worked alone in front of the computer, at their own pace, guided by the instructions of the online survey (by Questback EFS Surveys) (i.e., without verbal instructions from the investigators). In the beginning of the study, an open web browser window (i.e., Mozilla Firefox) was on display showing all participants the same university website.

In the beginning of the survey, the demographic variables were assessed, as were participants' self-reported ISEBs. In the next step, the following fictional scenario was constructed: All participants were asked to imagine themselves as teachers. They had the task of searching for information about mobile phone

use in class in preparation for a fictional school conference about this topic (see **Supplementary material 1**). For this, they were asked to select relevant web content (henceforth called *web items*, WI) that would allow them to build an opinion about the topic. Then, all participants were asked to search for about 20 min for educational information about the topic and to select two or four WI (see also, section "The number of selected web items related to the search task as control variable"). Accordingly, all participants sought pedagogical information on the same topic of "students' use of mobile phones in class" on the Internet. Based on their actual search results, they selected online WI that they perceived to be relevant for forming opinions and making decisions. Participants were allowed to select any type of WI (e.g., scientific articles, videos, and blog entries). During the search task, participants' search behavior was captured by recording their screens.

The educational topic

Students' use of mobile phones in class is a highly debated topic. It is not only a question of school administration but also a topic that is frequently addressed by the media and academics. Schools in Europe, and in Germany's federal states, regulate the use of mobile phones in classes very differently. The research within the field of educational sciences deals with the advantages and disadvantages of mobile phone use in class regarding students' attention and learning outcomes, as well as students' social and digital competencies (e.g., Sung et al., 2016). This topic was selected for the search task because it has practical relevance and because diverse and conflicting educational evidence can be found on the Internet.

The number of selected web items related to the search task as control variable

The data in this study were collected as part of a larger online experiment with the hypothesis that participants would reason their selection of WI differently depending on whether they reason in an individual or collaborative setting (Zimmermann and Mayweg-Paus, 2021). After participants were told about the search task (which is reported here and was nearly the same for all participants regardless of which experimental condition they were eventually assigned to) participants were divided into two groups according to the experimental conditions. As part of the experiment, the only aspect that differed between experimental conditions during the search task was that participants were asked to select either four WI in the individual reasoning condition or two WI in the collaborative condition. Thus, $n = 33$ participants were part of $\text{group}_{4\text{WebItems}}$, and 50 participants were placed in $\text{group}_{2\text{WebItems}}$.

Since in this study we exclusively focused on the information search process (i.e., the search task of the experiment), in the following we do not differentiate between individual and collaborative reasoning settings. However, as participants either selected two or four WI during the search task, in this study we can control for any effects due to the number of selected WI related to the search task (i.e., two vs. four WI). In this sense, the number of search results/links that students were told to select might also have impacted their searching behavior. Thus, in a preparatory analysis, we analyzed whether the number of selected WI related to the search task had any influence on participants' searching strategies, i.e., (1) the number of search engines they used, (2) whether they adapted or formulated new search terms; (3) the rank and number of SERP associated with the WI they selected; and (4) whether they performed a quality check.

Four binary logistic regressions with the categorial independent variable two vs. four WI were analyzed. The dependent variables were defined as binary variables (i.e., as in the main analysis). The independent variable was not found to contribute to the models, meaning that selecting two vs. four WI did not significantly influence participants' search behavior: (1) $\beta = -0.16$, $SE = 0.48$, $Wald = 0.11$, $p = 0.74$; (2) $\beta = 1.45$, $SE = 1.11$, $Wald = 1.71$, $p = 0.19$; (3) $\beta = 0.21$, $SE = 0.34$, $Wald = 0.39$, $p = 0.53$, and (4) $\beta = -0.33$, $SE = 0.54$, $Wald = 0.38$, $p = 0.54$. All together, this means that the number of WI that the participants were told to select during the search task (i.e., whether participants selected two vs. four WI) had no significant influence on the dependent measures and, thus, was not included in our main analyses. Therefore, the results reported below come from analyzing the first two selected WI of participants in the $\text{group}_{4\text{WebItems}}$ as well as the two selected WI of participants in the $\text{group}_{2\text{WebItems}}$.

