

**Geo-Skill Evolution: Transforming an Organization's Competitive Advantage through
Advanced Training Strategies in Geospatial Analytics**

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Abstract

According to a detailed market research report (Sreedhar, B., 2022), the global geospatial analytics market was valued at \$58.35 billion (USD) in 2020 and is projected to reach \$158.84 billion by 2025. In 2022, the United States geospatial analytics market was estimated at \$10.6 billion and was forecasted to reach \$34.5 billion in 2032 with a projected growth of 12.5% (Future Market Insights, 2022). Geospatial analytics encompasses the collection, analysis, and visualization of geospatial data from devices such as GPS, smartphones, location sensors, drones, and satellites (Fortune Business Insights, 2022). Given the anticipated growth of the geospatial analytics field, we seek to understand the best training method for employers to implement for employees to learn and become proficient in geospatial analytics. Additionally, we want to explore how an employee's individual characteristics, such as prior experience, learning preferences, and job roles, are reflected in the efficacy of the training method. Specifically, our case study relates to training and skill development in the geospatial analytics field. This study focuses on the manager's perspective on the preferred training method for employees, some of whom have minimal exposure to geospatial analytics skills used in the workplace.

Synopsis

Purpose

This qualitative study aims to understand optimal training methods for geospatial analytics. The research focuses on how individual characteristics such as prior experience, learning preferences, and job roles influence the efficacy of training methods. The study involved interviews with twelve managers/supervisors and inductively identified eleven key themes.

Problem of Practice

This study explores the most effective training methods for employees to achieve proficiency in geospatial analytics. Given the rapid growth in the geospatial analytics market, organizations need to invest in training strategies that enhance employees' skills efficiently. The research examines the impact of individual characteristics from the managers' perspective on the effectiveness of different training methods, focusing on one-on-one versus group training approaches using Environmental Systems Research Institute (ESRI) technologies. The goal is to provide insights to guide organizations to optimize training programs, foster employee development, and gain competitive advantages.

Results

From the interviews with geospatial analytic managers, an inductive a priori understanding emerged revealing foundational insights and patterns that were not previously anticipated. Table 1 below summarizes the emerging themes and results.

Table 1	
<i>Study's Key Findings</i>	
Theme	Results
Feedback and support	Managers emphasized the importance of continuous feedback and support during training, which significantly enhances the learning experience and proficiency levels.
Group training and professional development	Group training sessions provide general knowledge and foster team bonding, which can be beneficial for professional development. However, it may not address individual learning needs as effectively as one-on-one training.
Learning preferences and individual characteristics	Acknowledging and adapting to individual learning preferences and characteristics is crucial for effective training. Tailored training plans based on these factors lead to better outcomes.
Role of one-on-one training in skill development	This method is particularly effective for developing specific skills and overcoming individual challenges due to its personalization. Employees

	receiving one-on-one training demonstrated significant improvement in their proficiency.
Challenges of data and technological changes	Technical issues and the need for updated software can pose significant challenges during training. Addressing these issues promptly is essential for maintaining the effectiveness of the training program.
Application of skills and knowledge gained	Practical application of newly acquired skills in real-world scenarios is crucial for reinforcing learning and ensuring long-term proficiency.
Project-based learning	This approach is highly effective in one-on-one training settings as it allows employees to apply their skills to specific tasks and projects, thereby enhancing their practical knowledge and proficiency.
Preparation for real-world challenges	Training programs that bridge the gap between theoretical knowledge and practical application better prepare employees to meet job requirements.
Importance of foundational knowledge	Building a strong foundation of basic geospatial knowledge is essential. Employees must understand fundamental concepts to develop advanced skills and effectively apply their learning in the workplace.
Role of ESRI technologies	Utilizing ESRI's tools and resources effectively supports the learning process and ensures that training remains relevant to industry standards.
Impact of learning management systems	These systems play a vital role in organizing and delivering training content, providing a structured and supportive learning environment.

Conclusion

This study revealed that a multifaceted training approach is most beneficial to achieving proficiency in geospatial analytics. In assessing the effectiveness of training modalities, our study shows distinct outcomes based on the training format. Proficiency assessment metrics, based on a scale of 1 to 5 with 1 being low and 5 being high proficiency, indicate an observed improvement in geospatial analytics proficiency. From the managers' perspective, the average proficiency before training was 2.29 for one-on-one sessions and 2.04 for group sessions. After training, these averages increased to 3.65 and 3.42, respectively; one-on-one training led to a proficiency gain of 59.39% while group training resulted in a 67.65% improvement in proficiency amongst employees. Given our proficiency results, from a managerial perspective, a holistic approach should combine foundational knowledge, personalized training, project-based learning, and robust feedback and support systems to achieve optimal skill development. This tailored strategy enhances individual proficiency and contributes to the organization's efficiency, decision-making capabilities, and competitive positioning. As geospatial technologies continue

to evolve, fostering a culture of continuous learning and adaptation will be essential to harness and realize the full potential of geospatial analytics. Organizations that invest in comprehensive and adaptable training frameworks will be better positioned to navigate the complexities of the geospatial domain, drive innovation, and achieve significant cost savings and improve efficiencies.

Practical Relevance

The applied significance of this study is noteworthy for organizations aiming to enhance their geospatial analytics capabilities. By identifying the most effective training methods, organizations can customize their training programs to optimize individual learning preferences and job roles, leading to higher employee proficiency. Implementing a tailored training approach that combines one-on-one and group training, supported by continuous feedback and the use of relevant technologies, can lead to improved internal decision-making, cost savings, and efficiencies. Furthermore, fostering a culture of continuous learning and adaptation ensures that employees remain proficient in the evolving field of geospatial analytics, ultimately providing organizations with a competitive edge.

Methods

The Research Question

The research question of this case study is “Given the variability in employee characteristics, such as prior experience, learning preferences, and job roles, which training method is more likely to increase employee proficiency in geospatial analytics?”

Method and Design

In this study, a qualitative case study approach was adopted to gain an in-depth understanding of the effectiveness of one-on-one versus group training in geospatial analytics. The study focused on interviewing twelve managers who oversaw employees with geospatial analytical skillsets. These managers were selected based on their direct involvement with employees undergoing geospatial analytics training, making them a well-suited sample for this research.

