

Designing Classroom Practices for Teaching Online Inquiry: Experiences from the Field

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Increasingly, students turn to the internet to seek information to address a problem or complete a learning task. These forms of online inquiry require students to locate relevant and credible information from multiple online resources and build a coherent representation of the explored issue (Leu et al., 2019). Although online inquiry is a common practice, students' competencies are often under-developed (Brand-Gruwel & van Strien, 2018), resulting in uncritical engagement with online information. Furthermore, many teachers find it challenging to embed instruction of these competencies into their curriculum (Derakhshan & Singh, 2011).

To address these issues, we developed a learning unit designed to intentionally translate relevant theories and design principles into effective classroom practices for teaching online inquiry. Five language arts teachers from Finland collaborated with us to provide initial feedback on the unit; after revisions, they agreed to implement the lessons in nine upper secondary classrooms and reflect on their teaching experiences. In this paper, we describe the theoretical and pedagogical underpinnings of our unit's design and how it was implemented in classrooms. Then, we share teachers' reflections about the unit, including ideas for improvements.

Theoretical Underpinnings

Two theoretical models guided our work in defining core competencies students need to engage in productive online inquiry: the New Literacies of Online Research and Comprehension (Leu et al., 2019) and the Documents Model (Rouet, 2006).

According to the New Literacies perspective of Online Research and Comprehension, successful completion of an online inquiry task involves using the internet to search for and evaluate information, synthesize important ideas from multiple online texts, and, finally,

communicate the results of the inquiry to others (Leu et al., 2019). Skilled online readers are able to regulate these cognitively demanding comprehension processes across iterative cycles of online inquiry processes (Cho et al., 2017).

Students do not necessarily engage spontaneously in these processes, or if they do, their processing is often shallow (Quintana et al., 2005). In addition, students tend to overestimate their online inquiry skills (Aesaert et al., 2017). Therefore, students need to be intentionally guided through online inquiry processes with models, scaffolds, and feedback that support their ability to engage in cycles of deeper thinking (Quintana et al.,

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2005). As new literacies are increasingly social (Leu et al., 2019), teachers can use technology to design learning spaces that offer opportunities for readers to model and share how they regulate their thinking during online inquiry.

To amplify core competencies that occur during productive online inquiry, we applied the Documents Model framework that explains how readers build a coherent understanding of multiple online texts (Rouet, 2006). Building a coherent understanding of an explored topic requires readers to integrate information within and across multiple texts. Additionally, readers need to connect information found to their respective sources (e.g., author, publisher) and then build an understanding of the relationship between these sources. This includes understanding how sources support or contradict each other. These processes are often labeled as sourcing, or "attending to, evaluating, and using available or accessible information about sources of documents" (Bråten et al., 2018, p. 8).

Sourcing is important to educators because to become a skilled reader, one needs to integrate content from multiple online texts while also connecting content claims to their respective sources. In doing so, students are able to construct a deeper and more complex understanding of content by realizing that most issues can be viewed from multiple perspectives. This more sophisticated understanding is what separates expert thinkers from novices (Alexander, 2005) who take a more surface-level approach to understand the multifaceted nature of issues conveyed across multiple sources. When moving toward deeper understandings, students are better able to critically

consider online information that is a core competence in the post-truth era.

Sourcing can occur across all phases of online inquiry rather than just at the end (Kiili et al., 2021). When planning for online inquiry, readers can think of potential sources (e.g., professions or organizations) that may provide useful and accurate information. Then, these potential sources can be incorporated into search queries (topic + source). Sources can also be used to make inferences about the credibility of online texts when reading search results and actual websites. Finally, sourcing skills enable readers to share not only ideas found from online texts, but also the origin of those ideas when communicating the results of their online inquiry (Strømsø & Bråten, 2014). When combined, sourcing skills help readers articulate judgments about the quality of an author's claims in relation to the author's affiliation and level of expertise (Coiro et al., 2015).

