International Journal of Training and Development

RESEARCH ARTICLE OPEN ACCESS

Design and Transferability of a Digital Training to Improve Generic and Domain-Specific Critical Online Reasoning

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Received: 2 May 2024 | **Revised:** 25 February 2025 | **Accepted:** 3 March 2025

Funding: This study was part of the BRIDGE project (FKN 01JD1906), funded by the German Ministry of Education and Research.

Keywords: digital training | performance-based evaluation | professional training | training design | training transfer

ABSTRACT

The Internet has become the main information source of graduates, trainees and young professionals, who use online information to base their professional decisions and actions. However, trainees often perform poorly when it comes to correctly evaluating the credibility of online media and critically dealing with online information, which can negatively impact their professional decisions and actions. Competent handling of online sources can only be achieved if trainees systematically learn to search for, critically evaluate and reason using high-quality information. Based on prior research, we define this skillset as 'critical online reasoning' (COR). In this study, a corresponding digital COR training was developed and implemented in the professional education of students in medicine, law and teacher training degrees. In these three domains, competent Internet use and COR skills play an increasingly significant role in professional practice. As prior research indicates, COR-related skills can be improved through targeted training. So far, however, existing tools have only addressed partial COR facets and mostly in a domain-independent manner; no comprehensive training addressing all online information processing stages for these three domains has been available. In this paper, the theory- and evidence-based conceptualization and implementation of the COR web-based training according to the five main phases of the well-established ADDIE (Analysis, Design, Development, Implementation, Evaluation) model of instructional design is presented. The COR training comprises tasks embedded into realistic search problems regarding relevant topics in the respective domains and thus provides an authentic learning environment. The initial evaluation findings indicate that the COR training can be transferred across and improve trainees' COR skills in the three domains. At the same time, some limitations became apparent, which led to calls for further development and the professionalization of training that is presented here.

1 | Relevance and Research Focus

The Internet has developed into one of the main information sources for graduates and trainees today (Grothaus et al. 2021). Online sources are often used more frequently to access information than traditional sources (Mauer et al. 2020). While the immediate availability and variety of online media offer information resources at low effort and expense, the vast quantity of low-quality information imposes several risks and challenges for decision-making and acting using Internet sources (Walton et al. 2020). Online information is oftentimes untrustworthy, incomplete, erroneous or biased, challenging users in their judgement of the quality of the content they find on the Internet (Zhang and Ghorbani 2019). For instance, they

feel overwhelmed by the amount of information they encounter online, which can negatively impact their professional decisions and actions (Feroz et al. 2022).

The ability to judge the credibility of online media is an essential 'cultural-technical skill' for several domains and professions in the 21st century (Redecker 2017). Although today's graduates and young professionals, also described as a generation of 'digital natives', have grown up using digital devices and browsing the Internet regularly (Osborne et al. 2022), they often perform poorly when it comes to correctly evaluating the credibility of online media (Ziv and Bene 2022). For instance, they fail to question the author of a source, do not recognize the real intention or base their judgement on irrelevant criteria, such as the design of a website or the authority of a search engine (Wineburg and McGrew 2019). The ability to competently deal with online sources and information is required for appropriate decision-making and acting using Internet-based sources (McGrew and Byrne 2020). Competent handling of online information can only be achieved if graduates and young professionals systematically learn to search for, critically evaluate and reason using high-quality information (McGrew and Kohnen 2024).

In prior research, this skill set is defined as 'critical online reasoning' (COR; Molerov et al. 2020). COR plays a crucial role in evidence-based decision-making in various fields, including medicine (Kuhn et al. 2020). This accounts, in particular, for the professional training of medical, legal and teaching trainees, since (young) professionals in these domains increasingly use online media for everyday work purposes (Haag et al. 2018; Drapezo et al. 2022; Vaskov et al. 2021). Despite the high importance of COR skills in these three domains, previous studies indicate substantial deficits among young professionals (Zlatkin-Troitschanskaia et al. 2021; Nagel et al. 2024), leading to the question of whether and to what extent the ability to deal with online information critically can be effectively fostered in professional training.

Generally, COR-related skills can be improved with training (McGrew and Chinoy 2022). However, existing training methods only address partial COR-related facets and hardly focus on transfer to domain-specific contexts. To address this limitation and effectively foster all COR facets across the three domains, a novel web-based training (WBT) for COR has been conceptualized, developed and implemented in the BRIDGE project (Zlatkin-Troitschanskaia et al. 2024). The training design follows the principles of the ADDIE instructional design model, which describes the five phases: 'Analysis', Design', 'Development', 'Implementation' and 'Evaluation' that are progressively performed in the development of digital teaching arrangements (Saltsman and Shelton 2011; Branch 2009). The main part of this paper is structured according to these five phases of the ADDIE model and focuses on elaborating on corresponding research questions (see Section 4).

This paper primarily addresses the theoretical and didactic conceptualization of the training. Thus, the first three phases 'Analysis', 'Design' and 'Development' are elaborated in detail, while 'Implementation' and 'Evaluation' are briefly addressed due to their comprehensiveness. In Section 2, the relevant research and theoretical-conceptual background of this study are outlined. Subsequently, research questions are derived according to the main phases of the ADDIE model (Section 3). In Section 4, findings regarding the research questions are presented. Finally, conclusions are drawn regarding the transferability of the training across professional contexts (Section 5).

2 | Conceptual Background and Prior Research

2.1 | Framework of Critical Online Reasoning (COR)

The COR framework (Molerov et al. 2020) was used as a conceptual basis. This framework, derived from a systematic analysis and synthesis of relevant related constructs (e.g., information problem-solving), outlines a necessary skillset for the competent use of online information. It is defined as the ability to effectively "search, select, access, process, and use online information to solve a given problem or build knowledge from this online information while critically distinguishing trustworthy from untrustworthy information and reasoning argumentatively based on trustworthy and relevant information from the online environment" (Molerov et al. 2020, p. 7). According to this definition, COR consists of the following three main interconnecting facets:

- Online Information Acquisition (OIA): OIA concentrates on searching and accessing online information, for example, using search queries on search engines and databases or visiting websites.
- Critical Information Evaluation (CIE): CIE focuses on the selection and evaluation of information sources based on website features (graphics, text, audio-visuals) to differentiate between high- and low-quality sources.
- Reasoning based on Evidence, Argumentation, and Synthesis (REAS): REAS focuses on the integrative evaluation of collected information as well as the consideration of different (possibly contradictory) perspectives in an argumentatively coherent manner.

A corresponding newly developed Internet-based COR assessment was comprehensively validated (Nagel et al. 2022). This research indicates substantial deficits in respective COR skills among students and graduates. Therefore, the superordinate objective of the training was to minimize the deficits existing after college studies and to foster effective all three COR facets in professional training.