The data gathering procedure involved conducting semi-structured interviews, which allowed for detailed exploration and clarification of responses. The interview protocol included questions to assess employee proficiency post-training, prior experience in geospatial analytics, individual learning preferences, and job roles within the organization. The research team, consisted of three members from the University of Missouri-St. Louis (UMSL) Doctor of Business Administration (DBA) program, class of 2025. Our method and design allowed codes and themes to emerge inductively throughout the research process. The study received Institutional Review Board (IRB) approval from UMSL, and informed consent was obtained from each interview participant.

The interviews were designed to compare two training models: one-on-one and group training using ESRI technology; both aiming to identify the best training method to enhance proficiency in geospatial analytics. Each interview lasted up to one hour, ensuring comprehensive coverage of the topics while allowing for detailed responses from the managers.

Data Collection, Sample, and Analysis

The data collection for this case study employed qualitative research methods, primarily using semi-structured interviews to gather detailed insights from managers overseeing employees

with geospatial analytic skillsets. The research team coordinated and executed the data collection process.

Participants were recruited using personal networks within the geospatial field. The study's target population includes adults over the age of 18 working in the geospatial community and supervising or managing employees trained in ESRI technologies using one-on-one and group training. Once identified as possible candidates for the study, a recruitment email (Appendix B) and flyer (Appendix C) were sent to each participant which outlined the study's objectives and invited participation via Zoom at a convenient time for the participant.

The interview procedure included the following:

1. The interviewer greeted and thanked the participants for their time and cooperation in our study.
2. The interviewer reviewed the informed consent information and obtained verbal consent.
3. The interviewer reviewed and confirmed the participant's demographic data and inclusion criteria.
4. The interviewer asked purposeful interview questions approved by the IRB (Appendix A).

In total, twelve participant interviews were conducted. The semi-structured interviews lasted up to one hour each, followed a standardized script (Appendix D) that included questions about the structure of training programs, challenges faced, feedback mechanisms, and the perceived effectiveness of the training methods.

The analysis involved several steps. First, the researcher read and reread transcripts, adding exploratory notes, and formulating questions to identify connections between participants' experiences and insights. Interviewee responses were analyzed and compared to identify overarching themes in the data. In instances where clarification of the interviewees' responses to questions were required post-interview, the research team contacted participants via email. The transcriptions of the interviews were cleaned and redacted, and names of the participants, companies, and other identifiable references were changed for anonymity. Each interview that the research team recorded was securely stored in the UMSL online cloud storage in accordance with IRB approval (Appendix A).

Demographic information collected and summarized in Table 2 provides an overview of the managers' characteristics, including key variables such as years with the current employer, years as a manager, highest education level, number of employees sent through one-on-one training, number of employees who participated in group training, percentage of time working remotely, employee percentage of time working remotely, age, and race.

Table 2***Geospatial Manager/Supervisor Characteristics & Demographics***

Pseudonym	Years with Current Employer	Years as a Manager	Highest Education Level	# Employees Sent Through One-on-One Training (all years)	# Employees Sent Through Group Training (all years)	Percentage of Time Work Remote	Age (Years)	Race (Self-reported)
Ronda	17 years	12 years	Bachelors	250	75	60%	41	White
Carl	13 years	4 years	Masters	10	10	0%	46	White
Thomas	9 years	22 years	High School Diploma	50	24	60%	48	White
Emily	12 years	5 years	Masters	30	120	10%	43	White
Lilly	19 years	15 years	Bachelors	15	5	15%	50	White
Danny	0.5 years	20 years	Doctorate	6	6	25%	46	White

Grant	10 years	9.5 years	Bachelors	9	5	0%	37	White
Bob	0.6 years	22 years	Masters	65	65	20%	47	White/American Indian
Ben	1 year	18 years	Bachelors	30	270	90%	44	White
Gunner	8 years	8 years	Masters	8	30	10%	50	African American
Jack	4.5 years	4 years	Masters	18	72	10%	35	White
Brian	4.5 years	4 years	Bachelors	50	50	80%	29	White

The analysis then proceeded with a comprehensive review of the cleaned and standardized interview transcripts for an in-depth understanding of the data. The research team imported each transcript into Quirkos (Quirkos, 2023) for coding. The team used inductive a priori codes to categorize the data, allowing themes to emerge directly from participants' responses. The key themes that emerged were as follows: feedback and support, learning preferences and individual characteristics, group training and professional development, application of skills and knowledge gained, challenges of data and technological changes, role of one-on-one training in skill development, project-based learning, preparation for real-world challenges, importance of foundational knowledge, role of ESRI technologies, and the impact of learning management systems. The next step was to start coding the data manually in Quirkos by highlighting sections of text and assigning each code to the appropriate theme. This was accomplished by dragging and dropping text onto the relevant 'quirk' (bubble) in Quirkos.

Following a thorough coding of relevant interview responses, we developed a code mapping which consists of codes and definitions to maintain consistency for the study. For a detailed analysis of these code mappings, refer to the Findings section. The identified themes were ranked based on the frequency of mentions during the interviews, providing a clear picture of the most significant factors influencing geospatial analytics training. The research team

ensured reliability by following a standardized protocol for data collection and analysis, regularly meeting to review findings and maintain consistency.

To enhance validity, multiple sources of evidence were used, including direct observations, employer proficiency assessments, and feedback from employers. The team concluded that saturation was reached after twelve interviews, as additional data did not yield new insights.

In summary, the data collection, sample, and analysis methods employed in this study provided a robust framework for exploring the effectiveness of different training methods in geospatial analytics. By focusing on managers' perspectives, the study offers valuable insights into the factors influencing training outcomes and employee proficiency in this rapidly evolving field.

Practical Problem

The case study explores the evolving geospatial analytics field, aiming to identify optimal training methods for employees to excel in geospatial analytics. It explores individual traits' impact on training efficacy, focusing on prior experience, learning preferences, and job roles, while also examining the delivery methods of the training itself. Conducting research around the areas of geospatial analytics training methods can offer substantial insights into the efficacy of the methodologies and their implications on employee skill development within geospatial analytics. Successful outcomes, such as positive or negative indicators of proficiency, will prescribe the preferred training method based on attributes of the employee being trained which, in turn, will lead to improved internal decision-making, increased cost savings and efficiencies, and ultimately competitive advantages for organizations. The study targets managers of

employees with geospatial analytics skills, emphasizing upskilling existing staff over external recruiting and hiring for geospatial analytics roles.

