Margaux Coeuret, Joris Falip, Aurélien Bénel (2025): Cooperating in Academia with underspecified protocols: A case study of students and researchers practitioners of Grounded theory methodology (GTM). In: Proc. 23rd EUSSET Conf. on Computer-Supported Cooperative Work - Exploratory papers, DOI: 10.48340/ecscw2025_ep03

Cooperating in Academia with underspecified protocols: A case study of students and researchers practitioners of Grounded theory methodology (GTM)

Margaux Coeuret, Joris Falip, Aurélien Bénel
LIST3N/Tech-CICO, Université de Technologie de Troyes, France
margaux.coeuret@utt.fr

Abstract. As scientific projects become increasingly cooperative, we can identify two approaches: the first one tends to distribute datawork among participants performing the same task while the other brings together different experts to work on the same data. Grounded Theory Methodology (GTM) is frequently used for academic cooperative projects but does not clearly specify how cooperation should be organized. This paper aims to identify the different cooperative work practices of actors who use this method. We conducted a qualitative study combining semi-structured interviews with participant and non-participant observations involving social sciences researchers and students. We find that cooperation in GTM projects relies on continuous adjustments, informal task distribution, and digital artifacts not explicitly designed to support this methodology. Qualitative analysis tools incorporating coordination protocols are often perceived as too constraining, requiring actors to engage in additional articulation work. Based on these findings, we propose recommendations to improve the design of existing tools and design artifacts better suited to cooperative work in GTM. These artifacts would accommodate more adaptable and customizable protocols, facilitating task coordination and enhancing collaboration within research teams.

Introduction

Teamwork has become an essential component of scientific research in academia, driven by the pressure to publish, the need to tackle increasingly complex problems, and access to shared resources (Abramo et al. (2009); Tkachenko and Ardichvili (2020)). These studies highlight that scientific collaboration is not merely an accumulation of individual contributions but involves complex organizational and structural dynamics that require continuous adjustments among researchers. In the social sciences, collaboration takes different forms: some approaches involve replicating the same tasks across different locations with local research actors (e.g., integrating national surveys into the European Social Survey); others bring together diverse expertise around the same data, as seen in multidisciplinary studies on census data (Neang et al. (2021)). However, these models are less applicable to qualitative methods, which depend on an iterative, interpretative process that requires careful coordination of tasks and the harmonization of interpretations and analytical frameworks.

In contrast, the grounded theory methodology, formalized by Glaser and Strauss (1967), stands out for its ability to construct theories from empirical data. More than just a series of procedures, this method provides a structured framework that facilitates the development of theories directly grounded in field data (Muller and Kogan (2012)). It is based on an iterative process in which data are continuously compared and refined, allowing theory to emerge progressively. While GTM encourages collective analysis, it does not offer concrete guidelines for organizing collaborative work. The need for organization and coordination stems from cooperative research, which often involves multiple people performing interdependent tasks and working together within the same research domain (Schmidt and Simonee (1996)). In this context, coordination mechanisms—such as protocols defining how tasks should be executed and artifacts (digital or physical) facilitating this organization (e.g., shared documents, software tools, coding frameworks)—become essential.

Specialized tools, especially computer-assisted qualitative data analysis software (CAQDAS) such as MAXQDA and Atlas. ti, have been developed to support researchers in qualitative analysis. However, although they are effective for individual use, they do not adequately meet the needs for organizing, sharing, and coordinating tasks within research teams. This gap raises a central question: How is cooperative work structured in research based on Grounded Theory, and how can digital artifacts be designed to support this organization better? We will analyze the coordination mechanisms used in GTM-based projects to explore this, drawing on a field study. From this analysis, we will propose recommendations to improve the design of digital artifacts that better support cooperative work in this methodological context.