Based on the COR validation, the (meta)cognitive requirements were conceptually further differentiated into generic and domain-specific contexts (GEN- and DOM-COR; Zlatkin-Troitschanskaia et al. 2021), assuming that the main COR facets are the same in GEN- and DOM-COR contexts, but that their specific combination and application can lead to different profiles and development paths within and across domains. Research indicates a significant impact of domain-specific knowledge of search behaviour (Liu and Zhang 2019). Experts use extensive knowledge to craft more complex and precise search queries when compared to those of novices. Their

expertize enables them to reformulate and recombine queries effectively, enhancing their ability to find relevant information. Thus, understanding the search behaviour of experts can help improve how information is searched for via web-based sources by identifying specific strategies related to web experience or domain knowledge (e.g., Watanabe et al. 2022; Brand-Gruwel et al. 2017). This research was considered in designing different modules for training GEN- and DOM-COR skills respectively in the three domains.

2.2 | Training Methods of COR-Related Skills

Research and practical experiences consistently emphasize the relevance of the critical handling of online media in professional training (McGrew and Chinoy 2022; O'Connor et al. 2021). However, while various training methods exist to foster single COR-related facets, no comprehensive approach covers all relevant skills across different professional domains.

The most prevalent training method is the usage of checklists, where users systematically assess website credibility using predefined criteria (Shah et al. 2015). For instance, the RADCAB method by Christennson (2006) includes the criteria Relevance, Appropriateness, Detail, Currency, Authority and Bias. Similarly, the CRAAP test by Blakeslee (2004) assesses Currency, Relevance, Authority, Accuracy and Purpose. The more criteria are applied, the more credible is the corresponding source. While these checklists outline the relevant evaluation criteria, their practical implementation and prioritization are not clearly explained (Meola 2004). Additionally, the criteria application varies across media types and professional contexts and the simplistic 'right-or-wrong' approach overlooks the complexity of online media (Breakstone et al. 2018). The Checklist approach connects with COR based on credibility cues, similar to CIE skills, but overlooks OIA and REAS facets.

Another method involves presenting exemplary online media that exhibit highly incredible, extremist or disinformation features (Mathson and Lorenzen 2008). First, preselected online media containing dubious features are presented to the students. Subsequently, they receive further examples from various fields in which the credibility cues are harder to detect. While this method is extremely illustrative, the preselected media are always topic-related (Meola 2004). Moreover, identifying disinformation is oftentimes harder in reality than in the selected examples. Consequently, students are sensitized to untrustworthy sources in the presented topics but fail to evaluate sources in other fields. Although this method especially addresses the CIE facet by examining specific cues and the evidential value of online sources, it also neglects the OIA and REAS facets, since it does not practice accessing and selecting online sources for decision-making purposes.

Meola. (2004) 'context approach' highlights that the Internet contains both erroneous and credible information (e.g., in verified databases of libraries), which students must learn to access and use effectively. Instead of simply analyzing predefined criteria, such as accuracy or relevance, students are encouraged to access credible information sources and compare them with at least two additional sources. The comparison strategy is vital to verifying information with proof and evidence (Dahlen 2012). Identifying similarities and differences between sources activates a (meta)cognitive process, aiding in the detection of biases and misleading statements. In contrast to the checklist and example approaches, students are asked to freely navigate the Internet and search for data and facts from credible sources to prove the online source. This approach specifically addresses the OIA and CIE facets and highlights that the competent use of online sources entails a multistep process aligning with the COR definition (Molerov et al. 2020). However, the REAS facet is hardly considered.

Another method, rooted in cognitive development theory (Jackson 2007), aligns with the 'Perry scheme' (Perry 1970), which posits nine cognitive stages that students progress through during their studies. Consequently, training methods should cater to students' cognitive stages, offering tasks of varying difficulty levels that foster the students' strengths and weaknesses. The recognition of students' cognitive stages informs a constructivist approach to web evaluation (Benjes-Small et al. 2013), where learners actively construct their knowledge instead of passively absorbing information. Instead of presenting preselected media and checklists, tasks following this method encourage students to freely navigate the Internet and evaluate sources based on their criteria. Feedback is essential to ensure students' learning success, allowing them to reflect on their solutions and internalize the targeted skills more effectively (Benjes-Small et al. 2013). Although this method requires complex development and implementation, it promises the highest knowledge gain, as its learner-centred strategy adapts tasks to students' cognitive stages (Jackson 2007).

Additionally, prior research emphasizes the relevance of autonomous training in real-world scenarios (Taylor and Dalal 2014). This entails students learning to utilize search and evaluation strategies in decision-making and action in varying professional contexts, facilitating the successful transfer of such strategies and skills across specific contexts (Grossman and Salas 2011). These previous methods and findings were systematically considered in the conceptualization of COR training.

2.3 | ADDIE Model of Instructional Design for WBTs

Before conceptualizing the content of the training, its technological format and didactic structure were determined. The terms 'technological format' and 'didactic structure' refer to the specific ways in which the training is delivered and organized. The technological format encompasses the tools and platforms used to facilitate learning, while the didactic structure pertains to the organization and presentation of the content.

As the training seeks to improve online skills, the technical WBT format was selected as it can be easily accessed directly via web browsers without specific software, allowing users to participate anytime and anywhere. WBTs are particularly well-suited for graduates in professional training, enabling them to flexibly engage with the learning material before, during, or after work, and also revisit content at their own pace on mobile

devices or laptops (Driscoll 2002). WBTs further support individualized learning experiences by allowing users to pause, resume and repeat modules as needed, without disrupting the overall learning process. This is particularly advantageous in view of the varying prior knowledge and learning types of the target group. Additionally, WBTs enable the collection of user data to monitor learning progress, provide feedback to users and guide training developers in improving the training modules, which also simplifies the adaptability and transfer of the training to a wider range of professional contexts (Caballé et al. 2014). The Internet environment of a WBT facilitates reciprocal feedback since users can easily fill out and send contact forms communicating criticism and suggestions for improvement as well as receive corrective feedback regarding their training results (Wang and Wu 2008). Such feedback is essential for the subsequent orientation towards the training objectives (Brown 2017).

WBT is compatible with various media designs (i.e., interactive applications, direct integrations of online media via links), and modules can be flexibly complemented and adapted (Drigas and Karyotaki 2016). Apart from the potential costs of a WBT, a critical factor is the dependence on stable Internet connection and technical infrastructure, which should ideally be the same for all users.

WBT's didactic structure relies on the most prevalent learning theory in this field: Instructional Design, defined by Smith and Ragan (2005, p. 8) as "the systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation", aiming at the best possible learning environment for a given training purpose and its underlying conditions. Several corresponding theoretical models exist focusing on the implementation of didactic and psychological principles for the conception and serving as frameworks for the design of e-learning methods (Kerres 2018; Niegemann and Niegemann 2018; van Merriënboer et al. 2002). A model predominantly used for the conceptualization of digital teaching environments is the ADDIE model (Branch 2009).