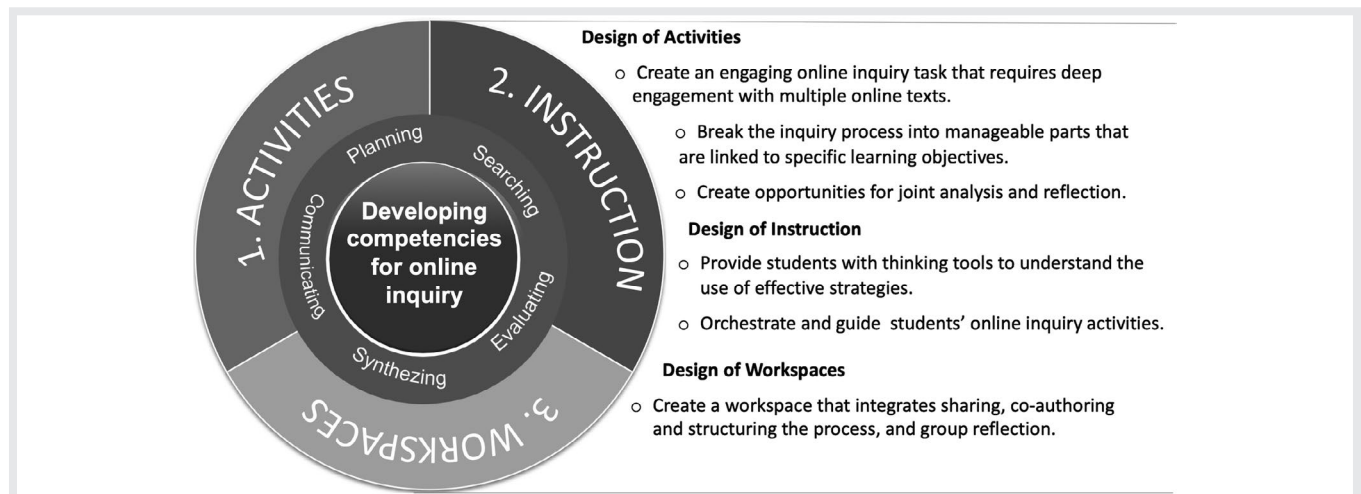
Pedagogical Design Principles

In addition to theory, our work was also guided by design principles divided into three sets of intentional decision making about practices that promote students' online inquiry competencies: the design of activities, instruction, and workspaces (Figure 1).

Design of Activities

The first set of design principles focuses on designing meaningful activities for learners by creating an engaging task, structuring the process, and creating opportunities for joint analysis and reflection. The creation

FIGURE 1
Intentional Practices Linked to Three Sets of Design Principles



of an online inquiry task is a crucial part of the design because the task characteristics guide students' activities. Online inquiry tasks that connect students to relevant, real-world concepts and events (Herrington & Oliver, 2000) and involve the creation of a meaningful product (Ainley et al., 2006) have the potential to elicit learners' interest. Activities should also require students to search for and engage with multiple online texts that provide various perspectives on inquiry topics (Brante & Strømsø, 2018).

Online inquiry is a complex process that can be supported by sequencing the inquiry process into manageable parts (cf. De Hei et al., 2016). To ensure students engage in all of the critical activities, task sequences are typically designed according to a theoretical model (Kobbe et al., 2007); in our case, the framework of Online Research and Comprehension. Furthermore, sequencing the process and specifying learning objectives and requirements for each task can help students cope with the complexities of online inquiry (cf. Wingate, 2012). Third, activities should provide students with opportunities for joint analysis and reflection because peer interaction focused on achieving a common goal often has positive effects on students' performance (Lou et al., 2001).

Design of Instruction

Designing instruction includes the design of thinking tools that support strategy use while also anticipating the need for just-in-time intervention. Thinking tools can help students understand *why* they should invest cognitive resources in searching for versatile information sources, evaluating online texts, and comparing and contrasting sources; they can also elicit and support areas of declarative (*what*) and procedural (*how*) knowledge needed to engage in productive online inquiry (Afflerbach et al., 2020).

As groups work on their inquiry task, teachers orchestrate students' engagement and react to their needs. One aspect of this orchestration relates to implementing lessons as designed. Another aspect of orchestration may require improvisation, such as reacting to spontaneous input from students or contexts or acting on teachable moments (Mæland & Espeland, 2017).

Design of Workspaces

The third set of design principles focuses on creating workspaces that enable sharing, co-authoring, and group reflection. When students collaboratively engage in online inquiry, efforts to regulate the group's process are essential (Schoor et al., 2015). Students need to

negotiate joint goals and strategies as well as monitor and evaluate their progress toward set goals (Miller & Hadwin, 2015). Next, we detail components of the planned inquiry unit informed by these three principles.

Designed Unit

Task Assignment

We offered students four alternative online inquiry topics on a controversial health issue: cell phone radiation, food additives, sun and health, and sleeping pills. To ensure the task would promote sourcing, we confirmed that various stakeholders were expressing their ideas about the topic on the internet. Students were provided with a short task scenario that included hints about the controversy surrounding the issue and connected the topic to young people's lives. For example,

I am a 21-year-old athlete from Vantaa. I utilize biohacking to monitor my training and recovery. I do this to optimize my training to match the vitality level of my body. Before going to bed, I put the cell phone next to my pillow. The phone follows my movements and interprets the quality of my sleep. However, my friend told me that one should not keep the cell phone next to one's head if not necessary. Could you clarify what the internet says about the issue?

After choosing a topic, students were tasked with selecting two different stakeholders, the views of which they would explore. Three questions provided a task overview:

- Who are the stakeholders (e.g., researchers, experts, politicians, laypersons, vendors) that write about the topic, and what are their points of view on the issue?
- Why do different stakeholders write about the issue? What is their expertise on the issue, and what is the evidence they rely on?
- Compare the point of views of different stakeholders: What is common, and how do they differ? What kinds of tensions and contradictions appeared between the points of view? From the two selected stakeholders, whose views are most plausible and why?