Related Work

The methodological challenges of qualitative analysis have been widely discussed in the literature. However, few studies have focused on how collaborative work is structured within the Grounded Theory Method (GTM). Methodological manuals (Glaser and Strauss (1967); Charmaz (2006); Bryant and Charmaz (2007)) outline the individual steps of the method and encourage the collective construction of theory. However, they often remain unclear about the practical organization of work among researchers. Strauss (1988) emphasizes the importance of coordination, planning, and task articulation in team-based research projects. However, these organizational aspects are rarely addressed in qualitative analysis publications, which focus on presenting theoretical results rather than describing the cooperative work process. Within computer-supported cooperative work (CSCW), several studies have analyzed work coordination, emphasizing that collaboration is not merely about dividing tasks but also involves interpretation, negotiation, and collective adjustment processes (Schmidt and Bannon (2013); Fidel et al. (2004)). The concept of articulation work has been beneficial for understanding how researchers synchronize their contributions (Lee, 2006). Research on collaborative practices in data science has also highlighted the importance of digital artifacts in coordinating research teams. The study by Larsen-Ledet et al. (2020) examined the challenges and strategies involved in managing multiple artifacts in collaborative writing projects, while Muller et al. (2019) explored teamwork dynamics in data science from a human-centered perspective, emphasizing how researchers use qualitative methods to organize and structure their collaboration. However, these studies have primarily considered grounded theory methodology as an analytical tool rather than a framework for structuring cooperative research practices. The question of coordination mechanisms specific to this methodology remains underexplored. Our study contributes to this gap by analyzing how researchers using grounded theory methodology coordinate their work and proposing recommendations for developing artifacts that facilitate collective work within this methodological framework.

Settings and Methods

To understand the structure of collaborative work within the GTM practitioner community, we conducted an ethnographic study between March and April 2024 at the Department of Social Sciences at the University of Liège. The study included 12 participatory and non-participatory observations and eight semi-structured interviews with various participants: researchers teaching in psychology, sociology, and management sciences; undergraduate sociology students; master's students in education sciences; and PhD students participating in GTM training seminars. We began our field research by participating in a master's seminar in education sciences, which brought together eight students, most of whom were transitioning from careers in teaching. They participated in this workshop as part of their master's thesis, where they applied qualitative methods and remarkably grounded theory analysis to better understand the experiences of the people they encountered. Held weekly, these sessions aimed to train them in qualitative approaches within a collaborative analytical framework. Data collection, coding, and analysis were carried out individually by different members and then discussed and refined by the group during the seminar. The second group observed consisted of PhD students in management sciences participating in a doctoral seminar on grounded theory methodology. This seminar was designed for Belgian PhD students wishing to deepen their knowledge of qualitative methods for their thesis research. We had the opportunity to conduct participatory observation during the sixth session of the year at the University of Namur. During this session, the PhD students, divided into four groups of four, had chosen a topic at the beginning of the year. One of the groups, for example, chose the theme "Toujours togé," in which they had to use grounded theory methodology to analyze participants' experiences at student parties. The observed session focused on refining the coding process, specifically concentrating on the selective coding phase. These observations allowed us to compare the collaborative dynamics between undergraduate sociology students, who worked in teams of four on a supervised GTM project, and the PhD students, who adopted a more autonomous approach focused on applying the method to their research. To deepen our understanding of research practices, we conducted individual interviews with three volunteer PhD students from the Namur seminar working on the theme "toujours togés." These PhD students, who come from various academic fields such as literature, education sciences, and linguistics, shared their experiences with GTM training and explained how they adapted collaborative learning to their own individual research practices. We also interviewed researcher-educators trained in GTM after university studies and have led multidisciplinary cooperative projects using this methodology. Among them, a researcher in management sciences from the University of Mons detailed her academic journey, explaining how she was introduced to GTM during doctoral seminars before teaching the method and incorporating it into her thesis methodology. Finally, an interview with a psychologist specializing in social psychology and public health provided additional insights into applying qualitative methods. He described how he gradually moved away from experimental approaches in favor of qualitative methods better suited for studying patients' experiences with chronic illnesses. These observations and interviews allowed us to analyze coordination dynamics and organizational practices within collective GTM projects. This article explores cooperative work practices by comparing two contexts: collaboration between researchers from different academic disciplines working together on a common research project ; and students conducting a collective research project on a chosen topic throughout the semester, under the supervision of their instructor.