In the first phase, 'Analysis', the needs of the training and learning offer, the overarching guidelines, as well as the training objectives and content are determined. Additionally, the requirements of the target group are analyzed, which are essential for developing a competence profile and deriving purposeful learning strategies (Branch 2009). The analyses form the basis of the actual learning modules and content (Hodell 2007). In the second phase, 'Design', the external structure of the training is established, in which the content is grouped and sequenced into modules by determining their order and duration (Welty 2007). In the third phase, 'Development', the actual learning material is created and designed by developing single tasks, audio recordings or videos (Hodell 2007). In the 'Implementation' phase, the conceptualized learning tool is tested in practice (Saltsman and Shelton 2011). The final 'Evaluation' phase entails a summative and formative evaluation of the learning tool and usually leads to a revision and improvement of the concept. Despite criticism of its rigid structure, this model provides a progressive development process and facilitates a logical and transparent conceptualization, which is usually carried out in iterative loops.

3 | Research Questions

In accordance with the above-mentioned theoretical foundations and the five phases of the ADDIE model, the following research questions are derived, which correspond to these main phases:

RQ1 *"Analysis": What are the main training objectives needed for training in the target population, i.e., which particular skills in development must training focus on across the three professional domains?*

To investigate RQ1, an analysis of special COR-related requirements across the three domains was conducted. Interviews with experts from the three domains were subsequently carried out. Finally, data from a survey on prior COR-related training experiences and expectations of online training in professional practice were analyzed. Based on the results of RQ1, the next phase addressed:

RQ2 "Design": How must training be designed to effectively meet the needs and expectations regarding the promotion of COR skills in professional training across the three domains?

To explore RQ2, and thus derive the general structure and create a template for the learning modules and content of the training, established didactic principles and digital learning models drawn from pertinent research were considered. Furthermore, these prior findings and training methods were appended to the construct definition of COR and its facets (Molerov et al. 2020), which describe the individual skills to be fostered. Building on this, detailed learning objectives for each module were formulated and operationalized.

Since the COR training seeks to improve the critical use of online media, Web-Based training (WBT) was selected as the most suitable format. WBT enables the direct integration of relevant online media for the training, offers students the opportunity to pursue training courses independently, and allows developers to save and evaluate user data, which provides important insights into users' learning processes (Garrison 2011).

In the next phase, the WBT needs to be theoretically and content-wise conceptualized based on established didactic principles and learning models. Thus, the following RQ was investigated:

RQ3 "Development": How should the training materials be developed, considering technological, didactic, and content-oriented criteria?

To address RQ3, the design of the graphical user interface (GUI) for the WBT was conceived, and careful consideration was given to media didactic design elements (Lee and Owens 2004). Subsequently, training methods were derived from the predefined learning objectives. These methods incorporated practices suitable for e-learning as well as the traditional design elements of WBT, including text, video and images (Lee and Owens 2004). Additionally, practices were informed by adhering to established principles of multimedia learning (Mayer 2017) to

enhance instructional effectiveness in the multimedia learning environment.

In the next phase, addressing RQ4 of the 'technical Implementation', the learning content undergoes practical testing, facilitating the practical application of the instructional design. The WBT was implemented using the open-source learning management system 'Moodle', which allowed participants to access the training independently (Costello 2013). The web-based format provided flexibility in timing and location, and could therefore be adapted to participants' schedules. Moodle also facilitated data collection and feedback, helping monitor the participants' progress.

During the final phase, 'Evaluation', both summative and formative assessments were conducted on the learning content. It was tested among law, medical and teaching trainees during their practical training in Germany. The COR training was evaluated using pre- and post-assessment surveys and participant feedback, addressing RQ5 "*What conclusions can be drawn in terms of its effectivity and transferability?*"

4 | Analysis, Design, Development, Implementation and Evaluation of the COR Training

4.1 | Requirement Analysis

The first phase of the ADDIE model, 'Analysis', sets out the requirements for training. Due to increasing digitalization, the competent use of online information has become an essential skill in the 21st century for several professions. This is especially true for fields requiring evidence-based decision-making and acting, that is, training medical, teaching and legal professionals. However, graduates and trainees often lack the necessary skills, for example, to critically evaluate online information (McGrew and Chinoy 2022). Although such weaknesses are widely known, there exists no training approach, which promotes all relevant skills for critically dealing with online information. Based on the COR concept and previous training approaches, this research deficit is addressed by conceptualizing training in the WBT format.

The overarching training objectives are derived from drawing on previous research (e.g., Merrill 2015; Kerres 2018). According to Möller. (1976) theory of learning objective levels, which vary in their degree of abstraction, overarching training objectives only provide a general description of the intended behaviour of the training, without the presence of a concrete assessment standard for verifying the realization of these objectives. These objectives refer exclusively to the area of intended changes according to learning objective taxonomies (see Section 4.4) and provide an initial rough specification of the training content:

- secure, technical navigating of the Internet;
- critically access and evaluate information on the Internet;
- apply evidence-based argumentation methods;
- metacognitively reflect on the learning process.

The intention of the training is to foster COR skills, reflecting the individual learning process and contributing to lifelong learning (Dahlen 2012), that is, the trainees and young professionals acquire transferable knowledge and skills, applicable to different professional contexts.

The target group was then defined and analyzed according to their learning requirements. To derive a meaningful learning strategy, background data and the relevant knowledge of learners were determined. A requirement was characterized by a gap between the level of COR skills and their target level after completing the training. The requirement analysis served as the basis of a competence profile, which contains all relevant COR skills that participants should possess on completion. This analysis was essential to define the content and focus of training (Saltsman and Shelton 2011) as well as to assess the anticipated benefits for the target group, particularly how the training content supports their professional practice and enhances their motivation for learning (Dahlen 2012).

4.2 | Analysis of the Target Group

The target group includes medical, legal and teacher trainees in their practical training (preparation for prospective professional career) in Germany who participated in the BRIDGE project (see Table 1). To understand the requirements of COR training, semi-structured interviews were conducted with a total of 20 experts across the three domains: medicine, law and teaching. The experts included physicians with affiliations to medical education and evidence-based medicine, lawyers with a background in educational science and experienced teachers involved in professional training. The interviews examined the relevance of COR for everyday working life in its respective domain. Additionally, the assessment of the extent to which these skills are already considered in higher education and professional training was investigated, as well as the suggested approaches to COR instruction. The responses were then examined through qualitative content analysis (Mayring 2003). The interviews allowed for in-depth exploration of each expert's perspective on COR skills and training needs. Thematic analysis was employed to identify key themes and insights from the interviews, which were then integrated into the training design.

With an average age of 25.1 years, the target group corresponds to the main users of the Internet who have grown up in an environment dominated by the Internet ('Google Generation'; Rowlands et al. 2008). Since all participants have completed their college studies, it is assumed the target group has at least achieved the cognitive stage of *relativistic thinking* (Black and Allen 2017). All participants are adult learners who, in contrast to children and adolescents, are characterized by higher self-motivation, goal orientation and the ability to build upon existing knowledge (Conde-Gafaro 2022). These characteristics are considered when designing the learning tools in subsequent phases.

In all domains, practical training promotes the application of acquired knowledge and skills in different professional contexts, which are essential for working life. Medical students are

TABLE 1 | General characteristics of the target group in medicine, law and teacher education.