Materials

Different materials were designed to support participating teachers and students. For teachers, we created manual and presentation slides to support their explicit teaching of online inquiry strategies. Each presentation included important declarative (*what*) and procedural (*how*) knowledge about effective strategies (see

TABLE 1
Summary of Contents in Teacher Instructions

Online inquiry competence	Why?	What?	How?
Planning and implementing the search	<ul style="list-style-type: none"> ▪ To find various kinds of resources and perspectives on the issue ▪ To identify different stakeholders that have interests in the issue ▪ To formulate a justified and plausible view on the issue 	<ul style="list-style-type: none"> ▪ Formulation of search queries by using main concepts and defining concepts ▪ Use of different concepts and keywords that represent the information problem ▪ Use of potential sources to define the search (e.g., organizations) 	<ul style="list-style-type: none"> ▪ Identify the main concept(s) and define concepts by analyzing the task assignment and using prior knowledge on the issue ▪ Try different keywords and their combinations ▪ Identify new potentially useful concepts during the course of the search
Evaluating	<ul style="list-style-type: none"> ▪ Relying on reliable information when learning and making important decisions in various areas of life ▪ Being better able to recognize misinformation and disinformation 	<ul style="list-style-type: none"> ▪ Source features, such as expertise and intention of the author or publisher ▪ Quality of evidence ▪ What other sources say? 	<ul style="list-style-type: none"> ▪ Use multiple aspects of the source and content features in evaluation ▪ Corroborating
Synthesizing & Communicating: Citing sources when comparing and contrasting different views	<ul style="list-style-type: none"> ▪ The background of the author and publication venue affect the interpretation of the message ▪ Decontextualizing the message may change its intended meaning ▪ Readers of the newly composed text can evaluate the plausibility of presented claims 	<ul style="list-style-type: none"> ▪ Comparison of views and ideas of different stakeholders ▪ Critical reflection ▪ Presenting a justified conclusion 	<ul style="list-style-type: none"> ▪ Use connecting words ▪ Connect ideas to their sources ▪ Provide the readers with rich enough information about the sources ▪ Considering why the views of different stakeholders may differ (e.g., various motives) ▪ In conclusion, rely on the most plausible sources

Table 1), providing specific thinking tools for strategy instruction.

For students, an information package detailed the task assignment, alternative task topics, task phases, learning objectives, and evaluation criteria. A Google Docs working document was created for each group with analysis and reflection supports (see Table 2) to guide students' inquiry work. The inquiry task included multiple points that required students' negotiation, such as selecting the topic, stakeholders, and sources to explore in-depth. Working documents were intentionally constructed to make the inquiry process visible for both students and teachers. This enabled teachers to not only offer feedback about the products, but also highlight the value and purpose of each step in the inquiry process.

Workspace

Finally, we created a workspace in Microsoft OneNote, in which all groups of students were able to access instructional materials designed for the whole class as well as a set of Google Docs working documents for each small group (Figure 2). These materials were designed to help students monitor and regulate their joint inquiry work.

Methods

Once the unit was designed, we conducted a qualitative study in two phases to acquire teachers' insights on how the unit works in classrooms and how it could be developed further. In Phase 1, we requested feedback from five teachers who worked with us as part of a larger research

TABLE 2
Analysis and Reflection Supports Provided for Students in Working Documents

Online inquiry competence	Analysis support	Reflection support
Planning the search (Day 1)	<ul style="list-style-type: none"> ▪ What are the main concepts related to the topic? ▪ Who could write about the topic? ▪ What organizations could provide information about the topic? 	<ul style="list-style-type: none"> ▪ How good were the search queries we were able to formulate?/How did we manage to formulate good search queries?
Searching (Day 1)	<ul style="list-style-type: none"> ▪ What new potential search terms did you observe during the initial search phase? ▪ What kinds of stakeholders write or publish about the topic? ▪ Select the most interesting sources that represent two stakeholders. ▪ Why did you select these sources? 	<ul style="list-style-type: none"> ▪ How did we utilize information about organizations, publishers, and stakeholders in formulating the searches?
Evaluating (Day 2)	<ul style="list-style-type: none"> ▪ What kinds of expertise does the author/publisher have about the topic? ▪ What are his or her motives to publish the text? ▪ What is the main claim that the author wants to deliver to the audience? ▪ How well does the author justify the claim? ▪ What kind of evidence does he or she use (e.g., research, experience)? ▪ How is the author's expertise reflected in the way in which he or she justifies the claims? 	<ul style="list-style-type: none"> ▪ How well did we consider different source features when evaluating the quality of online texts? ▪ How well did we find the main claim and supporting reasons?
Synthesizing (Day 3)	<ul style="list-style-type: none"> ▪ How did the views of different sources differ from each other? ▪ What was common? ▪ What may explain the differences (e.g., motives, expertise)? ▪ What two issues that you observed in your comparisons were most exciting or surprising? ▪ Which of the actors was more plausible and why? 	<ul style="list-style-type: none"> ▪ How well did we find differences and commonalities between the different sources? ▪ How well were we able to consider the potential explanations for the differences?

project (Sormunen et al., 2015–2019) that sought to enhance adolescents' epistemic practices required in future academic and work careers. The five participating language arts teachers (four females and one male ranging in age from 35 to 61 years) taught upper secondary school students (ages 17–18) in one of four schools (one rural school and three city schools). Three teachers taught one group of students, one teacher taught two groups, and one teacher taught four groups.

Four of the five teachers participated in a 3-hour session with our research team to discuss design principles

and consider ways that teachers might contribute to the unit plan. Thereafter, we incorporated teachers' suggestions into the unit, and the same teachers implemented all of the lessons in nine upper secondary classrooms.

Unit Implementation

Preparations

Before the first lesson, students were asked to familiarize themselves with learning materials in the information

package so they could efficiently begin their online inquiry on Day 1. The unit was taught in four 75-minute lessons across four different days.