Cooperative Work

Defining roles

In qualitative research, the first step is to define the research topic and organize the distribution of tasks. In the collaborative work reported by the researchers interviewed for this study, this distribution follows a negotiation process taking into consideration skills from each team member. Team members then take on specific research activities (such as conducting interviews, labeling data, or analyzing literature) based on their individual expertise, while maintaining the flexibility to adjust their roles as the project progresses. This role adjustment was highlighted during an interview with a researcher who had been invited to join a multidisciplinary research team as part of a project using the grounded theory approach. However, by the time he joined, the roles had already been assigned, and since the interviews had already been conducted, his initial role was limited to data coding. As he explains:

> The lead researcher was the one who initiated the project, and we both became principal co-investigators. Well, not exactly principal co-investigators because she conducted the data collection, and I conducted a few interviews, but more towards the end of the project.

As the research protocol evolved and required a return to the field, a renegotiation of roles (project organizer, interviewer, labeler, literature analyst) was initiated to support the execution of new investigations. Moreover, we observed that a researcher with expertise in qualitative methods and grounded theory was often designated as a mentor, responsible for guiding and advising colleagues throughout the process. In this context, researchers used a digital artifact to track role and task distribution adjustments. However, when no one felt legitimate enough to take on this role, the researchers moved forward together at each methodological stage, as one of them explained:

> In fact, we were committed to doing it together, almost as a safeguard. That is, we were not experts in GTM; ultimately, it was our first time practicing it.

The absence of a designated mentor encourages the participants to track their individual work more thoroughly to reach a collective opinion. This need to make individual contributions visible reflects awareness (Dourish and Bellotti (1992)), which refers to the visibility of personal contributions and the coordination of tasks within a collaborative environment. In our observation, this awareness is implicitly activated by one of the participants, who encourages their colleagues to use a single artifact to make their roles and contributions visible.

In educational contexts, the negotiation of roles takes a different form. The instructor assigns roles and then adjusts them at each stage. This rotation of roles allows students to gain a comprehensive understanding and gradual mastery of different steps in qualitative analysis, including Grounded Theory. Educational requirements often dictate these adjustments and aim to provide students with a complete experience of the method. As noted in my observation during a master's learning seminar: "Three main roles were defined at the beginning of each session by the instructor: the Secretary, responsible for writing the seminar minutes; the Labeler, responsible for labeling the interview conducted by another participant, and the Reader, who reads the interview in advance and provides feedback on its structure during the session." However, these roles will be assigned to different members at each session to ensure they are trained in every aspect of the method. This organization relies on standard procedure, where predefined roles and procedures frame collective activity and ensure a structured distribution of work (Schmidt and Simonee (1996)).

In the educational context where this fieldwork was conducted, the teaching of qualitative analysis using grounded theory was based on the approach proposed by Christophe Lejeune in his book Manuel d'analyse qualitative: Analyser sans compter ni classer (2019). To facilitate learning and operationalize research protocols, Lejeune developed the qualitative analysis platform Cassandre, designed to support collaborative work. This tool was used by the students as well as by some researchers conducting cooperative research projects Although the Cassandre platform is designed to support collaborative work, it does not allow for precise tracking of authorship: each contribution or modification cannot be linked to its author. In a cooperative context where documents are continuously updated due to shifting roles and tasks, researchers need to identify the author of each modification. This lack of adaptability is not unique to Cassandre but is a broader issue with CAQDAS software, which struggle to accommodate role changes. Thus, to better track and assign roles and visualize who is doing what in the project, participants rely on other tools such as Google Docs, which allows them to track the authorship of text edits, and Calendar, which helps organize and monitor task distribution. These real-time shared documents promote mutual adjustment, where participants continuously adapt their coordination based on the changes in the collective work.

Articulation work and backchannels

Conversely, the observed actors who solely relied on CAQDAS lacked effective reminders for tasks to be completed and often required frequent updates. To compensate, participants developed additional methods to articulate their cooperative work. They communicated spontaneously outside of meetings, sometimes without the entire group present. It has been observed that when actors cannot collaborate face-to-face, they continue their analyses individually. This independent work can lead to changes in tasks and, in some cases, roles—especially when one actor has completed their task and wants to support a teammate. According to the initially defined protocol, any task or role modification was supposed to be updated in the CAQDAS software.Such a readjustment was observed in the digital logbook on Cassandre used by a group of students during a practical session:

> O.... has completed her interview and will search for four articles in advance to help V...... with the interview analysis to choose the most relevant article once the interview has been conducted.