Domain	(Human) Medicine	Law	Teaching
Average age	26.2	24.4	24.8
Gender	Female: 63.3%	Female: 55.9%	Female: 61.6%
	Male: 36.7%	Male: 44.1%	Male 38.4%
Duration of practical training	12 months (4 months each in the areas of internal and general medicine, surgery or a further clinical-practical domain)	2 years (min. of three months each at a civil or criminal court, prosecution, administrative authority, so on)	18 months (Hesse: 21 months; Bavaria: 24 months) in the respective subject of teaching (here, economics)
Objective of practical training	Practical application of knowledge and skills from college studies	Familiarization with legal professional practice and its social foundations	Preparation for professional practice through autonomous teaching
Required (written) reports in practical training	Logbook documenting observed/ applied work techniques, clinical cases, and so on.	Assisting in preparing documents in practical legal contexts (e.g., court reports)	Various written reports (e.g., observation reports, lesson plans)

required to keep a logbook, whereas students from law and teacher education must regularly prepare written documents focusing on tasks related to professional practice. The target group is confronted with new tasks and content in their practical training and thus has an acute need for information (e.g., in clinical cases, court decisions, lesson plans). Inferring from previous studies, they are likely to use the Internet, especially when quickly accessing information (Grothaus et al. 2021). Therefore, the target group can benefit practically from the WBT by fostering COR skill within the three domains.

In *medicine*, online media are becoming increasingly important for professional practice (Mesko and Győrffy 2019); the Internet has become a significant research tool for disease patterns and diagnostics. Apart from consulting databases, search engines are commonly used in medical practice, for example, to access medical guidelines and survey articles. The study curriculum in Germany has not yet been adapted for digitalization nor is there a unified schedule for teaching COR skills (Haag et al. 2018): about 60% of medical students rated their search engine skills as good; in using online databases, 50% rated their skills as good. This corresponds with other studies on digital competences among medical students (O'Carroll et al. 2015) and with the results of this study, in which medical students were surveyed regarding their media usage. Although they report COR as a necessary skillset for study and professional success, they indicate that it has only moderately been addressed during their college studies (Nagel et al. 2024). Remarkably, they regard REAS as the most important facet of COR. Medical students regularly prefer online medical databases (AMBOSS, PubMed), which they also classify as the most credible type of media, and favour online sources over print media (e.g., textbooks). The actual frequency and preferences of online media use and the deficits in COR skills imply a strong need to train these skills.

In *law*, a similar picture emerges. A self-organized and critical examination of underlying factual circumstances and cases in professional practice is needed (Drapezo et al. 2022). The increasing offer of digital media and expert literature on the Internet leads to a complex environment of juridical research instruments, demanding legal professionals to access and deal critically with online information. The curriculum of law studies in Germany is also lacking courses focusing on COR, which has effects on achievement among law students, that is, the repeated usage of unreliable online sources in term papers (Braunheim et al. 2023). Law students are generally taught to search for judgements and legislative texts but not evidence-based online information. Law graduates who participated in the BRIDGE project also consider COR skills as highly important for their study and professional success, with REAS being considered the most relevant COR facet. Compared to medical students, they report that COR has been less present in their college studies. They also prefer legal online databases (Beck-online, Juris), followed by textbooks and lecturers' slides. They further regard databases and textbooks as most reliable.

In *teaching*, COR is also essential, since teachers are not only required to critically deal with online information in their professional practice but also 'transmit' relevant skills to students. Although e-learning and technical facilities have recently been addressed (similar to medicine and law), there exists no unified curriculum for COR skills in teacher education. Student teachers learn to technically administer online media but rarely to navigate them critically. This corresponds with the findings from the surveyed trainee teachers, who regard COR and especially REAS as a necessary facet for their study and professional success, but criticize how the respective skillset has only moderately been addressed during their studies. As the Internet is increasingly used as a resource for planning and designing lessons, a lack in COR can have substantially negative effects on the quality of teaching. For instance, illustrative learning materials can easily be retrieved; however, the vast amount of freely accessible content needs to be examined. While student teachers regard their abilities in searching and processing online information as high, they rate their abilities in analysing, reflecting and solving information problems as low.

In addition, interviews with experts from the three domains were conducted who reported that COR is necessary for medical, legal and teaching professional practice, but not

systematically and sufficiently promoted during college studies. Experts state that the importance of COR has increased over the past decade and a high risk of adopting technically and didactically wrong information exists. The experts state it is crucial for trainees in these domains to understand the initial research problem and connect it to expert knowledge to find relevant and credible information. The metacognitive facet also plays a significant role in the overall research process, for example, to be able to engage in critical evaluation of sources (Brand-Grwuel and Wopereis 2006). Moreover, trainees should be instructed to use precise search terms and operators in search engines and databases. All experts regard the usage of search engines as more complex and critical in contrast to databases. Targeted training of COR skills is thus essential.

The results of the requirement analysis correspond with previous studies, indicating that prospective medical, legal and teaching professionals have weaknesses in critically examining online media, despite this skillset being crucial in these domains. A lack of instruction of COR in the study curricula exists. For instance, while search engines and databases are predominantly used to access online information, students have difficulty competently dealing with these types of media. Overall, there is a substantial need for the COR training for the three domains.

4.3 | Targeted Competence Profiles

The requirement analysis elaborates a competence profile describing the target state of COR skills after completing training. The required COR skills can be tied to specific activities on the Internet, which are defined in the information problem-solving model (IPS-I) by Brand-Grwuel and Wopereis (2006). Since the process-related character of COR is particularly important in the newly developed training, the IPS-I model serves as a key reference to specify the required COR *processes*. This also ensures that the training does not promote the three COR facets separately, as in previous approaches, but integrates them into a cohesive learning process. The link to the IPS-I model highlights that the new training programme portrays an entire research process in its natural sequence, emphasizing the interconnections between the COR facets.

Defining the information problem constitutes the first step, which is central to understanding the given problem, activating previous knowledge, developing a goal-oriented strategy and applying it, for example, by using search engines to access the required information. The information is then skimmed, selected and examined. Finally, the results are evaluated, summarized and presented. To address the entire COR process, the structure of the IPS-I model was transferred and extended to the COR concept, as shown in the resulting competence profile (see Table 2). The left columns contain the activities of the IPS-I model transferred to the facets of COR. The right columns describe all skills to be fostered through training. For instance, to obtain credible information from the Internet, trainees must technically navigate the Internet and develop, implement and adjust their search strategy to find the required information. Therefore, they must orient themselves in the overall COR process and reflect on each stage of online information processing.

Following the IPS-I model, the COR process begins with the definition of an information problem, that is, trainees can specify the goal of a research problem to derive a suitable and applicable strategy. When subsequently searching for information, trainees need to select an appropriate platform, for example, a search engine, to access information. They further need to recognize, select and understand relevant terms and text passages and correctly evaluate the credibility cues of the sources. Trainees should access and compare multiple sources and simultaneously skim texts, and identify and evaluate credibility cues in iterative loops. Subsequently, trainees must examine the argumentative structure of a source. Finally, the information needs to be summarized, structured and prioritized to form a concluding judgement. This step requires trainees to bundle the content and create a valid, sound argument, that is, regarding the credibility of a source. All these skills should therefore be taught in the COR training.