Measurements

Science-relatedness of selected web items

In sum, we analyzed 154 WI that were selected by participants (i.e., two WI for each participant). We considered those WI to be science related if the content referred to primary or secondary scientific sources (i.e., scientific journal articles, scientific reports, monographs, scientific blogs, school textbooks, or university theses). They were considered not to be science related if the content referred to journalistic sources or anecdotal evidence (i.e., online news portals, information platforms, or blogs or YouTube videos by teachers) (first author and last author, 2021).

Basic vs. advanced search strategies

To shed light on participants' search strategies, we followed in line with the literature and analyzed the following aspects: (1) the frequencies of the search engine types used among all

participants and for each participant, (2) the number of search engines participants used during the entire searching process, (3) whether participants adapted or formulated new search terms during the searching process, (4) the rank on the SERP and the SERP page number associated with the WI they selected, and (5) whether they checked the quality of sources during the search process.

The *frequencies of the search engine types used* (e.g., Google or Ecosia) refers to the two selected WI (i.e., the type of search engine that was ultimately used to find the selected WI). The frequencies represent how often the search engines were used among all participants.

The *number of search engines used* indicates the quantity of different search engines a participant used during his/her search task (i.e., even if the used search engine did not lead to the final selected WI). In cases where a participant used at least two search engines to retrieve web results (e.g., to compare results or to conduct further research), the search strategy (in terms of the number of used search engines) was considered advanced.

The variable *adapting or formulating new search terms* indicates whether a participant (1) specified searches by using variations of the same search term, (2) used new search terms, or (3) used a mixed strategy that included specified terms and new search terms. In the case that a participant used one or both strategies, the search strategy (in terms of search term adaptation) was considered advanced.

The variables *number of SERP* and *rank of WI on SERP* indicate, respectively, whether the WI was selected on the first, second, or subsequent SERP and, when it was selected from the first SERP, what its rank was. When participants did not simply select one of the first four WI on the first SERP but instead selected at least one of the two WI from a lower rank or from one of the following SERPs, this was considered an advanced strategy, as it indicates that participants considered more than only the highest-ranked WI.

The variable *quality check* indicates whether a participant checked for quality (i.e., the trustworthiness of the author/source or the credibility of the statements via hyperlinks). For instance, we considered it a quality check when a participant examined a prior search result by using the name of the provider as a search term. In the case that a participant checked for quality during the search process, this was considered an advanced search strategy.

Lastly, to examine each participant's overall search strategy for the entire search process, an *overall index* was calculated to give insights into participants' competencies in sourcing. The index was calculated based on the four aspects of a search strategy, namely whether participants (1) used more than one search engine, (2) formulated new or adapted the search terms, (3) did not select WI from the first four ranks on the first SERP, and (4) checked for quality of sources and content. Thus, for each participant, an index of $i = 0$ was calculated, and the value was added by $i + 1$ if one of the search strategy aspects was fulfilled. Thus, the index depicts five competence levels of information searching (from 0 to 4) that are described as follows: basic search strategy, advanced search strategy, intermediate search strategy, proficient search strategy, expert search strategy.

Internet-specific epistemological beliefs

We assessed participants' ISEBs based on the questionnaire by Bråten et al. (2005). The questionnaire addresses dimensions concerning web-based knowledge (what one believes that knowledge is like on the web) and web-based knowing (how one comes to know on the web). The 14 items yielded an internal consistency of Cronbach's $\alpha = 0.87$.

Results

Science-relatedness of selected web items

Of the total 154 WI participants selected, 32 WI (20.8%) were determined to be science related (see first author and last author, 2021, for a list of all selected WI, incl. hyperlinks and how often they were selected among all participants). We also analyzed whether any (and how many) of the science-related WI were among those WI that participants considered relevant for building an opinion about the search topic. Fifty out of all 77 participants did not select any science-related WI; the other 27 participants selected at least one WI that was determined to be science related. Interestingly, these findings indicate that while most participants did not select any science-related WI, still about one-third of the participants at least considered scientific evidence in addition to other forms of information (e.g., anecdotal evidence from teacher colleagues in blogs, or journalistic information) for building an opinion about a pedagogical problem.