This excerpt illustrates how group members adapt their task distribution to meet collective needs. Initially responsible for conducting an interview, one participant expanded her role by taking on a literature search to support her colleague's analysis. These adjustments reflect the implementation of articulation work, which is necessary to adapt and reorganize activities as the collective work progresses.

However, these changes were not always visible to other team members, as they did not receive notifications or check the document daily. This rigidity of CAQDAS and their lack of features generated additional articulation work: to address these issues, participants adapted the protocol using backchannels, allowing them to communicate more directly, share information more smoothly, and effectively share updates with the entire team. During our observations of student groups and our discussions, we noticed that participants used messaging applications such as Facebook Messenger or WhatsApp to create discussion groups. They relied on this platform to share photos of their progress, record exchanges for meetings, and seek feedback from team members. Using the tagging feature, they could directly reach out to colleagues who had already completed a specific methodological step. The observed participants used messaging applications such as Facebook Messenger or WhatsApp to create discussion groups. They relied on these platforms to share photos of their work progress, record exchanges during meetings, and seek feedback from team members. Using the tagging feature, they could directly reach out to colleagues who had already completed a specific methodological step. As one participant explained:

> I clearly remember that we exchanged messages on WhatsApp, and we took the first words from a message Julien sent us to conduct our micro-analysis based on that.

This testimony highlights that these tools were used for coordination and as a means of analysis and collective work construction.

Coding

After coordinating their efforts to collect data, participants will discuss how to analyze it. They go through a coding stage, also known as labeling, where they annotate interview transcripts and observation notes with keywords in the margins (Lejeune (2010)). The procedures used by actors to label their data varied depending on the context.

It has been observed that when a project brings together researchers from various disciplines with different approaches to data analysis (quantitative, qualitative), they always chose to carry out all coding collectively. Actors discussed which labels were most suitable and adjusted their interpretation based on each researcher's experience and perspective, leading to debates and successive refinements of the labels used during this coding step. However, a member of one of the student groups we met expressed the limitations they encountered in collaborative coding, mainly when differing interpretations slowed down the progress of the work. When disagreements persist within the group, an alternative strategy is dividing the text into sections; each person codes individually. The group then compares interpretations, adjusts the coding rules, and redistributes tasks accordingly. One of the collaborators explained:

> I think there's a limit to group work because there are things we fundamentally disagree on. So we don't argue or anything because we know it's just an exercise [. . .] But as a result, I feel like it prevents us from really getting into the true depth and nuance of the work. It's a bit less thorough than when we individually divide the analysis and rework the codes.

This testimony also highlights that the need to avoid conflict and maintain a harmonious group dynamic can sometimes take precedence over pursuing a rigorous and nuanced interpretation of the data.

Methodological books (Strauss and Corbin (1990); Charmaz (2006))detail a coding stage strictly composed of three sequential steps (namely open coding, axial coding, then selective coding). The coding protocols described in academic literature have been integrated into CAQDAS software. However, some researchers we interviewed explained that in specific research projects, they limited their process to open and axial coding without proceeding to selective coding. The protocol for the latter lacked clarity in the literature, leading them to refine their axial coding instead. They adapted the protocol by establishing general guidelines rather than strict rules to make it more adaptable. As a result, the protocol functions more like a map, providing greater flexibility in decision-making (Schmidt and Simonee (1996)). Students had less freedom in choosing their coding protocol, as it was often determined by the instructor and structured through a specific software such as Cassandre, which enforces a strict coding sequence and precise formatting of research logs. As one student explained:

> It is formatted according to the different frameworks of qualitative research. You can't just open a word processor to take notes. You have to say, 'Okay, I will open a report of this specific type,' where everything must be categorized according to the type of report it will be.