4.4 | Training Objectives

The competence profile of COR allows for defined learning objectives to be derived, which then serve as a basis to construct learning units in subsequent phases. In addition to the overarching training objectives (see Section 4.1), defined learning objectives have the highest degree of concretization. With regard to individual training modules, they can be regarded as sequence-related learning objectives in the overall learning process (Möller 1976). A successful learning process should address all groups of educational activities and their respective taxonomies. This study considers three types of taxonomies, which encompass disparate aspects of learning objectives. The first is the taxonomy of cognitive learning objectives, which focuses on targeted mental skills and knowledge (Bloom et al. 1956) revised by Anderson and Krathwohl (2001), and further developed to digital-related taxonomies by Passig (2003) and Churches (2010). The second is the taxonomy of affective learning objectives, which concerns related attitudes and emotions (Krathwohl et al. 1984). The third is the taxonomy of psychomotor learning objectives, which comprises relevant manual and physical skills (Dave 1968). Considering the taxonomies and the taxonomy levels they encompass, the initial training learning units were designed to commence at the lower levels of taxonomy and to progress towards higher levels as the training advanced. A set of tasks therefore becomes increasingly complex to achieve, not only the reproduction of knowledge, but also the evaluation of newly acquired content and the transfer of knowledge into professional practical tasks. Thus, the classification of learning objectives according to educational activities allows for the ordering and operationalizing of the training activities and are therefore considered in the following conceptualizations. The definitions of the learning objectives are predominantly based on the relevant curricular dispositions, as well as the evaluations from the expert interviews (Section 4.2). These definitions are then mapped into the above-mentioned teaching-learning taxonomies (Section 4.4).

The content of the training constitutes securely and technically navigating the Internet. Although the target group is expected to be familiar with the overall function of the Internet, specific

TABLE 2 | Competence profile of COR.

IPS-I Model	Framework of COR	Actions and related competences of COR
	Metacognitive activation (MCA)	Activation of and orientation in the research process and reflection on the status of information acquisition
		Development of a research strategy to solve an information problem, for example, in terms of finding information, extracting content, etc., in iterative loops until the required information is found/information problem is solved
		Recognition of information problem: Intention and objective of information acquisition, examination of the initial situation
Define information problem Search for information	Online information acquisition (OIA)	Selection of a point of access/platform/source for information acquisition (search engine, database and so on)
		Implementation of research strategy on the point of access/platform/source (entering precise search terms and URLs, following links, and so on)
Scan/process information		Identification, selection, reading and understanding of relevant content and entries
	Critical information evaluation (CIE)	Accessing and comparing multiple (external) online sources; Identification and evaluation of credibility cues
		Examination regarding evidential value, objectivity, validity and stringency
Organize and present information	Reasoning based on evidence, argumentation and synthesis (REAS)	Identification of arguments and their specific components in an online source/structuring and weighing of information collected in previous steps
		Creating a correct, evaluative judgement regarding the credibility of an online source and concluding synthesis of the information problem
		Creating a convincing, evidence-based solution to the information problem, for example, an argument in favour of/against the credibility of sources used

COR-relevant terms (e.g., browser, URL) should be defined more precisely. This ensures a unified basic vocabulary and understanding throughout the training and also enables more accurate feedback. Additionally, effective Internet navigation requires secure eye-hand coordination. The resulting *(cognitive; psychomotor)* learning objective is:

1. *Trainees name all COR-relevant technical terms and demonstrate secure technical use of the Internet*

Second, the recognition and definition of the information problem is crucial to deriving a goal-oriented, efficient search strategy and avoid wasting time browsing the Internet. Trainees need to specify the intention and requirements of the information problem to form all subsequent search steps (Dahlen 2012). As the training focuses on the improvement of students' COR in different generic and domain-specific professional contexts, it comprises dealing with general content, for example, ecological issues as well as relevant aspects of the domains. After defining the information problem, trainees must develop a research strategy, which usually involves comparing multiple sources to select the most suitable one(s). The *(cognitive)* learning objective is:

2. *Trainees define an underlying information problem and derive a goal-oriented research strategy*

Next, the practical implementation of the research strategy follows where trainees select a platform to access information, that is, search engines or databases. Databases and online libraries are usually designed for academic purposes, whereas search engines serve rather general research objectives. As search engines are increasingly used when accessing information in studies and professional practice, training aims to improve the use of the most popular search engine Google (Taylor and Dalal 2014). Google is the most comprehensive search engine, enabling access to, for example, websites, pictures, digitalized books and scientific articles. The training thus focuses on using Google and its search options, which requires the ability to enter and adjust search queries with precision, using keyboard and mouse clicks, leading to the *(cognitive; psychomotor)* learning objective:

3. *Trainees define and purposefully apply the functions of Google*

   The search results are presented in rankings on search engine results pages (SERPs), containing the title, summary of the content and link to the respective results. Trainees must read the SERPs to find relevant sources in a short time. This activity is defined as 'skimming' or 'scanning' (Jalbout and Taleb 2019). Skimming is an efficient methodology to quickly recognize suitable information, and thus essential for the COR training. The *(cognitive)* learning objective is:

4. *Trainees quickly identify and highlight relevant content within search results and linked online sources*

   Since the SERPs and linked websites could also contain unreliable or erroneous information, trainees must examine the content for credibility, that is, brand logos, advertisement and vocabulary (McGrew and Chinoy 2022). The purpose is to accustom trainees to cues relating to the credibility of a source (Choi 2015). This step is crucial to sensitize trainees to credibility cues so that they learn to identify, interpret and internalize them as part of their value system. The *(cognitive; affective)* learning objective is:

5. *Trainees identify and classify credibility cues of search results and online sources*

   Next, trainees are required to access and compare multiple online sources simultaneously. This is an essential step in understanding the necessity of examining information by comparing various sources (Taylor and Dalal 2014). Cross-checking online sources not only provides an essential reference base to detect erroneous information but also verifies credible content (Choi 2015). Accordingly, the *(cognitive; affective)* learning objective is:

6. *Trainees cross-check multiple online sources and critically compare content*

   For the comprehension of online sources, trainees need to identify and evaluate arguments and their components. Based on the Toulmin model (Toulmin 1958), which subdivides arguments into five components (claim, reason, evidence, warrant and response), trainees are taught to recognize these elements and examine the quality of argumentative structures within online sources in relation to their evidential value, objectivity, validity and stringency, leading to the *(cognitive; partially affective)* learning objective:

7. *Trainees identify and examine the components and quality criteria of an argument*