Literature Review

The research question seeks to reveal which training method is more likely to increase employee proficiency in geospatial analytics given the variability in employee characteristics, such as prior experience, learning preferences, and job roles. The theoretical frameworks of Technology Acceptance Model (TAM), Technology-Organization-Environment (TOE), and the learning theories of Cognitivism and Constructivism guide the analysis, exploring factors influencing technology acceptance and the impact of training methods on employee proficiency (Davis & et al, 1989; Baker, 2012; Ertmer & Newby, 2008).

The evolution of geospatial analytics mirrors the rapid growth and transformation within the geospatial industry, driven by technological advancements and market demands. As highlighted in industry reports, the global geospatial analytics market is experiencing substantial growth, with projections indicating a significant increase in value by 2025 and beyond (Sreedhar, B., 2022). This growth underscores the importance of understanding the most effective training methods for employees to excel in geospatial analytics. The theoretical frameworks, Technology Acceptance Model (TAM) and the Technology-Organization-Environment (TOE) framework, have roots in seminal works that have shaped our understanding of technology adoption and organizational dynamics. Developed by Davis in 1989, TAM emphasizes the critical factors influencing user acceptance of technology: perceived usefulness and perceived ease of use. This theory is particularly relevant in assessing employees' comfort level with technology and their willingness to embrace new analytic tools such as ESRI technologies. Introduced by Baker (2012), the TOE framework provides a structured organizational level approach to analyze how

different training methods lead to adoption and implementation within an organizational context and its impact on employee proficiency. The TOE framework provides a broad holistic view on the adoption, training, and the implementation of technology which is relevant to geospatial analytics.

Learning theories augment the adoption of technology, and learning theories, such as cognitivism and constructivism, contribute to our framework. Cognitivism emphasizes knowledge acquisition, mental processing, and feedback (Ertmer & Newby, 2008). The related Cognitive Load Theory (CLT) emphasizes techniques for managing working memory load to assist with long term memory, which is important in optimizing training methods (Paas et Al., 2004). By understanding how learners process information and the limitations of cognitive capacity, trainers can design technology-based learning interventions that reduce cognitive overload and enhance retention. Constructivism equates learning with meaning from context and experience, including mentors, as individuals are active learners and excel in a collaborative learning environment (Ertmer & Newby, 2008). This theory supports the integration of technology by promoting environments where learners can interact with digital tools, share knowledge, and build upon their experiences collectively. Both cognitivism and constructivism learning theories assist with determining the best training method to design and implement effective training instruction in geospatial analytics. By leveraging these theories, trainers can create immersive and interactive training programs that not only facilitate the adoption of new technologies but also ensure that these technologies are used to their fullest potential, enhancing overall learning outcomes and organizational performance.

By considering the interplay between technology, organizational factors, external environment, and learning theories, these frameworks offer a comprehensive lens through which

to evaluate the efficacy of training methods in enhancing geospatial analytics skills among employees. The relevance of these theoretical frameworks lies in their applicability to the business problem at hand, which we summarize as enhancing the geospatial analytics skills among employees in organizations where geospatial analytics tools are increasingly complex and essential for organizational success. Organizational successes can significantly enhance strategic advantage by leveraging advanced geospatial analytics. Organizations that excel in geospatial analytics make more informed decisions (Andrienko et al., 2007). Effective training methods not only improve employee proficiency, but also contribute to innovation and improved performance, ultimately driving sustainable growth and advantage (Kunche et al., 2011).

Delving into these theories and their historical evolution, this study aims to shed light on the preferred training method for upskilling employees in geospatial analytics. The insights gained from exploring these training methodologies within the context of geospatial analytics training not only contribute to academic discourse but also offer practical implications for organizations seeking to enhance employee skill development and gain a competitive edge in the dynamic geospatial analytics market.

In a landscape where geospatial analytics tools are often very complex in design and usability, understanding how individual characteristics interact with training methods becomes paramount. Moreover, organizations fostering a culture of continuous learning and providing resources for intensive training are likely to yield better outcomes from such methods (Ahmed et al., 1999).

For this study, we used inductive a priori codes that emerged by directly examining the data from our research interviews. This provided a theoretical framework for examining our participants' experiences.

Findings

To enhance our understanding of effective training methods in geospatial analytics, we embarked on a detailed case study comparing two distinct approaches that enabled employees to gain proficiency in geospatial analytics. We examined two models of training methods to identify which method leads to employee's proficiency in geospatial analytics from the manager's perspective. In Model 1, the method analyzed is one-on-one training. In Model 2, the method analyzed is group training. The employee training was directed by their respective supervisors/managers. Our unit of analysis was the manager and their perspective on proficiency gained by their direct reports who had undergone one-on-one and group training in ESRI technologies. By focusing on the manager as the unit of analysis, the research team was able to gather rich, detailed data that highlights the complexities and nuances of training in geospatial analytics, ultimately leading to actionable insights and recommendations for optimizing training programs.

Our study is based on qualitative research using semi-structured interviews which allowed us to delve deeper into responses and to ask for further clarification or examples as appropriate. Our research team maintained a focus strategy on managers of employees who had experienced one-on-one and group training. We asked these managers specific questions regarding whether their employees were able to apply their new geospatial analytic skills to basic and more complex situations. Also, we inquired about the managers' perception of the efficacy of employee one-on-one and group training, including comparisons and suggestions for future training success. The managers' perspective of employees' proficiency in geospatial analytics provided us with insight into the preferred training method preferred by the manager. In our examination of the interview data, our team distinguished between "gain in" and "gain of"

regarding geospatial analytics skills. We found that "gain in" refers to an enhancement in basic understanding or foundational knowledge of geospatial analytics, as noted by managers. This represents a deepening of proficiency. On the other hand, "gain of" pertains to acquiring measurable skills that meet specific job demands and are necessary for handling complex geospatial products at work. This implies an actual acquisition of new abilities that are essential for professional requirements.