Day 1: Planning and Implementing the Search. On Day 1, lesson objectives were that students learn to specify their information needs and formulate search queries by utilizing core concepts and source information. After forming small groups and selecting a task topic, teachers gave a 15-minute introduction to effective search strategies (Table 1). Students were encouraged to try alternative search terms, including source information, and skim search results to find new search terms and alternative perspectives.

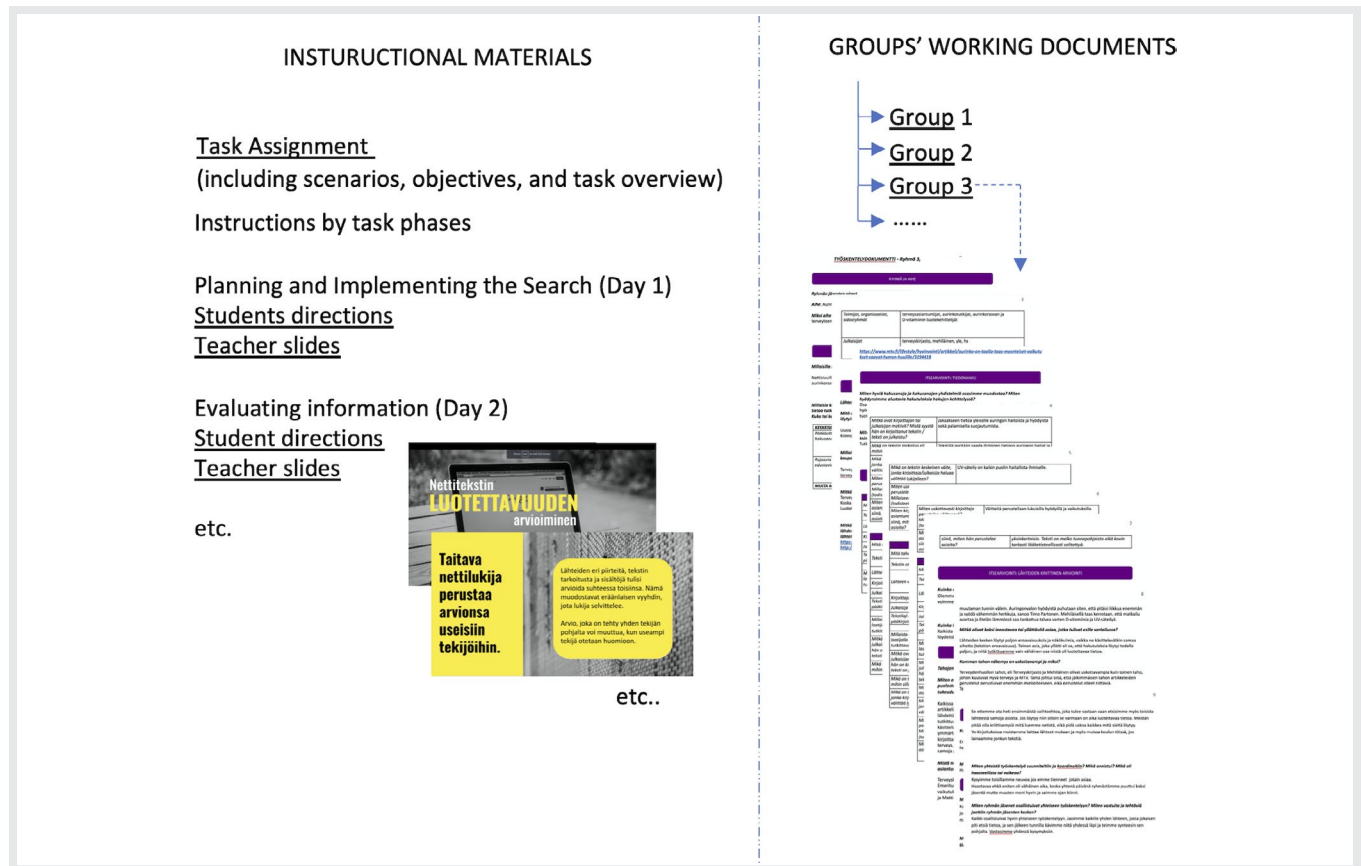
Next, small groups were asked to apply presented ideas with their selected topic using designed supports on the working document (Figure 3). The idea was that students should plan their search before turning to Google. Students were tasked with finding two different stakeholders who talk about the topic online and two sources representing each stakeholder (four

sources altogether). In the online inquiry task, the idea of stakeholders was crucial because we wanted students to think beyond each specific source to discern patterns among sources. The materials explained that a stakeholder refers to persons or groups that have a common background (e.g., education, profession), interest in, or way of thinking about an issue.

Day 2: Evaluating Information. Objectives for Day 2 were as follows: Students are able to (1) evaluate multiple aspects of online texts and (2) evaluate sources, content, and the interplay between them. Again, teachers began by introducing effective evaluation strategies and highlighting the importance of evaluating credibility from multiple perspectives (Table 2).