   REAS also comprises an evaluative judgement, for example, regarding the credibility of an online source, and constructing a concluding synthesis of information. This must be structured and summarized into a convincing, evidence-based solution. This step relies on the learning content of examining argumentative structures, which can now be used for creating one's own comprehensive argument. It incorporates the extended cognitive and emotional responses previously acquired upon completion of the preceding modules. The *(cognitive; affective)* learning objective is:

8. *Trainees structure and connect information throughout the research process and make a concluding evaluative judgement*

   As the training intends to foster GEN- and DOM-COR, a learning content includes the effective use of research tools in practical training. The use of specialized databases is highly relevant for prospective law and medical professionals, whereas prospective teachers search the Internet for methods and media for their lessons. The COR training consequently aims to introduce the most prevalent types of domain-specific online media for research and integrate them into professional practice. The *(cognitive; affective)* learning objective is:

9. *Trainees effectively utilize the most prevalent research tools in their respective professional domain*

   Finally, the training not only aims to improve trainees' COR skills but also how they reflect on their overall learning process. Trainees thereby connect learning content with mental processing. They should therefore think about their newly acquired skills to recognize their learning progress, which in turn will motivate them to further improve (Dahlen 2012). This step contains analyses of the trainees' expectations of the training, difficulties and learning results. The results provide useful insights for the trainees as well as for revising and improving the training. The *(affective)* learning objective is:

10. *Trainees define learning objectives for themselves and analyze and reflect on their learning process*

    These content and learning objectives are subsequently formed into modules in the next phases of training conceptualization.

4.5 | Training Design

In the 'Design' phase, the structure, order and duration of the training are defined (Saltsman and Shelton 2011). First, the learning objectives are narrowed down to determine the structure, order and modules of the training. Accordingly, the content is grouped into nine modules (see Table 3). The first module, 'Preparation and Planning of a Goal-Oriented Information Acquisition', contains two learning units, focusing on the technical terms and navigating the Internet, and the definition of the research problem and strategy. Units 3 to 6 are part of the module "Efficient Research with Google" in which the search functions, effective use of search terms and operators are explained. Units 7 and 8 focus on the 'Skimming and Scanning of Information' of search engine results and linked websites. Units 9–11 form the module 'Credibility Cues' that teaches structural and textual indicators of the credibility of online sources. Unit 12, 'Cross-Checking', focuses on the simultaneous comparison of multiple external sources. The subsequent module 'Argumentation Analysis', which consists of units 13 and 14, instructs the components and quality criteria of a valid

TABLE 3 | Structure of the COR training.

Modules	Units	
Self-reflection	Self-reflection	↴
Preparation and planning of a goal-oriented information acquisition	Technical terms and handling of the internet	Feedback + Reflection
	Information problem and research strategy	
Efficient research with the Search Engine Google	Google Functions I	Feedback + Reflection
	Google Functions II	
	Effective Search Terms	
	Google Operators	
Skimming and scanning of information	Skimming and scanning of search engine results	Feedback + Reflection
	Skimming and scanning of online sources	
Credibility cues	Source cues	Feedback + Reflection
	Author cues	
	Text cues	
Cross-checking	Cross-checking of online sources	Feedback + Reflection
Argumentation analysis	Components and Variants of an Argument	Feedback + Reflection
	Quality criteria of an argument	
Judgement formation and research synthesis	Summarizing information/passing a judgement	Feedback + Reflection
	Construction of an evidence-based argument	
Effective research in law, medicine and teaching	Effective research in teacher education	Feedback + Reflection
	Effective research in medicine	
	Effective research in law	
Self-reflection	Self-reflection	↵

argument. Units 15 and 16, which form the module 'Judgement Formation and Research Synthesis', comprise creating a final evaluative judgement and an evidence-based solution to the information problem. Units 17–19 of 'Effective Research in Law, Medicine and Teaching' concentrate on the usage of the most used domain-specific research methods in the respective domains. Finally, the units 'Feedback and Reflection' form the module 'Self-Reflection', which serves as reflection points at the start, during and end of the COR training.

Based on the principle of sequencing an action process by the ISP-I model, the structure of the training modules follows the order of an entire COR process (Table 2); that is, trainees undergo and internalize the interrelated steps of solving an information problem from beginning to end. This structure allows for the construction of progressive learning material that is embedded into a unified context, that is, one authentic information problem that is solved during training. As each module constitutes a relevant step of the overall COR process, all learning units are mandatory. The feedback and reflection units are to be inserted after the completion of a module.

The duration of the training is flexible and determined by the available time and attention span of trainees, that is, focusing on a task without getting distracted. On average, adults have an attention span of 20 min (Bradbury 2016). After that, instructional methods should be changed to effectively use the available time and achieve the learning objectives. Accordingly, the training consists of short micro-learning units approximately 15 min in length, after which trainees receive direct, corrective feedback. In two units, training requires 30 min (per day). The training modules are connected, except for units 11 and 12. Since unit 12 requires the application of all skills, there is no interruption to the overall learning process. The overall training duration, including two reflection units (20 min), is 285 min (4.75 h). As the WBT allows the trainees to process the training individually, depending on their individual learning speed, deviations may occur.

Before and after the training, the corresponding pre- and post-assessment surveys are processed independently and take approximately 10 min each.

Based on this external structure, the internal structure of the training, that is, the visual representation and individual learning units, is conceptualized next.

4.6 | Training Development

The 'Development' phase deals with the creation of individual learning units and their material (Saltsman and Shelton 2011). In the first step of the 'Development' phase, the GUI is specified. Since this paper focuses on the theoretical elaboration of the training, and not the detailed technical implementation, only the main GUI used to navigate and process individual tasks is exemplarily described here. The GUI delivers the first impression of the training and should thus be aesthetic but also functional, as its design also has a strong motivational impact (Lee and Owens 2004). The GUI consists of three main elements. The 'marking area' shows the users which training module they are processing. In the 'learning and working area', the tasks are presented and solved. The 'control area' contains all navigation functions. Fixed control elements are presented horizontally as they follow the natural viewing angle and eye movements when reading (Pettersson 2014). Additionally, control elements, which need to be accessed repeatedly, that is, notepads or glossaries, are found more easily (Johnson 2014). Overall, the functional division of the GUI is well structured and clearly visible (see Figure 1).

The marking area is situated at the top of the GUI, signaling the respective training module, unit and page number. Underneath is the learning and working area, which is metaphorically designed as a desk surface, since realistic analogies have a positive impact on working motivation and efficiency (Johnson 2014). The control area is located at the bottom, which allows users to navigate through the training, save their progress and write down notes on a virtual notepad, look up technical terms in a glossary and contact the training developers for feedback. Furthermore, trainees can jump back and forth between pages and report difficulties.

After the trainees log into the WBT via a web browser, they are presented with a welcome page introducing them to the training and listing its intentions, clarifying the benefits and motivating trainees. Moreover, the most important navigation functions are explained, and trainees start the training.