The type of search engines

Google was by far the most frequently used search engine. More than three-quarters of the selected WI (78.0%) were found via Google. Furthermore, Google Scholar (6.0%), YouTube (2.7%), Google Videos (2.0%), Google News (2.0%), and Google Books (0.7%) were used for WI selection. Thus, over 90% of the selected WI were reached via search engines of Google LLC. The second most often used search engines were the university's library search engine (i.e., Primus) and Google Scholar, considered two scientific search engines. The only used commercial search engine that was not associated with Google LLC was Ecosia (2.7%), which is a non-scientific search engine. **Table 1** displays the frequencies of all used search engine types by referring to participants' selected WI.

Results in terms of search strategies

Use of more than one search engine

We analyzed the use of more than one search engine, as this is considered an advanced search strategy. Most participants (62.3%) did use more than one search engine: About one-third of participants used either two or three search engines, and a small group (5.2%) even used four search engines. In contrast, still more than one-third of all participants used only one search engine (37.7%) (Table 2). Even though a rather high proportion of participants used an advanced search strategy, namely using at least two search engines, it is important to again highlight that even different search engines might be associated with a single company (i.e., as in this study: Google LLC).

Adaptation or formulation of new search terms

Another important aspect of a skilled search strategy is formulating new search terms or adapting the search terms during the search process. The strategy adapting search terms was used by almost one-third of participants (29.9%), while almost one-fifth (19.5%) formulated new search terms. Both strategies were used by $n = 32$ participants (41.6%), while $n = 7$ (9.1%) used only one search term (Table 3). Accordingly, $n = 70$ participants (90.9%) used an advanced search strategy regarding formulating new or adapting search terms.

Position of selected web items on search engine result page

In terms of 152 WI, almost all the selected WI (148 WI, 97.4%) stemmed from the first SERP (Table 4). Furthermore, in terms of 151 WI, most of the selected WI (104 WI, 68.8%) were selected from those WI that were highly ranked (i.e., in first four listed results) (Table 5: The coding of two –respectively, three— WI was not possible due to technical issues). As described above, we also analyzed whether participants considered lower-ranked WI for their sourcing process. Results showed that for 54.7% of all participants, at least one of their WI (of the two selected) stemmed neither from the first four ranks nor from the first SERP, indicating an advanced search strategy.

TABLE 1 Frequencies of used search engine types.

Search engines	WI*	Percentage
Google	117	78.0
University library search engine	9	6.0
Google scholar	9	6.0
Ecosia	4	2.7
YouTube	4	2.7
Google videos	3	2.0
Google news	3	2.0
Google books	1	0.7
Total	150	100

*All participants selected two WI. Coding of four WI was not possible due to technical issues.

Quality check

Another important aspect of skilled search strategies is checking the quality of sources and content during a search process. For participants' analysis of their search processes, we considered two different forms of quality checks. First,

TABLE 2 Number of used search engines.

Number of search engines used	Frequency	Percentage
Only one search engine used	29	37.7
Two search engines used	23	29.9
Three search engines	21	27.3
More than three search engines	4	5.2
Total	77	100

TABLE 3 Adaption of or using of new search term.

Form of adaption	Frequency	Percentage
Search term specified	23	29.9
New search term	15	19.5
Specified and new search term	32	41.6
Only one term for all WI	7	9.1
Total	77	100

TABLE 4 Search engine's result page.

Selected result page	WI*	Percentage
First page	148	97.4
Second page	3	2.0
Third page	1	0.7
Total	152	100

*All participants selected two WI. Coding of two WI was not possible due to technical issues.

TABLE 5 Rank of WI on the result page.