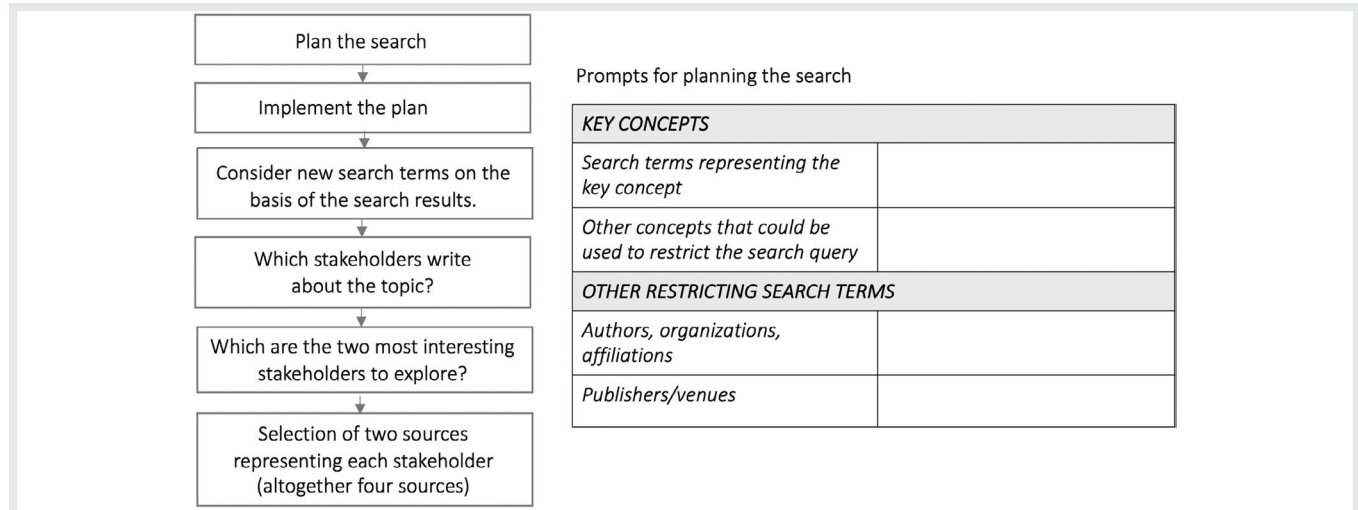
After learning evaluation strategies, students continued by evaluating four selected sources with the help of supports presented in Figure 4. Six prompts asked students to identify and record relevant source information from the online text. The next four prompts involved analyzing and evaluating different but single aspects

FIGURE 2
Components of OneNote Workspace



Note. The color figure can be viewed in the online version of this article at <http://ila.onlinelibrary.wiley.com>.

FIGURE 3
Analysis Supports for Planning and Implementing Search



of credibility. Responses to these four prompts were intended to scaffold students to then consider the last and most demanding prompt, which asked students to think across credibility aspects and consider how source expertise and motives were reflected in the text. This prompt was designed to stimulate students to think deeply about the interplay of different credibility aspects (Forzani, 2020).

Day 3: Synthesizing Information. Learning objectives for Day 3 were that students are able to compare the viewpoints of online texts in terms of their sources and evidence behind these views and cite their sources. In their 15-minute introduction to synthesis, teachers demonstrated different ways that sources could be connected to text contents (Table 1).

Analysis supports in the working document asked students to compare the views and evidence in the online texts and consider reasons for potential differences. Students were also asked to think of interesting or unexpected issues that appeared when comparing the texts. Finally, students were asked to provide a justified conclusion about which of the examined stakeholders was more plausible.

Day 4: Communicating Information. The objective of Day 4 was that students learn to communicate findings from their inquiry to other students and engage in discussions about those findings. To achieve these goals, teachers divided students into groups so that different task topics were represented in each seminar group. Depending on class size, three to five groups were formed. Students selected a chair to lead each seminar group.

In the seminar, each group had 10 minutes to present their findings, after which 5 minutes were reserved for joint discussion. During their presentations, students were encouraged to utilize their working documents and make their sources explicit. To facilitate discussion, teachers provided supporting questions. At the end of Day 4, students reflected on their learning and collaborative processes and considered takeaways for the future.

Data Sources

In Phase 2, data from teachers' diaries and teacher interviews were collected to understand how teachers implemented the revised researcher-designed unit as well as their impressions and suggestions for improving the lessons. In their diaries ($N = 9$), teachers were asked to report problems encountered in the lessons and modifications that were made. After completing all four lessons, teachers were asked to comment on the whole unit. Afterward, we interviewed teachers ($N = 5$) about their experiences in implementing the unit design. Interviews were transcribed, and lengths varied from 31 to 67 minutes.

Data Analysis

Content analysis and inductive coding (Saldaña, 2013) were used to analyze teacher diaries, resulting in 13 codes (see Table 3) that we then mapped according to principles related to the design of activities and instruction. In the diaries, there was no mention of workspace design, other than general comments that teachers

FIGURE 4
Analysis Supports for Evaluating Sources

SOURCE 1	
What stakeholder the source represents?	
Title of the text	
URL-address	
Author	
Publisher or publication venue	
Type of the document (e.g., blog, article, editorial)	
What kind of expertise does the source (author, publisher, venue) have about the topic?	
Which are the intentions of the source? Why is the text written/published?	
What is the main claim that the source would like to deliver for the readers?	
How reasonable is the source's justification for the claim? What is evidence?	
How does the sources' expertise or intentions reflect on how the source justifies his/her knowledge claims?	

appreciated the structured documents. As a considerable portion of the interviews was beyond the scope of this paper, we only used interviews to enrich findings from the teacher diaries. Next, we report our findings of teachers' experiences and follow-up impressions mapped onto the principles with which the unit was designed.