In addition to GUI, further didactical considerations are important. The target group of the training is graduates in practical training, who possess previous knowledge and who are characterized by a goal-oriented, self-motivated working behaviour (Dahlen 2012). Tasks should thus be designed to intrinsically motivate trainees throughout the entire module by having them engage in meaningful practice-related tasks. This is accomplished by presenting explicit learning objectives and the practical significance of the learning content when introducing each module. Moreover, motivation is maintained though the provision of feedback and completion of reflective tasks after each module.

To avoid demotivation and confusion, it is essential for trainees to recognize an actual benefit to training (Gegenfurtner et al. 2016). This is best achieved if trainees directly implement

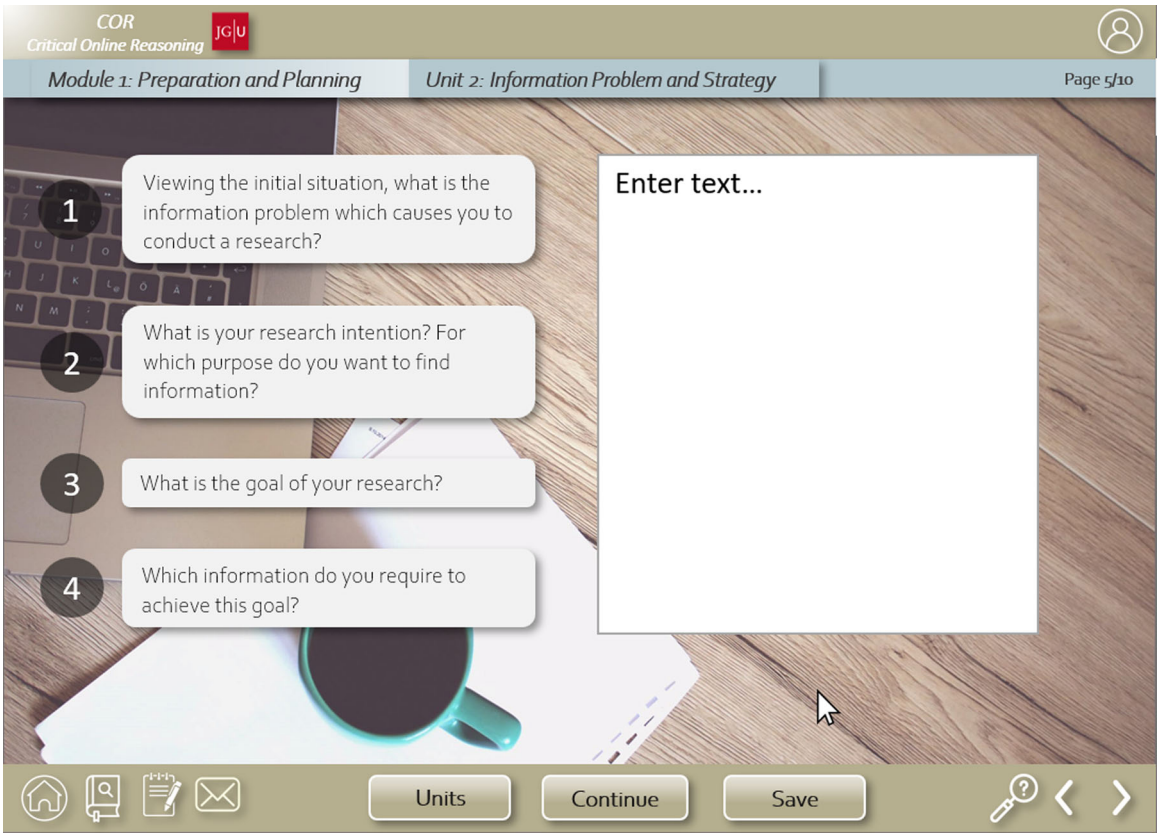

FIGURE 1 | Schematic presentation of the GUI. [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 4 | Principles of multimedia learning (Mayer 2017).

Principle	Design implications
Coherence principle	Avoid irrelevant words, images and sounds.
Signaling principle	Highlight important information deliberately.
Redundancy principle	No simultaneous text is necessary when verbal explanations accompany images.
Spatial contiguity principle	Place related text and images close together (not far apart).
Temporal contiguity principle	Present related text and images at the same time.
Segmentation principle	Break learning units into smaller sections that learners can progress through at their own pace.
Pre-training principle	Ensure relevant terms are known beforehand.
Modality principle	Explain images with spoken text.
Multimedia principle	Use both text and corresponding images, instead of text alone.
Personalization principle	Write texts in a conversational style (instead of formal language, for example, through direct address).
Voice principle	Use human voices instead of computer-generated voices.
Image principle	Showing the speaker's image does not improve learning outcomes.

the acquired knowledge (Dahlen 2012). Previous knowledge is activated by using introductory pages listing the learning intentions at the beginning of each module and through the pre-assessment survey before the training. To engage learners in real-world problem-solving and decision-making, as introduced in *design-based instruction* (Fortus et al. 2004), *scenario-based* learning modules were developed (Clark 2009). The tasks were designed using authentic/realistic *action-oriented* examples (Griesehop 2017), which facilitate the transfer of knowledge to daily and professional life (Boere et al. 2023). These include prevalent *problem-based* scenarios (Merrill 2002), such as retrieving clinical information for the development of evidence-based diagnostic plans in medicine, identifying reliable legal sources and productive use of recognized legal databases, and for the research for teaching materials to create authentic lesson plans. By providing scenarios that reflect these challenges, the training enables trainees to practice critical online reasoning skills in a context that mirrors future professional experiences. Subsequently, the description of single learning units is derived from the preceding structure and learning objectives. The theoretical-didactical conceptualization and the design of WBTs, that is, videos and interactive elements are mainly based on *constructivist learning theory* (Driscoll 2007) and *principles of multimedia learning* (Mayer 2017; see Table 4).

4.7 | Training Implementation and Evaluation

As this paper focuses on the theoretical and didactic conceptualization of the training, the two final phases 'Implementation' and 'Evaluation' are only briefly outlined. In the 'Implementation' phase, the designed learning content is tested and applied practically. The WBT was deployed via the open-source learning management system 'Moodle', selected for its extensive capabilities in creating multimedia learning materials and integrating content from diverse sources into a digital training environment (Costello 2013). Moodle helped trainees to access the WBT autonomously using a laptop/computer from home. The WBT was available for a duration of approximately 6 weeks, during which the participants were notified of the specific time frame allocated for the training. All trainees participated in the WBT on a part-time and voluntary basis. While the GEN-COR modules of the WBT had to be completed by all participants, the DOM-COR modules were assigned to the participants of each domain, respectively. Due to their similar training structures and characteristics identified in the requirement analysis, they were considered suitable for comparative analysis conducted in the next 'Evaluation' phase. Throughout the training period, process data (i.e., log data on the duration of training participation) and performance data (i.e., scored task results) were collected. In addition, socio-demographic data (e.g., gender, age, educational and professional background) were controlled and assessed via online surveys (for details, see Nagel et al. 2024).