Thus, the artifactually imprinted procedures limited students' freedom in organizing their note-taking and coding, forcing them to adopt a predefined structure. In this educational context, the protocol operated as a script, precisely defining each step of the process and its associated expectations, thereby guiding students in their progress. This structured approach contrasts with more flexible methods, such as maps, which allow for a more adaptable and malleable organization. By imposing a rigid framework, these predefined protocols restrict opportunities for adjustment and spontaneity in data management, leaving little room for experimentation and improvisation (Schmidt and Simonee (1996)). Nevertheless, students we met during the practical workshops adjusted their protocol by incorporating an intermediate drafting stage to explore different possibilities before finalizing their coding in the CAQDAS software. This phase took shape through word-processing artifacts or a shared notebook, allowing team members to test multiple versions of the same code, experiment with different formulations, and document the process leading to the final label. The researchers we interviewed also expressed the need for an intermediate drafting stage before integrating written content into qualitative analysis software. As one researcher explained

> We would first write them in Word. If I remember correctly, I even think we did some work to go... No, maybe we wrote them directly and then put them into NVivo. Then, if there were a review or back-and-forth, we would save them directly from there.

These remarks suggest that directly inputting data into software like NVivo does not always allow for immediate analysis structuring and that adjustments are necessary beforehand. Using a word-processing tool provides greater flexibility for drafting, modifying, and reviewing text segments before formalizing them in the software.

One of the strengths of CAQDAS tools is their ability to facilitate collaboration by providing all project members access to shared documents. However, this transparency can create granularity issues when an analysis is still in progress. For students, this means that unfinished work is exposed to instructors, while for researchers, it may reveal incomplete ideas to project organizers. The visibility of ongoing analyses can become a constraint, as it may display work that isn't fully developed. To address this issue, users have developed workarounds to keep certain reflections private. The observed users often use tools like Google Docs or paper drafts to keep specific reflections private. A particular preference for paper drafts has been noted, as they allow teams to share their analysis exclusively among themselves, ensuring the confidentiality of their ongoing work. This approach of restricting shared information aligns with the work of Olson and

Olson (2000), who emphasize the importance of maintaining control over developing information, particularly in remote collaboration contexts. Once their analysis is finalized, they integrate it into the CAQDAS software after collective discussion and validation. This process ensures a rigorous structure and provides a version that peers can review and evaluate effectively.

Theoretical refinement and schematization

Our observations of researchers and students show that after coding their data, they sort it to identify emerging concepts. CAQDAS tools offer various tools for mapping these relationships. However, these tools often rely on rigid, predefined representation models, which constrains this exploratory phase.

To support their protocol for articulating categories while maintaining adaptability, the researchers we encountered or interviewed chose a medium they described as more flexible: paper-based schematization. This approach allowed them to physically manipulate elements, test different configurations, adjust connections as their reasoning evolved, and reorganize labels according to their analytical needs. They formulated their categories on paper labels, cut them out, and connected them using paper strips. Each researcher could propose a configuration, discuss it among team members, and annotate it as a written statement in a notebook. Unlike the fixed visual representations offered by CAQDAS software, this artifact provided a shared and flexible space that facilitated real-time exploration and adjustment.

Based on our field observations during the practical session, students employed various methods to organize data and refine concepts, adapting their protocol within a single medium. Some students followed the schematic process proposed by the Cassandre software, which represents relationships between categories through graphs. However, participants reported that this predefined design sometimes constrained their reasoning, limiting their ability to adjust connections freely.

Although students could modify the order of labels in their graphs, it was noted during the sessions that changing labels was cumbersome, requiring several steps within the software. To circumvent this limitation, they replicated the graph articulation protocol on paper, as they found that this medium allowed for clearer visualization of relationships. A student thus explained during an interview:

> I try to map out and structure my ideas using post-it notes or small pieces of paper to see how the labels fit together. It's a rather messy process, with arrows everywhere, but I try to bring some order to it. At one point, to better structure my ideas, I even tried making diagrams with sticks like Cassandre.