The total managerial experience among our interviewees amounted to 99.1 years. On average, interviewees had been with their current employer for 8.26 years. Figure 1 is an example of the average duration of managing or supervising geospatial analytic staff, which equated to 11.96 years. 41.67% of the interviewees held either a bachelor's or master's degree, with an equal number of each as shown in Figure 2. On average, our interviewees have supervised 45 employees who have undergone one-on-one training. Furthermore, on average, our interviewees have supervised 61 employees who attended group training sessions (Table 2).

Figure 1

Managerial Experience and Tenure

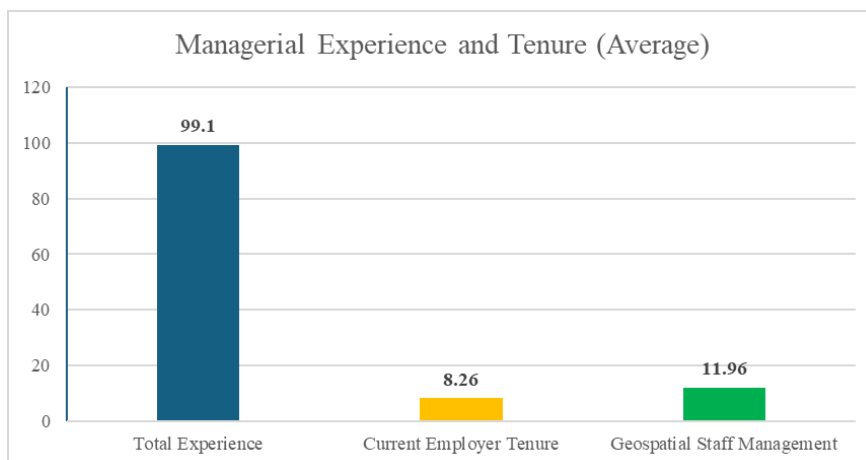
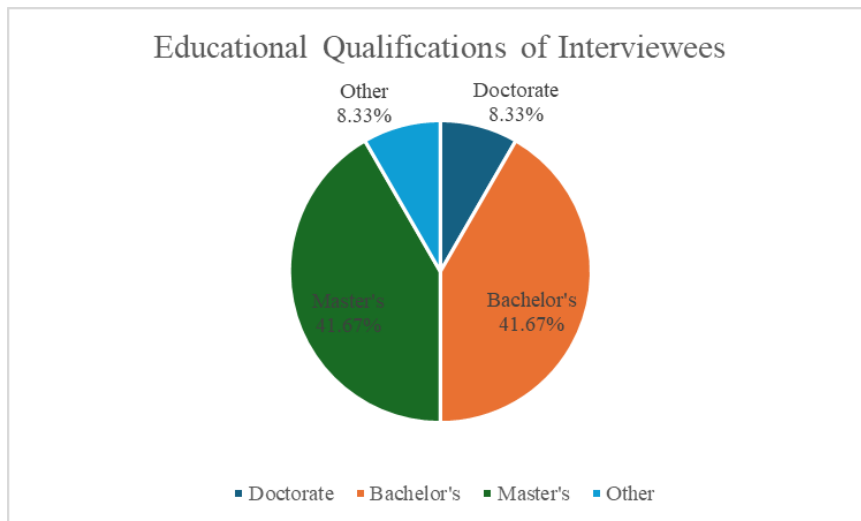


Figure 2*Educational Qualifications of Interviewees*

In summary of our team's analysis of the interviewees' responses, we identified 808 transcribed direct quotes which were methodically mapped to eleven emerging themes. The identified themes are ranked in order of the number of times each theme was mentioned or interpreted during the interviews per our coding using Quirkos; resulting summary is shown in Table 3.

Table 3	
<i>Summary of Emerging Themes Derived from Interviews</i>	
Theme	Number of Mentions or Interpreted Mentions in the Transcripts
Feedback and support	133
Group training and professional development	121
Learning preferences and individual characteristics	111
Role of one-on-one training in skill development	90
Challenges of data and technological changes	61
Application of skills and knowledge gained	58
Project-based learning	58
Preparation for real-world challenges	56
Importance of foundational knowledge	43
Role of ESRI technologies	42
Impact of learning management systems	35

Our research team used a word cloud created from coded interviews to visually emphasize the most frequently used terms, providing immediate insight into key themes, emerging trends for future exploration, and other topics of interest within the geospatial analytics field. Figure 3 below highlights prevalent concerns, popular technologies, and common methodologies, offering a snapshot of current trends and focal areas in geospatial analytics.

Figure 3

Word Cloud for the Study Interviews (Quirkos, 2023)



Chain of Evidence

The themes that emerged were consistent across the interviewees' responses, as revealed by the chain of evidence gained through the coded interview quotes. To bolster the study, we provide authentic excerpts (direct quotes) or interpreted mentions (our understanding of the quotes) correlated to the emerging themes as evidence for the case study.

The theme of Feedback and Support featured the most coded quotes from the research team's transcriptions, totaling 133. We gained an incredible understanding about the role of

feedback and support within one-on-one and group training sessions and the effect on the learning experience (Table 4). The quotes reveal the importance of feedback which can lead to not only improved training, but also synergies in prerequisites related to the skill level needed for the employee attending training. Furthermore, feedback provides the employee with a check-in on their progress and level of knowledge which is integral to the learning process (Wakefield et al., 2014). The responsive nature of the training program reflects a commitment to continuous improvement and a supportive learning environment tailored to employee needs.

Table 4 – Feedback and Support	
Authentic Excerpts	Interviewee
“The feedback and support during the one-on-one training process was appreciated, because it provided employees with the understanding of how they were performing in a new role.”	Ronda
“. . . and you know, sometimes with the self-training, if you do a couple of classes, and you're like, oh, no, this is too simple, or whatever, you can change curriculums quickly . . . with the online one. Once you buy in [class training], it's sometimes harder to [change] levels, set your knowledge and your expectations because . . . it's that 3 or 5 days that you're already in the middle of. So, it can be hard to check in and . . . redirect if the training is not appropriate.”	Lilly
“. . . an employee asks a lot of questions. That feedback is received quickly, and it's implemented, and they usually do very well for themselves, even though they might be slow to start, or they're kind of annoying to ask a lot of questions.”	Thomas

Group training and professional development featured the second most coded quotes from the research team's transcriptions totaling 121. Interestingly, managers felt that group training allowed employees to gain awareness and general knowledge of geospatial analytics and then employees could take the next step to delve deeper into a specific aspect. Also, managers referenced the team bonding aspect that occurred during group training, which could enhance the employees' network and become a reference source for future projects and professional development.