Findings

Our analysis of teacher diaries and follow-up interviews suggests, in general, teachers had positive impressions of the planned inquiry activities and developed materials. All reported an intention to implement a similarly structured unit in the future. Next, we share teachers' experiences and ideas for improvements in line with the three sets of research-based principles for designing online inquiry activities.

Design of Activities

While teachers adhered to suggested lesson objectives, they provided suggestions for how to better allocate

time to certain activities to ensure that learning objectives could be accomplished within suggested timeframes. Teachers found that students needed more time than was allotted on Day 1 to search for suitable stakeholders and related sources. One reason for this might be that students were asked to approach their search differently than they were accustomed to. Rather than focusing searches mainly on the topic, the additional focus was on different stakeholders and related sources. Thus, students would likely need more time for internalizing this new approach. Notably, locating stakeholders that would be fruitful to compare was crucial to the entire task's success.

Two teachers also reported students would have benefitted from more time to prepare for the seminar. However, seminars did not require as much time as allocated. Teachers mentioned that the self-regulated work required in seminars was new for students, and teachers would have liked more guidance in how to effectively use the allotted time. As Juzwik et al. (2015) suggest, engaging in dialogue as part of teaching and learning can be challenging for teachers and students alike.

Teachers' comments about learning objectives focused on the appropriateness and achievement of objectives and related task demands. Teachers reported that student group performance of the task was quite varied, which is in line with previous findings (Cho et al., 2018). Accordingly, the task challenged students differently:

For some students, it [the difficulty level] was appropriate whereas some students would have needed even more challenge. On the other hand, students with good skills were able to broaden and deepen their thinking, in particular, in critical evaluation of sources, and thus, they were also challenged. (diary)

Specifically, teachers mentioned that synthesizing information across sources was difficult, but supports appeared to help:

I think that all learned about making a synthesis, at least to some extent. It is such a challenging task to learn about, which takes time, even in higher education. (diary)

Related to students' achievement of learning objectives, teachers reported gains in students' use of effective search and evaluation practices. In line with previous research (Aesaert et al., 2017), students were generally overconfident in their search skills prior to and even after participation in the online inquiry unit.

Clarity of task instructions was raised in five diaries, and most comments concerned the term stakeholder. Three teachers reported that students

TABLE 3
Coding Categories for Teacher Diaries

Category	Number of diaries with at least one comment	Number of teachers with at least one comment
<i>Design of activities</i>		
Allocation of time for online inquiry processes	6	5
Learning objectives	5	3
Task instructions	5	4
Cognitive and motivational engagement with the task	3	3
Engagement with collaborative work	2	2
Task topics	2	2
Student materials	1	1
<i>Design of instruction</i>		
Reacting to practical issues	7	4
Modifications or additions to unit plan	6	2
Guiding students	5	3
Students-related issues requiring attention	4	3
Group work	3	2
Instructional materials	3	3
Feedback	2	2

Note. There were nine diaries and five teachers. Two teachers taught more than one class.

struggled to understand the concept of a stakeholder, and two teachers sought more clarity in instruction about stakeholders.

... when students needed to find the stakeholders, the concept of stakeholder was difficult, even though it is basically easy. They may have filled in specific sources even though they would have needed to select something more general to have had something like experts or regular consumers. (interview)

For some small groups, teachers reported that students' insufficient conceptual understanding of stakeholders hampered or slowed down their completion of multiple task phases. For example, some students needed to go back to search for sources after realizing they misunderstood the meaning of stakeholders. Teachers also reported that some students selected stakeholders that were neutral or too similar. This, in turn, negatively influenced their comparison of

stakeholders and related sources, impeding the depth of processing. We defined stakeholder in the instructional materials, but it seems that more support was needed. One teacher suggested a clear improvement for instruction:

Probably the most crucial question of the whole project on Day 1 was "What are the two most interesting stakeholders that are worth investigating? Why do you think so?" The formulation of the question might have been problematic because the interest is subjective, and closely related stakeholders might be fascinating. For the project, it would have been beneficial if the stakeholders were truly different. Maybe, the directions could have been: "Select two stakeholders that are clearly different", maybe this might work. (diary)

Teachers also commented on how well the designed activities were able to engage students cognitively, motivationally, and collaboratively. Most students were

engaged with the task; however, for some students, “speed was everything.” Not surprisingly, in some groups, responsibilities were not evenly distributed. To increase engagement, teachers could consider different inquiry topics. One teacher suggested political topics, and another mentioned current topics, such as drones, that was the topic used in instructional materials for planning a search.

Design of Instruction

In terms of designing instruction, teachers’ comments focused primarily on the need to flexibly orchestrate planned experiences with in-the-moment decisions and useful feedback to guide students through the inquiry process. Teacher diaries revealed, for example, that practical issues, such as previously absent students, required both orchestration and just-in-time improvisation, as described next in the Day 4 seminar.

I employed [three] previously absent students by giving them a role of an observer. There were three seminars, and in each of them, there were three small groups and one observer. The observer considered every evaluation criterion and marked pluses and minuses according to how well the groups fulfilled the criteria. (diary)

This solution of assigning some students to be an evaluator could be embedded into the unit as a new design element. Taking on a different role offers students opportunities to revisit, reflect on, and apply evaluation criteria that may not have been considered previously.