This approach enabled them to test different configurations by modifying, crossing out, or redrawing multiple articulation proposals on the same surface, facilitating direct comparison.Other students observed during the practical sessions favored a textual approach to identify the most relevant connections between categories. Although formulating relationships through text was more cognitively demanding due to the need for multiple revisions, it allowed them to recontextualize category relationships and annotate their reasoning process. As seen in the field, this textual work was carried out in shared digital documents to experiment with different formulations before collectively validating a final version, which was then integrated into the CAQDAS software. However, the protocol that was artifactually imprinted by Cassandre still required them to use graphs for final validation. Additionally, due to limited annotation space, students reported having to make selective choices about which elements from their drafts to include. These strategies highlight how, in response to the constraints of digital tools, users adapt their protocol by combining different forms of articulation to structure their analytical work during a drafting step.

Concept refinement allows researchers to identify missing data necessary to explain a category and define its properties. At this stage, they apply the theoretical sampling method to generate new concepts and enrich the theorization process initiated during coding (Glaser and Strauss (1967)). However, the implementation of this method varies depending on the research context. As one of the interviewees reported, returning to the field for additional data collection is not always feasible due to geographical constraints or organizational limitations;

> We weren't able to do enough back-and-forth between our analysis and the field. We did a little bit, especially during the fluctuations, which allowed us to make some adjustments, but at times, we would have liked to return more to the field... We couldn't do these back-and-forths, as practical constraints prevented us from doing so.

This reflects the challenge of balancing fieldwork and analysis when practical constraints limit opportunities for further engagement with the field.

The educational context shapes the theoretical sampling protocol of the observed students, which encourages them to return to the field to explore new cases then conduct a literature review on related topics. However, as mandated by the instructor, this literature review can only be undertaken after their return from the field.They adjust their coordination protocol to incorporate comparing their results with existing scientific research. Within this dynamic, some team members continue field investigations while others conduct literature reviews, analyze data, and begin drafting the theoretical report. .Since the literature review can only occur after the fieldwork, the students encountered had to reorganize their roles and tasks accordingly, ensuring a smooth transition between data collection and theoretical analysis. To track and coordinate these different tasks, it was noted that students use a digital textual artifact (Google Docs), where each member develops their analysis by adding successive annotations. However, this method does not differentiate between different types of analysis (e.g., coding, literature review). The students implemented a collectively defined color-coding system to address this issue, allowing them to identify methodological elements and individual contributions visually. This process shows how students repurpose certain artifact features not originally designed to support this protocol to facilitate their analytical work. The artifact's flexibility enables them to iterate through different stages (coding, analyzing, comparing) without having to rewrite a new document for each step.

Proposals for enhancing artifact

Specialized artifacts, known as CAQDAS, have been developed to support the collaborative work of researchers and students in grounded theory methodology (GTM). These tools help structure and objectify the protocols described in methodological literature. In addition to facilitating the implementation of research procedures, they provide a shared workspace where all project members can access the same documents and annotations. However, these artifacts sometimes serve as strict scripts, restricting researchers' ability to adjust and refine their analytical processes. This raises a key question: how can digital artifacts be designed to structure GTM coordination while maintaining sufficient malleability to accommodate the needs of researchers and students? This reflection paves the way for recommendations on the adjustable design of digital artifacts, incorporating features that support protocol adaptability.

Our observations during the practical workshops highlight the importance of traceability within shared documents, particularly through features such as edit history and authorship tracking. An example from my field notes, collected during a workshop with third-year sociology students, illustrates this issue:

> To organize revisions, the students use a Google Doc to assign specific tasks to each member, indicating who is responsible for what. They mention that they do not always use the operational report generated by the CAQDAS software, preferring instead the suggestion mode in Google Docs, which allows them to differentiate the suggestions made by each member.

However, current tools do not allow for granular identification of the author for each modification to the project, textual or otherwise.

To address this limitation, we propose integrating a detailed history of individual contributions within the collaborative logbook, accessible for each document. This would help clarify responsibilities and decision-making processes.To better differentiate each member's contributions within the same document, as we noted during the sessions, a potential solution could be assigning a unique color code to each user along with an "authorship tracking" mode that would color code the entire document according to authors in order to make contributions visually identifiable. Additionally, an automated notification system could be configurable and displayed on the logbook page for modification tracking. It could also be useful to integrate an option for setting up and receiving email reminders of key deadlines, improving time management and facilitating smoother team coordination.