Table 5 – Group Training and Professional Development	
Authentic Excerpts	Interviewee
“I think [group training] is more generalized basic tools and capability rather than specific, you know, to a project or an analytic capability that needs to be trained. I think it's more	Ronda

general and broader . . . but the course typically provides that general knowledge or understanding, so they feel more comfortable to be able to take the next steps”	
“Yeah, they're team building . . . they actually developed a bond with another co-worker and a remote setting that helped carry them on into a part of the culture that they end up getting to. I know it's not just analytics, but it did help in that aspect, but that's about the only benefit, I would say.”	Thomas
“It provides opportunities to bring in. Other professionals to share their experiences.”	Emily

Learning preferences and individual characteristics emerged as the theme with the third most coded quotes at 111 (Table 6). Managers acknowledged that employees have different learning styles and, therefore, they need to be able to recognize learning preferences and individual characteristics to implement the optimal training guidelines for everyone. Recognizing learning preferences and individual characteristics allowed managers to adjust the training methods to ensure employees gain the applicable knowledge, proficiency, and skills to excel in geospatial analytics.

Table 6 – Learning Preferences and Individual Characteristics	
Authentic Excerpts	Interviewee
“I have a whole bunch of different learning plans. Some are guided towards if somebody is new to the team, new to geospatial, like, kind of a basic run through everything . . . different levels of training plans . . . appropriate for what their learning level is.”	Lilly
“I think in a perfect world you would expect someone to be nearly 100% proficient, but that isn't always the case, right? You must always tweak and alter the course of action. And take additional steps if proficiency isn't being achieved.”	Ronda
“. . . we still need to improve upon is thinking outside the box. It's not necessarily fundamental skills that [are] needed to get a job done, but may actually be more soft skill related, or understanding that they're empowered to go and engage with a developer, or think about how you can do something better, faster, quicker, or making your life easier. You know the communication with your fellow colleagues, and especially in a remote setting.”	Thomas

Our research team ensured that we explored the nature of the manager's perspective on employee's hands-on experience with one-on-one training in geospatial analytics, including specific tasks or projects they undertook. There were 90 coded quotes from the interviewees mapped to the role of one-on-one training theme. Given the emphasis on skill development through one-on-one training, and the transition to project execution, these insights illustrate a

comprehensive understanding of the training process leading to efficacy and impact on employee proficiency and confidence (Table 7).

Table 7 – Role of One-on-One Training in Skill Development	
Authentic Excerpts	Interviewee
“So, we provide specific one-on-one training that ensures, they have an understanding.”	Ronda
“One-on-one helps you get past these hurdles faster. Right? So, if you're having an issue the mentor, or you know, whoever's working with you, you can address it right away, and kind of just guide that experience for you. This tailored training experience is so much more personal and much more effective.”	Carl

Challenges of data and technological changes emerged as another theme with 61 coded quotes (Table 8). Geospatial analytics deals with a vast amount of data on a large scale which inherently results in challenges not from the technology acceptance aspect, but from technical issues and the requirement to keep software applications current.

Table 8 – Challenges of Data and Technological Changes	
Authentic Excerpts	Interviewee
“We deal with such data at large scale that sometimes that gets lost in translation . . . Our hurdle with ESRI is just how it doesn't really scale . . . you can't, you know, wait an hour for a Geo processing task to run.”	Lilly
“I would say the biggest problem was remote-setting technical issues. . . they're actually processing on a work computer, but they're VPNing [virtual private network] in through their home computer. So, the technical issues could range from work-related issues or their home computer.”	Thomas

Insights gained from our fourth theme, application of skills and knowledge gained, and the 58 coded quotes reveal a clear path from training to application, emphasizing the direct impact of acquired skills on understanding the project, creating the appropriate workflow, and being able to successfully apply the knowledge to the project or revise as necessary (Table 9).

Table 9 – Application of Skills and Knowledge Gained	
Authentic Excerpts	Interviewee
“The employees worked with the analyst a lot, for example, sitting down with them to see their geospatial workflow. That's how you know the customers' true mission and workflow. Then the employee takes that information and begins creating documentation and new workflows with the new software. It's been pretty successful.”	Lilly
“It's an up and down and around and you build it, and you break it, and you build it, and you break it and you finally get it.”	Emily

"Everything else you build on from . . . years of experience and working on a project that is utilizing [geodatabase] . . . how to connect, how to put data in it, how to use some of the functionality of the Geo database like archiving and versioning."	Carl
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Another theme was project-based learning with 58 coded quotes (Table 10). One-on-one training is optimal for project-based learning due to the specific nature of the project and tasks that employees need to understand as part of their geospatial analytics proficiency journey.

Table 10 – Project-Based Learning	
Authentic Excerpts	Interviewee
"So, the one-on-one training is directly 100% applicable to a project that they're moving into... It was literally applicable to the project that they were working."	Ronda
"I would personally like, when they're interning with me, they're working on one single project."	Emily

The theme, preparation for real-world challenges, emerged with 56 coded quotes (Table 11). This theme is valuable as it highlights the necessity of bridging the gap between theoretical learning and practical application, enhancing the effectiveness of training and an employee's ability to demonstrate proficiency to meet the demands within their organization as well as in their professional career.

Table 11 – Preparation for Real-World Challenges	
Authentic Excerpts	Interviewee
"Then give examples, a test area, or a test file to go through and accomplish certain tasks, then they would receive [feedback] . . . and then you continue that path over several weeks. The key is we want them to be fully productive and fully rounded on what they can do."	Thomas
"Here's all the documentation I have . . . report back to me where you think we're at and where we need to go next."	Emily

There were 43 coded quotes that supported the theme of the importance of foundational knowledge (Table 12). Given this emphasis on building knowledge in a sequential, layer-by-layer manner, and tailoring training to specific job functions, this insight speaks to the effectiveness of the one-on-one training structure in enhancing employee proficiency in geospatial analytics.