Rank result page	Responses	
	WI*	Percentage
1	37	24.5
2	23	15.2
3	26	17.2
4	18	11.9
5	7	4.6
6	10	6.6
7	10	6.6
8	7	4.6
9	6	4.0
10	7	4.6
Total	151	100

*All participants selected two WI. Coding of three WI was not possible due to technical issues.

TABLE 6 Quality check.

Form of quality check	Frequency	Percentage
No quality check	56	72.7
Author/source has been checked	11	14.3
Source was checked	10	13.0
Total	77	100

checking the author/source on other websites was done by $n = 11$ participants (14.3%). Second, checking sources or statements in relation to the content of the WI was done by $n = 10$ participants (13.0%) (**Table 6**). Conclusively, $n = 21$ participants (27.3%) carried out at least one quality check and, therewith, used an advanced search strategy.

Participants' overall search strategies

Lastly, we calculated an overall index to describe an advanced search strategy; the index was calculated based on the aforementioned aspects: (1) use of more than one search engine, (2) new/adaption of search terms, (3) no selection of a WI from the first four ranks on the first SERP, and (4) quality check. Only a small group of $n = 4$ participants (5.2%) performed a very basic search strategy, meaning that no criteria were met. This group only entered one search term, only used one search engine, selected their two WI from the first four ranks on the first SERP, and did not check for quality. Another small group of $n = 8$ participants (10.4%) pursued an advanced search strategy in which only one of the four advanced search strategies was applied. The largest group, $n = 32$ participants (41.6%), performed an intermediate search strategy using two of the four advanced search strategies. Almost one-third of participants, $n = 24$ (31.6%), used a proficient search strategy in which three of the four advanced strategies were applied. The group that used an expert search strategy, in which all four advanced search strategies were used, consisted of $n = 9$ participants (11.7%) (see **Table 7**). This group used more than one search engine, adapted the search term (or used new search terms), selected at least one WI that was not found on the first SERP within the first four ranks, and, finally, checked for quality.

The relation between Internet-specific epistemological beliefs and basic vs. advanced search strategies as well as science-relatedness of web items

Four binary logistic regressions were used to analyze the relationship between ISEB and use of the four aspects of search strategies as dependent variables. The dependent variables were defined as binary variables, i.e., participants either (1) used more than one search engine, (2) used new search terms, (3) did not select a WI from the first four ranks on the SERP, or (4) performed quality checks. The predictor ISEB did not contribute to the models, meaning that differences in participants' ISEBs did not significantly relate to their search behavior, (1) $\beta = 0.21$, $SE = 0.39$, $Wald = 0.29$, $p = 0.59$; (2) $\beta = 0.04$, $SE = 0.65$, $Wald = 0.005$, $p = 0.95$; (3) $\beta = 0.21$, $SE = 0.38$, $Wald = 0.31$, $p = 0.58$, and (4) $\beta = -0.20$, $SE = 0.42$, $Wald = 0.24$, $p = 0.63$.

To investigate whether participants' ISEBs related to their selection of WI, two further binary logistic regressions were conducted with the first as well as the second selected WI as dependent binary variables (science-related vs. not science-related). Again, the predictor ISEB was not found to contribute to both models, meaning that differences in participants' ISEBs did not significantly relate to whether the first or second selected WI was science related (first selected WI: $\beta = 0.36$, $SE = 0.45$, $Wald = 0.64$, $p = 0.43$; second selected WI: $\beta = -0.05$, $SE = 0.44$, $Wald = 0.01$, $p = 0.91$).

Discussion

Pre-service teachers' search strategies

With respect to describing pre-service teachers' search strategies in sourcing online educational information (RQ1), we analyzed several aspects as indicators of participants' search behaviors in terms of their use of different search engines, their adaptation of keywords to find WI, as well as their selection and evaluation of relevant WI. Interestingly, more than 90% of participants used search engines from Google LLC (e.g., Google's search engine or YouTube) to select their WI. As one aspect of an advanced search strategy, 29.9% of participants used two, 27.3% used three, and 5.2% used four search engines to combine their search results. However, 37.7% of all participants limited their searches to only one search engine. While it is promising to see that the other 62.4% of participants used more than one search engine, most of these search engines were associated with Google LLC. In terms of the position of WI, an alarming majority of selected WI (68.8%) were ranked among the first four search results of the first SERP. Thus, participants' selections of WI that they perceived relevant for building an opinion about the educational topic might be influenced by the specific media affordances of Google (e.g., search engine algorithm, interface) (Pan et al., 2007; Kammerer et al., 2009; Haas and Unkel, 2017).