In the 'Evaluation' phase, we follow a multi-perspective evaluation approach in the design (Kirkpatrick 1994; Warr et al. 1970) by (1) asking the participants for self-assessment, (2) asking the trainers for assessment, (3) and comparing the training results over time based on the above-mentioned collected data.

To this end, *pre- and post-assessments*, incorporating open responses, were conducted before and after the training to gather feedback from participants and to assess their overall learning experience.

Pre-Assessment Survey: Before the training, users were asked to complete a pre-assessment survey, which specifies the training objectives and activates previous knowledge. Based on Dahlen (2012), the survey asks the trainees about their study domain (medicine, law or teaching) and previous COR skills. The questions are based on the competence profile of COR (see Table 2) and are designed in a closed format, which allows the training developers to assess and compare COR levels among all trainees. Trainees were also asked about their expectations for the training. The results were used to revise the training.

Post-Assessment Survey: The COR training concluded with a post-assessment survey, which evaluates the learning success of the overall learning process. It enables users to have an overview of their own progress. These results were also important when revising the training. The survey is constructed similarly to the pre-assessment survey and asks the users about skills acquired throughout the training. Afterwards, the users were asked about to what extent their expectations for training have been met. The survey included questions concerning perceived usefulness, difficulty and familiarity with the training content, and the overall perceived improvement of COR skills. Additionally, participants were encouraged to provide comments and suggestions for enhancing the WBT experience through open-ended questions.

This approach was taken to examine the usability and transferability of the new WBT training and to identify areas for improvement (for details, see Kohmer et al. 2024). Open-ended responses from the evaluation surveys were then subjected to qualitative content analysis (QCA) (Mayring 2003) for further examination. The collected log- and performance data of the overall training period were statistically analyzed to determine and evaluate, for example, the time spent on each training module and typical mistakes in the task responses (for further details on the approach and results of the training evaluation, see Kohmer et al. 2024).

Overall, the WBT was regarded as useful by all participants, some of whom were already familiar with certain aspects of the training content. Furthermore, participants reported an improvement in their COR skills as a result of the training. The difficulty of the tasks was considered appropriate. Participants provided suggestions for improvement, including extending the training content, particularly in the DOM-COR modules, and offering additional exercises. Participants also expressed a need for more college courses focusing on COR-related skills before beginning practical training, deeming them crucial for professional practice. They requested that training content be accessible for future reference, emphasizing its practical utility in the three domains.

Finally, while the implementation and evaluation results indicate successful transferability of this newly developed WBT training across the three professional domains, participants' results in the various generic and domain-specific tasks show most had difficulties applying and successfully transferring their skills in different contexts.

5 | Discussion and Conclusion

Research indicates that students and graduates lack the necessary skills related to finding high-quality information and evaluating online sources, which are substantial in professions, such as medicine, law and education. Although this skill deficit is well known in educational and professional practice, no training method fostering all COR facets has existed to date. Therefore, based on the ADDIE model, a new training was theoretically-didactically conceptualized and technically implemented to effectively improve the GEN- and DOM-COR skills of trainees in medicine, law, and teacher education.

In the first phase, 'Analysis', the needs, intentions, resources and the target group of the training were determined and analyzed. The experts interviewed and the trainees surveyed report on (1) the high importance of COR for their professional practice where they predominantly access and use online sources; and (2) their skill deficits when solving information problems using the Internet, indicating the necessity of the COR training. Based on the conceptual framework of COR, that follows the IPS-I model, a competence profile describing the relevant COR skills was developed, providing the basis to derive the learning content and objectives of the training.

In the next phases, 'Design', 'Development', 'Implementation' and 'Evaluation', the content of the training was sequenced and grouped into coherent modules. One main practical advantage of the training is its format as a WBT with 15-min microlearning units, allowing flexibility in location and schedule. A further benefit is the easy adjustability of the content of the WBT so that necessary revisions can be permanently conducted in practice. This is also crucial for a successful transfer of the COR training across professional domains and contexts.

To evaluate and demonstrate to what extent the training objectives were achieved successfully, the option of sending feedback to the training developers was implemented, and the pre- and post-assessment surveys, as well as reflection tasks, were included. The evaluation results indicate that new COR training enhances the critical use of online media among trainees across domains, suggesting a transferability to and across professional contexts. Compared to previous training methods, the strength of this training lies in its novel approach: it teaches an *entire process* of information problem-solving using the Internet and related strategies, which can successfully be applied across domains. This feature, which is unprecedented in previous trainings, lies in fostering all three facets of COR by addressing a complete research problem in an open web context. The training modules are interconnected, and trainees subsequently internalize the required steps of the overall COR process. The tasks comprise realistic GEN- and DOM-COR information problems from professional practice, and encourage the trainees to freely navigate the Internet, constituting an authentic training environment.

Despite these advantages, some limitations need to be critically considered. First, the training exclusively focuses on the search engine Google. Although it still represents the most prevalent form of accessing information on the Internet, and additional functions of the platform, such as 'Books' and 'Scholar', are also addressed in the training, the requirement analysis showed that trainees also have difficulties when dealing with (professional) databases and online libraries. While the usage of professional databases in medicine, law and teacher training is taught in the three respective units of the training, general online libraries and platforms to access verified information should be included in further developments. In addition, training must be constantly adapted to the ever-changing digital information environment. For example, more and more students and trainees are now using AI-based tools, such as ChatGPT in their everyday learning and work tasks.

Second, the scope of the training is limited to selected realistic information problems, which serves to motivate the participants

and to thematically frame the learning process. Another, less restricted information problem should be included in further developments. Third, although the training is intended to be interactive and stimulating, it should be reconsidered whether single topics are rather to be taught via instructions in an audio format instead of text to achieve a better learning effect. These considerations should be reviewed with experts from the respective domains.

Another central aspect is the implementation of feedback, which is fundamental for the constructivist design of the training. Trainees need to receive auditory feedback on personal performance to achieve their learning objectives and to ensure successful and measurable learning outcomes (Benjes-Small et al. 2013). Tutors could provide manual feedback to the modules, though this solution would be complex and time-consuming since participants solve the training asynchronously. An intelligent and adaptive learning system providing automatized feedback and learning assistance would thus be the more convenient solution (Brown 2017), but its technical implementation is highly demanding.

Despite these limitations, this new training offers a convenient format for educational and professional practice that can enhance trainees' COR skills in the three domains. It also allows further specific and cross-domain developments and can also be easily transferred to other professional contexts, to foster the essential COR skills in the digital age.

Acknowledgements

We would like to thank all participating trainees as well as all experts who supported this study. Further, we sincerely thank the reviewers for their valuable comments and suggestions, which have greatly contributed to improving this manuscript. This study was part of the BRIDGE project (FKN 01JD1906), funded by the German Ministry of Education and Research. Open Access funding enabled and organized by Projekt DEAL.

Ethics Statement

Ethical review and approval for the study on human participants were provided in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by participants. Participant statements were anonymized, published in small excerpts only and checked to not reveal identifiable information.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The original contributions generated for the study are included in the article, including supplementary materials. Further inquiries can be directed to the corresponding author.

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