Table 12 – Importance of Foundational Knowledge	
Authentic Excerpts	Interviewee
"It's the foundation. Without developing the geospatial thinking, as in the why I'm pressing this button, the employees don't understand why they're pressing the button. As a result, they can't develop a workflow in the next step on their own."	Emily

“When employees are not as proficient as they need to be in the foundation knowledge, they essentially step them out of production and execution and move them back into a training role.”	Ronda
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During the interviews, our research team asked about the specific ESRI resources or tools provided to facilitate learning during the training. We identified 42 coded quotes supporting the Role of ESRI technology theme (Table 13). The responses by interviewees on specific software and the adaptation of training to include migration to newer platforms reflect a deep engagement with ESRI's offerings to ensure that employees remain at the cutting edge of geospatial technology. This strategic approach not only enhances the learning experience but also ensures that the training remains relevant and effective in the rapidly evolving field of geospatial analytics.

Table 13 – Role of ESRI Technologies	
Authentic Excerpts	Interviewee
“We have a point of contact at ESRI that we work with directly that either supports us or puts us in the right direction. This could be troubleshooting, or if development needs become more complex, they might pass us on to a better suited point of contact, but we have a designated ESRI professional that our company works with for any related questions.	Ronda
“... having companion documentation along with it, because a lot of time if you do one-on-one training and you've highly customized it ... for specific tasks for specific individuals ... if you can get companion documentation ... [to] reference or go back to because they're just not going to remember everything ...”	Carl

The final emergent theme is the impact of learning management systems with 35 coded quotes. The impact of learning management systems theme is essential as it highlights how digital platforms are not just logistical tools but are central to educational experiences. They support a more personalized, engaging, and accessible learning environment that can adapt to the diverse needs of modern learners with effective methods for a positive geospatial analytics experience. According to one interviewee, Ben, a key ingredient of learning management systems is “time.” Incorporating time management features into a learning management system can enhance the learning experience by providing structure, improving engagement, and supporting effective learning practices.

Table 14 – Impact of Learning Management Systems	
Authentic Excerpts	Interviewee
“For instructional techniques, we use a lot of demonstrations, and I make sure to record the group training sessions and provide the employee with the recording so that the students can go back to them asynchronously to watch the steps again. Having the recording seems to really help support their learning.”	Emily
“For employee learning, it would be useful to have some kind of training module that helped explain what the ESRI software was doing behind the scenes, even if it was a small vignette or something that just helped with the employees understanding”	Thomas

Discussion

Our case study revealed unexpected results. First, the analysis based on participants quotes showed that in group training senior employees benefit and gain more proficiency from group training than junior employees who were sent to the same training – this was unexpected yet revealing and helpful for employers to determine who would benefit most from different training methods. Second, Thomas's organization's one-on-one training is the only method that has historically worked for their organization due to their geospatial product complexity. It is worth noting that Thomas's organization has and still does send individuals to group training with minimal success, but only as needed. Finally, with both one-on-one and group training, a simple concept, yet often overlooked factor is, proficiency is positively driven by the employee's motivation in taking the training.

Our case study used various theoretical lenses to focus on gaining the manager's perspective on employee's geospatial analytics proficiency which included understanding employees' experience, projects, and ability to obtain a required level of proficiency for their workplace. Given the emphasis on foundational knowledge, skill development through one-on-one training, and the transition to project execution, these insights illustrate a comprehensive understanding of the training process's impact on employee proficiency and confidence. When employees see technology being effectively used by peers or managers, their perception of its usefulness increases. Additionally, we provide evidence that effectiveness of training methods

was supported by the insights gained in our study and reflect a deep appreciation for the nature of one-on-one training in enabling geospatial analytics skills while also recognizing the need for continuous learning and adaptation to ensure lasting proficiency. The emphasis on tailored learning experiences and the acknowledgment of the requirement for ongoing skill development to address the evolving landscape of geospatial analytics was reiterated in all our interviews. Tailored training methods that account for the learner's ease and ability to grasp technology reinforce the TAM notion that perceived ease of use is critical for technology acceptance. Lastly, we confirmed that application of skills insights was supported given quotes revealing a clear path from training to application, emphasizing the direct impact of acquired skills on project execution and workplace contribution. The progression from training to application reflects cognitivism's emphasis on knowledge acquisition and the use of feedback for learning.

Lessons for Practice

The insights gained from this qualitative study offer valuable lessons for organizations aiming to enhance their training programs in geospatial analytics. First, based on the findings and chain of evidence, a multifaceted training approach yields the best results. Combining one-on-one training with group sessions can address both individual learning needs and boost team collaboration. One-on-one training is particularly effective for developing specific skills and providing personalized feedback, which significantly enhances employee proficiency. Additionally, group training offers broader knowledge and promotes professional development and team bonding.

Second, the importance of continuous feedback and support cannot be overstated. Managers highlighted that ongoing feedback during the training process helps employees understand their progress, adjust learning paths, and overcome challenges promptly.

Implementing a structured feedback mechanism within training programs can greatly enhance learning outcomes.

Third, recognizing and adapting to individual learning preferences and characteristics is very important. Tailored training plans that consider prior experience, learning preferences, and job roles lead to better engagement and skill acquisition. This personalized approach ensures that training is relevant and effective for each employee, ultimately contributing to higher proficiency levels.

Fourth, the application of skills in real-world scenarios is essential for reinforcing learning and ensuring long-term proficiency. Training programs should incorporate project-based learning and practical exercises that allow employees to apply their newly acquired skills to actual tasks and challenges they will encounter in their organizational roles. This allows employees to understand how the newly acquired skills apply to their day-to-day work.

Finally, leveraging advanced tools and technologies, such as ESRI's suite of geospatial analytics tools, and robust learning management systems can support a more effective and efficient training process. These technologies facilitate access to resources, provide structured learning paths, and enable continuous learning and adaptation to new developments in the field.