In terms of adapting search terms as an aspect of a skilled search strategy, almost every participant (90.9%) either adapted the preliminary search term or formulated new search terms during their sourcing process, which likely helped them to retrieve more relevant WI (e.g., Hinostroza et al., 2018).

Checking the quality of sources and content is considered an important aspect of search strategies related to the evaluation of

TABLE 7 Sum index about applied advanced search strategies.

Index about applied advanced search strategies	Frequency	Percentage
Basic search strategy	4	5.2
Advanced search strategy	8	10.4
Intermediate search strategy	32	41.6
Proficient search strategy	24	31.2
Expert search strategy	9	11.7
Total	77	100

For all tables, the sum of the percentages may deviate slightly from 100% due to rounding.

information (e.g., Bromme and Goldman, 2014). In this sense, we analyzed (1) whether participants used the name of sources as a subsequent search term to indicate any checking of source's trustworthiness and (2) whether participants clicked on further hyperlinks to indicate whether they checked for relevance and the quality of the online information. It turned out that only about one-quarter of all participants carried out such strategies in evaluating the information (27.3%).

To give participants an overall competency score for their information sourcing, we combined all the single aspects into an index; this allowed us to see how many participants achieved more than one criterion of an advanced search strategy. In this vein, a promising number of n = 33 participants (43.3%) used a proficient or expert search strategy, in which they applied three or four, respectively, out of the four criteria for advanced strategies. However, still n = 12 participants (15.6%) did not fulfill any or more than one criterion of advanced search strategies.

(Pre-service) teachers are encouraged to base their decisions and practices on evidence from educational research (e.g., Bauer and Prenzel, 2012; Fischer et al., 2014), as scientific evidence is most relevant to pedagogical issues and has a high degree of certainty (Spencer et al., 2012). In a direct comparison, (pre-service) teachers seem to prefer anecdotal rather than scientific evidence (e.g., Bråten and Ferguson, 2015; Kiemer and Kollar, 2021). Accordingly, it is interesting to see that in this study, pre-service teachers indeed selected science-related WI in addition to non-science-related WI (e.g., with anecdotal evidence in blogs from teachers), whereby about one out of every five WI was science related (i.e., primary scientific sources).

With respect to the relation of pre-service teachers' ISEB to their searching strategies as well as their selection of evidence (RQ2), participants' ISEB did not significantly relate to their search strategies nor the science-relatedness of their selected WI. While this result is in line with some previous research (Yilmaz and Çakmak, 2016), it is still not possible to make a conclusive statement about any possible relation, since some research findings indicate that there is a relation between ISEB and search strategies (Tsai et al., 2011).