In the diaries, two teachers commented on other lesson modifications. One teacher described how she reacted to the seminar plan when the instructions did not necessarily lead to deep discussions about their online inquiry results:

When students were presenting their synthesis in the seminar, I realized that students read a few sentences that took only 15 seconds instead of 15 minutes. So, I instructed all small groups to tell what search terms they used and describe the whole process. This may have led others to learn something new. (interview)

This teacher asked students to take advantage of the explicit documentation of their inquiry process in the working documents to articulate their online inquiry processes to others. The documentation made it possible for students to retrieve steps that they took from the beginning of the task. If students had only their memory to rely on, this might not have been possible.

Teachers noted that guiding students during inquiry work was somewhat challenging due to large class sizes. Teachers also reported that planning search

queries was difficult for many students. One teacher explained how she reacted to this teachable moment:

I mainly helped them to consider better search terms and to restrict their queries...I thought that it would be better if they discovered issues by themselves. But in some cases, we thought together about synonyms and different ways to approach the issue. (interview)

Concluding Remarks

Overall, in their diaries and follow-up interviews, teachers articulated several challenging aspects of online inquiry. These challenges related to (1) planning and searching, (2) attending to multiple sourcing criteria to evaluate similar and competing claims around complex social issues, (3) synthesizing relevant information across multiple perspectives, and (4) engaging in discussions with classmates about their findings, their sources, and the processes used to conduct their inquiry. Our intentional design of four explicit lessons paired with research-informed supports for teachers and students likely facilitated teachers’ understanding of online inquiry processes. Moreover, participating teachers believed the designed teaching materials, thinking tools, and collaborative workspaces helped guide their own instruction and feedback while also enabling students to document their thinking and accomplish learning objectives aligned with becoming critical consumers of online texts.

Findings from this study also reinforced the critical role that teachers play in helping to design, pilot, and provide feedback that improves the intentional design of instructional plans and student materials to better promote skilled online inquiry as part of multiple source comprehension. Teacher feedback suggests at least three important practices to incorporate into our collection of effective design principles.

First, asking students to search for two stakeholders that consider a controversial issue from two clearly different perspectives, and locate online texts that represent these stakeholders, is a promising practice. It supports students in moving beyond considering and evaluating online texts as separate entities. It also supports students in thinking of sources at the beginning of online inquiry; a practice shown to help with evaluating the credibility of information (Kiili et al., 2021). However, teachers should also discuss with students the concept of stakeholder, provide models, and give feedback to ensure that all students have found stakeholders that are reasonable to compare.

Second, instructional materials can be revised to extend the number and types of roles that support

student agency and discussion as an integral part of the seminar experience. Teachers could ask students to circulate the roles of chair, presenter, and evaluator to support active participation and lively seminar discussions.

Third, students can be encouraged to revisit small group working documents to articulate their in-the-moment thinking during the seminar. This provides students with opportunities to reflect on their processes and learn from each other about strategies that worked and strategies that did not work. The documentation also allows teachers to access online inquiry processes that are normally hidden, which provides additional opportunities for feedback and evaluation. This might be particularly important because students do not necessarily put effort into planning and sourcing if they do not get feedback on these practices or if planning and sourcing are not taken into account when grading (Paul et al., 2017). Overall, the researcher-teacher collaboration seemed to be a fruitful endeavor that can assist in advancing the research-based design of productive online inquiry activities.