Contributions to Theory

Our case study contributes to theory by extending and integrating the existing theoretical frameworks of Technology Acceptance Model (TAM), the Technology-Organization-Environment (TOE) framework and learning theories of Cognitivism and Constructivism (Davis et al., 1989; Baker, 2012; Ertmer & Newby, 2008). Our study highlights the importance of tailored training methods, showing that personalized one-on-one training significantly enhances employees' comfort and proficiency with geospatial technologies. This extension of TAM

underscores that individualized feedback and support are crucial for improving perceived ease of use and usefulness, leading to better technology adoption. Additionally, the application of the TOE framework demonstrates the need to consider both internal factors (such as employee characteristics) and external factors (like technological advancements) to optimize training outcomes.

The study also integrates learning theories to design effective training programs, emphasizing structured, step-by-step training from Cognitivism and interactive, experiential learning from Constructivism (Ertmer & Newby, 2008). By proposing a holistic training model that combines foundational knowledge, personalized training, project-based learning, and continuous feedback, the study offers a comprehensive strategy for organizations to enhance employee proficiency. These contributions provide valuable insights into the critical role of feedback mechanisms and the need for adaptable, tailored training programs to ensure long-term proficiency and organizational competitiveness in geospatial analytics.

Keywords

GIS Training, Geospatial Analytics, Training Methods, Employee Characteristics, Prior Experience, Learning Preferences, Job Roles, Skill Development, Efficacy of Training

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Appendix A

IRB Approval Letter and Amendment

Figure A1

IRB Approval Letter



March 12, 2024

Principal Investigator: Justin W. Bennett
Department: Business DBA

Your IRB Application to project entitled Geo-Skill Evolution: Transforming an Organization's Competitive Advantage through Advanced Training Strategies in Geospatial Analytics was reviewed and approved by the UMSL Institutional Review Board according to the terms and conditions described below:

IRB Project Number	2100570
IRB Review Number	404218
Initial Application Approval Date	March 12, 2024
IRB Expiration Date	March 12, 2025
Level of Review	Exempt
Project Status	Active - Exempt
Exempt Categories (Revised Common Rule)	45 CFR 46.104d(2)(iii) with limited IRB review
Risk Level	Minimal Risk
Approved Documents	Interview Scripts
	Consent Form
	Email Template
	Research Flyer

The principal investigator (PI) is responsible for all aspects and conduct of this study. The PI must comply with the following conditions of the approval:

1. Enrollment and study related procedures must remain in compliance with the University of Missouri regulations related to interaction with human participants at https://www.umsystem.edu/ums/rules/collected_rules/research/ch410/410.010_research_involving_humans_in_experiments.
2. No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date.
3. All changes must be IRB approved prior to implementation utilizing the Exempt Amendment Form.
4. The Annual Exempt Form must be submitted to the IRB for review and approval at least 30 days prior to the project expiration date to keep the study active or to close it.
5. Maintain all research records for a period of seven years from the project completion date.

If you are offering subject payments and would like more information about research participant payments, please click here to view the UM Policy: https://www.umsystem.edu/ums/policies/finance/payments_to_research_study_participants

If you have any questions or concerns, please contact the UMSL IRB Office at 314-516-5972 or email to irb@umsl.edu.

Thank you,
UMSL Institutional Review Board

Figure A2

IRB Approval Amendment



April 26, 2024

Principal Investigator: Justin Bennett (UMSL-Student)
Department: Business DBA

Your Exempt Amendment Form to project entitled Geo-Skill Evolution: Transforming an Organization's Competitive Advantage through Advanced Training Strategies in Geospatial Analytics was reviewed and approved by the UMSL Institutional Review Board according to the terms and conditions described below:

IRB Project Number	2100570
IRB Review Number	409824
Initial Application Approval Date	March 12, 2024
Approval Date of this Review	April 26, 2024
IRB Expiration Date	March 12, 2025
Level of Review	Exempt
Project Status	Active - Exempt
Risk Level	Minimal Risk
Approved Documents	exempt form amended

The principal investigator (PI) is responsible for all aspects and conduct of this study. The PI must comply with the following conditions of the approval:

1. Enrollment and study related procedures must remain in compliance with the University of Missouri regulations related to interaction with human participants at https://www.umsystem.edu/ums/rules/collected_rules/research/ch410/410.010_research_involving_humans_in_experiments.
2. No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date.
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If you are offering subject payments and would like more information about research participant payments, please click here to view the UM Policy: https://www.umsystem.edu/ums/policies/finance/payments_to_research_study_participants

If you have any questions or concerns, please contact the UMSL IRB Office at 314-516-5972 or email to irb@umsl.edu.

Thank you,
UMSL Institutional Review Board

Appendix B

Recruitment Email Template

Subject: Geo-Skill Evolution: Transforming an Organization's Competitive Advantage through Advanced Training Strategies in Geospatial Analytics

Dear Name,

I am earning a Doctor of Business Administration degree from the University of Missouri - St. Louis (UMSL). I and two of my fellow DBA Cohort members, under the supervision of our Qualitative Methods II instructor, Dr. Joseph Rottman, are conducting a research case study for the program's second qualitative research learning and development course this spring semester.

Given the projected growth of the geospatial analytics market, we seek to understand the best training method for employers to implement for employees to learn and become proficient in geospatial analytics, and how employee's individual characteristics, such as prior experience, learning preferences, and job roles, are reflected in the efficacy of the training method. Specifically, our case study relates to training and skill development in the geospatial analytics field. We plan to examine two models of training methods to identify which training method leads to employee's proficiency in geospatial analytics.

We invite you to participate in an interview via Zoom. We are also happy to accommodate any of your colleagues who may be interested in contributing to this study.

Please reply to this email at your earliest opportunity to schedule an interview. I can be reached via email or by the phone number listed below.

Thanks in advance for your consideration of this request.

Sincerely,

[Student Name]
2025 DBA Cohort
Doctor of Business Administration (DBA)
University of Missouri - St. Louis
Email:
Phone:

Appendix C**RECRUITMENT FLYER****Figure C1***Recruitment Flyer*

We are conducting a case study related to training and skill development in the Geospatial Analytics field. We plan to examine different training methods, specifically one-on-one training and group training, to determine which training method leads to improved employee proficiency in geospatial analytics. Interviews will be conducted via Zoom at a mutually agreed time. Conducting research around the areas of geospatial analytics training methods can offer substantial insights into the efficacy of the methodologies and their implications on employee skill development within geospatial analytics. Successful outcomes such as positive or negative indicators of proficiency will lead to improved internal decision-making, increased cost savings and efficiencies, competitive advantages, and innovative problem-solving for organizations.