Another key point highlighted by our discussions and observations with both groups is the importance of drafting an initial version of reflections and analyses as a preliminary draft before producing a finalized version within CAQDAS software. Our observations indicate that these preliminary documents do not always follow a clearly defined structure, often combining different methodological aspects (coding, schematization) on the same page. This lack of organization can make tracking ideas and reusing or revising them more difficult. Moreover, these traces of reflective and collaborative work are not systematically transcribed into CAQDAS, leading to a loss of valuable information for the analytical process. Currently, CAQDAS does not provide a dedicated document typology for drafts, which limits their integration into the collaborative workspace. To better support users, it would be beneficial to introduce a feature that allows them to draft these preliminary documents directly within their project. This enhancement would enable users to organize and classify these documents based on their purpose—personal notes, collaborative sketches, or conceptual diagrams—thereby improving the structure of the research workflow. These features could also include access control options, allowing team members to restrict certain documents' visibility temporarily. In an educational setting, students could experiment with different analyses without making them immediately accessible to instructors, or at least clearly identify the documents as drafts when sharing them. Similarly, project members could refine specific ideas in a research context before sharing them with the project organizer. This revision of protocols, supported by a shared digital artifact, would create a more flexible cooperative workspace, encouraging experimentation and the adaptation of research protocols to the specific needs of each team.

This field research highlights that students and researchers go through multiple stages of schematization during their work. They use graphical representations not only to visualize the progress of their project but also to refine their analysis, organize coding, and structure their data. In practice, they often prefer paper-based artifacts, as these offer greater flexibility in handling and allow for customization of schema design (choice of colors, types of lines, orientation). Although CAQDAS software provides visualization tools for links and relationships between codes, these features are often inflexible and sometimes overly complex compared to users' needs. Moreover, these digital schematizations neither allow for direct manipulation nor offer a variety of representations adapted to researchers' practices. To improve data visualization and project tracking, we suggest integrating more dynamic and adaptable schematization tools into the software, such as interactive whiteboards or concept maps, to visually structure nodes derived from textual data. These interactive diagrams allow users to adjust link orientations, assign color codes, and select which connections to display. This ability to adapt protocols would serve as an actual analytical lens, helping users identify emerging trends and structures (Muller et al. (2016)).

Furthermore, some users reported in interviews that they bypassed the constraints of the schematic protocols supported in CAQDAS by creating their diagrams on a graphic tablet. They expressed the need to import and annotate these representations directly into their CAQDAS software as analytical documents, enabling them to enrich their work without losing fluidity. In certain projects, we observed over 270 documents presented as a list, requiring users to navigate back and forth to track their progress continuously. Moreover, this linear presentation limits the visibility of document relations and hinders exploration. Document graphs could be introduced to enhance navigation, allowing users to explore their data more efficiently and clearly identify connections between documents. Introducing a memo graph would highlight the anchoring links between different documents produced by the research team, providing a clearer view of the project's evolution. This system would offer users a dynamic mapping of their research protocol, facilitating the identification of the following steps and areas requiring further exploration.

Conclusion

This exploratory study on cooperative work practices in GTM demonstrates that protocols and the use of artifacts vary depending on the team's objectives, whether in an educational setting or a multidisciplinary research project. Multiple coordination mechanisms can coexist for the same methodological stage, highlighting the diversity of approaches adopted. However, when protocols or artifacts become restrictive in task execution, researchers and students rely on articulation work, enabling them to adapt and reorganize their analytical processes to maintain a smooth collaborative workflow. Given the diversity of protocols, we propose software solutions to increase tool adaptability, notably by integrating features such as document graphs, interactive diagrams, a detailed history of individual contributions, etc. Integrating document graphs would enhance the visibility of connections between sources and analyses, making it easier to explore the corpus. Additionally, interactive diagrams would provide greater flexibility by allowing real-time adjustments to the relationships between emerging categories, supporting a more fluid and evolving analysis. Finally, to assist team coordination, a detailed history of each member's contributions would ensure the traceability of individual inputs, clarify responsibilities, and facilitate the collective management of the project.