Conflict of Interest

None

REFERENCES

- Aesaert, K., Voogt, J., Kuiper, E., & Van Braak, J. (2017). Accuracy and bias of ICT self-efficacy: An empirical study into students' over- and underestimation of their ICT competencies. *Computers in Human Behavior, 75*, 92–102. <https://doi.org/10.1016/j.chb.2017.05.01>
- Afflerbach, P., Hurt, M., & Cho, B.-Y. (2020). Reading comprehension strategy instruction. In D.L. Dinsmore, L.K. Fryer, & M.M. Parkinson (Eds.), *Handbook of strategies and strategic processing* (pp. 98–118). Routledge.
- Ainley, J., Pratt, D., & Hansen, A. (2006). Connecting engagement and focus in pedagogic task design. *British Educational Research Journal, 32*(1), 23–38. <https://doi.org/10.1080/01411920500401971>
- Alexander, P.A. (2005). The path to competence: A lifespan developmental perspective on reading. *Journal of Literacy Research, 37*(4), 413–436. https://doi.org/10.1207/s15548430jlr3704_1
- Brand-Gruwel, S., & van Strien, J.L.H. (2018). Instruction to promote information problem solving on the internet in primary and secondary education: A systematic literature review. In J.L.G. Braasch, I. Bråten, & M.T. McCrudden (Eds.), *Handbook of multiple source use* (pp. 401–414). Routledge.
- Brante, E.W., & Strømsø, H.I. (2018). Sourcing in text comprehension: A review of interventions targeting sourcing skills. *Educational Psychology Review, 30*, 773–799. <https://doi.org/10.1007/s10648-017-9421-7>
- Bråten, I., Stadler, M., & Salmerón, L. (2018). The role of sourcing in discourse comprehension. In M.F. Schober, D.N. Rapp, & M.A. Britt (Eds.), *Routledge handbooks in linguistics. The Routledge handbook of discourse processes* (pp. 141–166). Routledge/Taylor & Francis.
- Cho, B.Y., Woodward, L., & Li, D. (2018). Epistemic processing when adolescents read online: A verbal protocol analysis of more and less successful online readers. *Reading Research Quarterly, 53*(2), 197–221. <https://doi.org/10.1002/rrq.190>
- Cho, B.Y., Woodward, L., Li, D., & Barlow, W. (2017). Examining adolescents' strategic processing during online reading with a question-generating task. *American Educational Research Journal, 54*, 691–724. <https://doi.org/10.3102/0002831217701694>
- Coiro, J., Coscarelli, C., Maykel, C., & Forzani, E. (2015). Investigating criteria that seventh graders use to evaluate the quality of online information. *Journal of Adolescent & Adult Literacy, 59*(3), 287–297. <https://doi.org/10.1002/jaal.448>
- De Hei, M., Strijbos, J.W., Sjoer, E., & Admiraal, W. (2016). Thematic review of approaches to design group learning activities in higher education: The development of a comprehensive framework. *Educational Research Review, 18*, 33–45. <https://doi.org/10.1016/j.edurev.2016.01.001>
- Derakhshan, M., & Singh, D. (2011). Integration of information literacy into the curriculum: A meta-synthesis. *Library Review, 60*, 218–229. <https://doi.org/10.1108/0024253111117272>
- Forzani, E. (2020). A Three-tiered framework for proactive critical evaluation during online inquiry. *Journal of Adolescent & Adult Literacy, 63*, 401–414. <https://doi.org/10.1002/jaal.1004>
- Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development, 48*(3), 23–48.
- Juzwik, M.M., Heintz, A., Caughlan, S., & Borsheim-Black, C. (2015). *Inspiring dialogue: Talking to learn in the English classroom*. Teachers College Press.
- Kiili, C., Forzani, E., Brante, E.W., Räikkönen, E., & Marttunen, M. (2021). Sourcing on the Internet: Examining the relations among different phases of online inquiry. *Computers and Education Open*. Article 100037. <https://doi.org/10.1016/j.caeo.2021.100037>
- Kobbe, L., Weinberger, A., Dillenbourg, P., Harrer, A., Hämäläinen, R., Häkkinen, P., & Fischer, F. (2007). Specifying computer-supported collaboration scripts. *International Journal of Computer-Supported Collaborative Learning, 2*(2–3), 211–224. <https://doi.org/10.1007/s11412-007-9014-4>
- Leu, D.J., Kinzer, C.K., Coiro, J., Castek, J., & Henry, L.A. (2019). New Literacies: A dual level theory of the changing nature of literacy, instruction, and assessment. In D.E. Alvermann, N.J. Unrau, M. Sailors, & R.B. Ruddell (Eds.), *Theoretical models and processes of literacy* (7th ed., pp. 319–346). Taylor & Francis.
- Lou, Y., Abrami, P.C., & d'Apollonia, S. (2001). Small group and individual learning with technology: A meta-analysis. *Review of Educational Research, 71*, 449–521. <https://doi.org/10.3102/00346543071003449>
- Mæland, K., & Espeland, M. (2017). Teachers' conceptions of improvisation in teaching: Inherent human quality or a professional teaching skill? *Education Inquiry, 8*(3), 192–208. <https://doi.org/10.1080/20004508.2017.1293314>
- Miller, M., & Hadwin, A. (2015). Scripting and awareness tools for regulating collaborative learning: Changing the landscape of support in CSCL. *Computers in Human Behavior, 52*, 573–588. <https://doi.org/10.1016/j.chb.2015.01.050>
- Paul, J., Macedo-Rouet, M., Rouet, J.F., & Stadler, M. (2017). Why attend to source information when reading online?

- The perspective of ninth grade students from two different countries. *Computers & Education*, 113, 339–354. <https://doi.org/10.1016/j.compedu.2017.05.020>
- Quintana, C., Zhang, M., & Krajcik, J. (2005). A framework for supporting metacognitive aspects of online inquiry through software-based scaffolding. *Educational Psychologist*, 40, 235–244. https://doi.org/10.1207/s15326985ep4004_5
- Rouet, J.F. (2006). *The skills of document use: From text comprehension to Web-based learning*. Erlbaum.
- Saldaña, J. (2013). *The coding manual of qualitative researchers* (2nd ed.). Sage.
- Schoor, C., Narciss, S., & Körndle, H. (2015). Regulation during cooperative and collaborative learning: A theory-based review of terms and concepts. *Educational Psychologist*, 50, 97–119. <https://doi.org/10.1080/00461520.2015.1038540>
- Sormunen, E., Marttunen, M., & Toom, A. (2015–2019). *Argumentative online inquiry in building students' knowledge work competencies*. Academy of Finland, No. 285817.
- Strømsø, H.I., & Bråten, I. (2014). Students' sourcing while reading and writing from multiple web documents. *Nordic Journal of Digital Literacy*, 9, 92–111. <https://doi.org/10.18261/ISSN1891-943X-2014-02-02>
- Wingate, U. (2012). "Argument!": Helping students understand what essay writing is about. *Journal of English for Academic Purposes*, 11(2), 145–154. <https://doi.org/10.1016/j.jeap.2011.11.001>