Limitations

With respect to measuring pre-service teachers' search strategies, it is important to mention that the described aspects (i.e., used search engine types, number of used search engines, adaptation of search terms, the rank of the selected WI on the SERP, and the quality check) were determined by using the screen-recorded videos that showed participants' search behavior during a realistic search task, where participants were allowed to select those WI that they perceived relevant for building an opinion about the educational topic. Thus, even though this study's search task represents a relatively externally valid investigation, the analyzed aspects only serve as indicators for pre-service teachers' actual competencies in sourcing online educational information. In this sense, these aspects only serve as hints on certain manifestations of sourcing competencies, as we only assessed participants' sourcing behaviors that were visible on their screens (e.g., selected WI, formulation of search terms). As such, we were not able to indicate, for instance, what information participants' read while browsing through the SERP's search results. In this sense, our use of the mere presence or absence of certain searching aspects represents only a first insight into pre-service teachers' actual sourcing competencies. For example, a participant may not have needed to check for a source's trustworthiness (i.e., use the name of the author/source as new search term during the search task)—no matter whether this checking refers to anecdotal evidence (e.g., of a teacher colleague in a YouTube video) or to scientific evidence (e.g., a journal article)—if they were already familiar with the author/source and, thus, might have already been aware of their level of expertise. Similarly, with respect to calculating the index for a participant's overall sourcing competency, we must note the four aspects used to calculate the index may have different levels of relevance for assessing sourcing competency. For example, regarding effectively and efficiently selecting relevant online information, the number of used search engines may not be quite as important as checking the quality check of a WI. Despite this limitation, the index provides a useful heuristic that gives an overview of pre-service teachers' overall search strategies by revealing the presence (or absence) of the single aspects related to skilled search strategies.

Regarding pre-service and in-service teachers' sourcing of educational information, one of the most important reasons that they may search for information on the Internet is simply because information on the Internet is accessible. However, in terms of searching for primary scientific evidence (e.g., scientific articles), even the Internet has obstacles, and teachers usually do not have the same access to such content that individuals at universities do. In our study, the participating pre-service teachers had access to the university network and, thus, were able to access scientific journal articles. Future research, thus, might investigate whether (pre-service) teachers' selection of science-related evidence might differ when they do not have access to scientific journals or how the search strategies may differ between pre-service and in-service teachers, for example because in-service teachers may have fewer capacities to spend time on intensive sourcing of online information. In this vein, we must also note that in our study, future teachers were explicitly asked to source online information to build their opinions. In the everyday life of a teacher, this prerequisite does not necessarily exist and teachers perhaps not engage in any research reception and evidence-informed practices at all, for instance, because they may perceive a lack of sourcing skills or a lack of time (Thomm et al., 2021a).

While the topic of students' mobile phone use in class is highly relevant for (pre-service) teachers, this study only focused on a single educational topic. As such, we cannot necessarily

generalize pre-service teachers' search strategies to other search tasks and topics. Hence, future research may expand these findings by focusing on different topics. In this context, it might be interesting to investigate whether the degree of scientific certainty related to a topic might lead to differences in pre-service teachers' searching behavior as well as to different results in terms of any impact of pre-service teachers' ISEBs on these searching behaviors. Similarly, it would be valuable for future research to explicitly examine whether the sourcing behavior of (pre-service) teachers changes over time and whether both technical and societal developments have an impact on their search strategies (e.g., with respect to developments of the search engine's adjustments to filter search results or a pandemic-related situation where teachers may have had to search more frequently for online information to adjust their teaching). In this context, we assume that the results of the present study can also be transferred to today's search strategies of (pre-service) teachers, at least to a large extent, since the findings indicate above all that (pre-service) teachers' awareness of the relevance of any influence of the search engines' affordances could be increased.

Conclusion and implications

In this study, we described pre-service teachers' search strategies when sourcing online educational information about the topic "students' mobile phone use in class" by focusing on several aspects of their sourcing behavior that indicate skilled search strategies.