Following this research, these proposals will be further developed through ideation sessions, and user tests will be carried out to assess the usability of this artifact. The involvement of researchers and students will be essential to improving these solutions and ensuring their suitability for the needs of teams working in GTM.

References

Abramo, G., C. A. D'Angelo, and A. Caprasecca (2009): 'Allocative efficiency in public research funding: Can bibliometrics help?'. *Research Policy*, vol. 38, no. 1, pp. 206–215.

Bryant, A. and K. Charmaz (2007): *The SAGE Handbook of Grounded Theory*. 1 Oliver's Yard, 55 City Road, London England EC1Y 1SP United Kingdom: SAGE Publications Ltd.

Charmaz, K. (2006): *Constructing grounded theory: a practical guide through qualitative analysis*. Los Angeles: Sage, repr edition.

Dourish, P. and V. Bellotti (1992): 'Awareness and coordination in shared workspaces'. In: *Proceedings of the 1992 ACM conference on Computer-supported cooperative work - CSCW '92*. Toronto, Ontario, Canada, pp. 107–114, ACM Press.

Fidel, R., A. Mark Pejtersen, B. Cleal, and H. Bruce (2004): 'A multidimensional approach to the study of human-information interaction: A case study of collaborative information retrieval'. *Journal of the American Society for Information Science and Technology*, vol. 55, no. 11, pp. 939–953.

Glaser, B. G. and A. L. Strauss (1967): *The discovery of grounded theory: strategies for qualitative research*. London New York: Routledge.

Larsen-Ledet, I., H. Korsgaard, and S. Bødker (2020): 'Collaborative Writing Across Multiple Artifact Ecologies'. In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Honolulu HI USA, pp. 1–14, ACM.

Lejeune, C. (2010): 'Montrer, calculer, explorer, analyser. Ce que l'informatique fait (faire) à l'analyse qualitative'. vol. numéro 9, pp. 15–32.

Muller, M., M. Feinberg, T. George, S. J. Jackson, B. E. John, M. B. Kery, and S. Passi (2019): 'Human-Centered Study of Data Science Work Practices'. In: *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*. Glasgow Scotland Uk, pp. 1–8, ACM.

Muller, M., S. Guha, E. P. Baumer, D. Mimno, and N. S. Shami (2016): 'Machine Learning and Grounded Theory Method: Convergence, Divergence, and Combination'. In: *Proceedings of the 19th International Conference on Supporting Group Work*. Sanibel Island Florida USA, pp. 3–8, ACM.

Muller, M. and S. Kogan (2012): *The human-computer interaction handbook: fundamentals, evolving technologies, and emerging applications*, Human factors and ergonomics. Boca Raton, Fla.: CRC Press, Taylor & Francis, 3. ed edition.

Neang, A. B., W. Sutherland, M. W. Beach, and C. P. Lee (2021): 'Data Integration as Coordination: The Articulation of Data Work in an Ocean Science Collaboration'. *Proceedings of the ACM on Human-Computer Interaction*, vol. 4, no. CSCW3, pp. 1–25.

Olson, G. M. and J. S. Olson (2000): 'Distance Matters'. *Human–Computer Interaction*, vol. 15, no. 2-3, pp. 139–178.

Schmidt, K. and L. Bannon (2013): 'Constructing CSCW: The First Quarter Century'. *Computer Supported Cooperative Work (CSCW)*, vol. 22, no. 4-6, pp. 345–372.

Schmidt, K. and C. Simonee (1996): 'Coordination mechanisms: Towards a conceptual foundation of CSCW systems design'. *Computer Supported Cooperative Work (CSCW)*, vol. 5, no. 2-3, pp. 155–200.

Strauss, A. (1988): ‘The Articulation of Project Work: An Organizational Process’. *The Sociological Quarterly*, vol. 29, no. 2, pp. 163–178.

Strauss, A. L. and J. Corbin (1990): *Basics of qualitative research: grounded theory procedures and techniques*. Newbury Park London New Delhi: Sage.

Tkachenko, O. and A. Ardichvili (2020): ‘Critical factors impacting interdisciplinary university research teams of small size: A multiple-case study’. *Team Performance Management: An International Journal*, vol. 26, no. 1/2, pp. 53–69.