As these aspects are only considered indicators for competency in sourcing online information (e.g., Hinostroza et al., 2018), future research my expand this study's description of pre-service teachers' search strategies by investigating whether any *advanced* strategy (e.g., adaptation of search terms or use of more than one search engine) indeed leads to more relevant information that is also of good quality. In this sense, any attempt to educate pre-service teachers on the skills related to advanced search strategies would also benefit from knowing which aspects of an advanced search strategy are the most important for retrieving relevant information. Yet, defining what exactly constitutes success in sourcing online information is challenging (e.g., Hendriks et al., 2021), so future research may benefit from considering not only pre-service teachers' self-perceived relevance of information but also objective judgments about this information's quality and relevance (e.g., ratings from educational research experts). In line with the RISP model (Griffin et al., 1999)—and other approaches that consider multiple ways of processing (online) information—determining success in sourcing online may also be related to personal factors, such as ones' motivation to find relevant information, and, thus, could be considered in future research. Similarly, considering a pre-service teacher's degree of motivation for retrieving relevant online information, future research should consider their personal background knowledge about search engines at a declarative as well as a procedural level (e.g., to assess whether they understand how search engines and their algorithms work and how interfaces can be used), as differences in such knowledge may also influence their sourcing behaviors. Lastly, with respect to in-service teachers' evidence-informed practices, future studies may examine how any selection of relevant online educational information (e.g., scientific evidence when it comes to theoretical explanations or reports from colleagues when it comes to practical tips: Hendriks et al., 2021) indeed is used, for instance, for teachers' actual lesson preparation and whether teachers' awareness about potentially influences caused by the media affordances on the Internet indeed leads to, for instance, finding and selecting the most relevant online information. Overall, searching for, selecting, and evaluating relevant information is, of course, not only important for the teaching profession, but sourcing information competently is of special relevance for teachers, as it relates not only to their own lifelong learning and evidence-informed practices, but it may also influence how they teach their students to competently source relevant online information (e.g., Caena and Redecker, 2019).

Taken together, the findings of this study indicate that most pre-service teachers adapted their search terms to retrieve more relevant information. However, at the same time, it is alarming that most of the pre-service teachers were likely influenced by the affordances of Google's search engines, as they often only used one search engine and almost always selected information that was ranked highly on the SERP, even though the search task was to select information that they perceived to be relevant for building an opinion about the topic. In this sense, the study clearly emphasizes that it is important to increase (pre-service) teachers' awareness about media affordances and about their own search strategies when sourcing online educational information. This has practical implications for teacher trainings and in-service teachers' sourcing practices. Also, the findings raise the question of whether increasing awareness about the potential influence of search engines' affordances may help (pre-service) teachers overcome the biases of search engines or go beyond using only basic search strategies that enforce these biases (e.g., only selecting high-ranked information). So far, it is unclear whether merely alerting pre-service teachers about the potential influence of search engines helps to increase their awareness of how search engine algorithms work; alternatively, it may also be necessary to implement specific interventions into teacher trainings that educate them about not only why but also how to use more advanced search strategies to retrieve relevant online educational information efficiently and effectively (e.g., how to adapt search terms effectively or why and when to use more than one search engine). In this context, it seems promising to implement interventions into teacher trainings that focus on fostering pre-service teachers' critical reflection about their own search strategies (e.g., settings in which pre-service teachers

collaboratively reflect on their own search strategies; first author and last author, 2021). In particular, promoting (pre-service) teachers' critical questioning of their own search strategies and, for instance, whether selected online information indeed is relevant—as metacognitive strategies (Kuhn, 1999)—may allow them to face the challenges of an ever-evolving media environment on the Internet.

By describing pre-service teachers' use of basic vs. advanced strategies, this study provides a foundation for further in-depth investigations into the strategies pre-service teachers use to search for online educational information. In this context, individual aspects like motivation, knowledge about search engines, or epistemic beliefs about knowledge from the Internet should be considered. Furthermore, the study points at the importance of considering the complex array of media aspects that influence online information searches (i.e., media affordances, such as search engines' algorithms) as well as the importance of fostering pre-service teachers' awareness about potential biases caused by these aspects. All in all, it seems important to foster pre-service teachers' critical reflection about their own search strategies and to additionally promote their knowledge about search engines' affordances and the potential biases caused by using certain search engines; giving them this type of knowledge may increase their *critical* search strategies (e.g., reflecting critically about whether the high-ranked information indeed is the most relevant information, or whether authors are trustworthy). This seems particularly important, as this study's findings indicate that pre-service teachers need to improve their sourcing competencies regarding using search engines, selecting information on SERPs, and checking for information quality and sources' trustworthiness.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MZ and EM-P conceived the idea of the study. MZ collected the data and took the lead in writing the manuscript. MZ and OE analyzed the data and engaged in writing sections of the manuscript. All authors provided feedback and ideas.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2022.976346/full#supplementary-material

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