You May Qualify If You

- Are over 18 years old
- Work within the Geospatial industry
- Currently supervise personnel
- Supervise or manage employees who have been trained in ESRI technologies using one-on-one and group training

FOR MORE INFORMATION

Please contact Justin Bennett at 217-390-8085, email jwb9fd@umsl.edu.

Appendix D

Interview Script

The following questions were used for the semi-structured interviews. The researcher conducting the interview asked follow-up questions and allowed the conversation to flow organically.

General Demographic Questions:

Introduction and Consent

Greet the participant and thank them again for their time. Maybe engage in a few minutes of "small talk" to establish rapport. State that before the interview begins, you would like to review some information about the project and confidentiality with them.

Review informed consent information. Ensure they understand that:

- Participation is voluntary and they may stop at any time.
- I will record the interview now; it will be stored on a secure, password-protected and UMSL-approved place and will be deleted after the study is published.
- We will use quotes from the interview when we write up and present the results of the study, but names and company names will be replaced with fake names to protect your privacy.

If they are amenable to participating, start the recording, and obtain verbal consent on the record.

Basic Screening Questions

Tell the participant that you would like to start with some basic questions and to confirm some information about their demographics. Say you know they answered some of these questions before they scheduled the interview, but you just want to reconfirm and get their answers on the record.

1. First, I know people have different preferences for how they like to be identified and how they like to refer to themselves. So, what are your preferred pronouns and how would you like me to refer to you?
2. What industry do you work in (Must work in the Geospatial industry)
3. Are you currently or have you been a supervisor or manager of one or more employees with geospatial analytic training?
4. Have you held this supervisory role for at least 6 months and within the past 2 years?
5. Do you know how your direct report obtained their geospatial analytics training? For example, was the training one-on-one or obtained in a group setting?

Define Geospatial Analytics: Geospatial analytics, a field experiencing rapid growth, harnesses the power of geographic information systems (GIS) to extract meaningful insights and patterns from spatially oriented data, thereby supporting management

objectives (Supak et. al., 2015). At its core, geospatial analytics involves analyzing and visualizing data in relation to specific locations. The insights gleaned from this spatial data can significantly enhance our understanding of various phenomena.

6. How long have you worked for your current employer?
7. How long have you been a direct supervisor (an estimate is OK)?
8. Do you work remotely at all? If so, how much of your week do you typically spend working remotely versus in-person?
9. Do the employees who do geospatial analytics work remotely at all? If so, how much of their week do they typically spend working remotely versus in-person?

Next, we have some standard demographic questions. Some of these might seem a little obvious, but we try not to make any assumptions. So, it's standard practice in research for us to ask you these questions even if we think we already know the answer. Ok, here we go...

1. How would you describe your race?
2. Age (or age bracket)
3. Highest education level (high school, some college, associate degree (major), bachelor's degree (major), master's degree (concentration), Doctorate (concentration))

(If, during the course of asking the above questions, you learn that the person does not meet the inclusion criteria, apologize to them and tell them that this particular study is looking at a very specific group of folks, and you don't want to waste their time if you can't use their information in the paper. Thank them profusely for their willingness to help you out before signing off.)

Interview Questions:

One-on-One Training

Note: focus will be on one employee at a time. Should the interviewee wish to discuss more than one employee, we will ask each question for each person they wish to provide information for in this study.

1. Can you describe your employee's experience with one-on-one training in geospatial analytics? What specific tasks or projects was the employee involved in during the training process?
2. How was the one-on-one training structured? Were there designated mentors or supervisors guiding the employee's learning process?
3. What ESRI resources or tools were provided to support their learning during one-on-one training in geospatial analytics?
4. Can you share any challenges or obstacles they encountered while learning geospatial analytics? How did they overcome them?
5. Did the employee receive regular feedback and support during the one-on-one training process? How did this feedback influence their learning experience?
6. In your opinion, what were the most effective aspects of one-on-one training for developing proficiency in geospatial analytics?

7. Were there any limitations or drawbacks associated with ESRI on one-on-one training in geospatial analytics? If so, how do you think they could have been addressed or improved?
8. Can you provide examples of how they applied the skills and knowledge gained from one-on-one training in geospatial analytics to their daily tasks or projects?
9. How do you perceive their proficiency in geospatial analytics after completing the one-on-one training program? What areas do you feel most confident in, and where do you see room for improvement?
10. Looking back, what suggestions or recommendations would you offer to enhance the effectiveness of one-on-one training for future employees learning ESRI technologies to perform geospatial analytics?
11. On a scale of 1 to 5, with 1 being low proficiency and 5 being high proficiency, based on your observation of the job role, how would you rate the employee's proficiency in geospatial analytics before undergoing the training?
12. On a scale of 1 to 5, with 1 being low proficiency obtained and 5 being high proficiency obtained, based on your observation, how would you rate the employee's proficiency in geospatial analytics using ESRI technology after undergoing the training? Please consider their ability to apply the concepts and tools in their day-to-day job roles. Could you provide specific examples or outcomes that illustrate this proficiency?"

Group Training (including certificate programs):

1. Describe the employee's experience with group training in geospatial analytics. What were the main topics covered, and how was the training structured?
2. What learning methods or instructional techniques were employed during the group training for geospatial analytics?
3. How did the group training environment differ from their typical work setting? Did they find this conducive to learning geospatial analytics effectively?
4. Can you discuss any challenges or difficulties they encountered during the group training in geospatial analytics? How were these challenges addressed?
5. Were there opportunities for hands-on practice or real-world application of geospatial analytics concepts during the group training sessions?
6. How did the group training contribute to their understanding and proficiency in geospatial analytics compared to other learning methods you've experienced?
7. Did the employee receive feedback during the group training? How did this feedback impact their learning experience?
8. In your opinion, what aspects of the group training for the employee was most beneficial for developing proficiency in geospatial analytics?
9. Reflecting on the employee's experience, what aspects of the group training could be improved or enhanced to better support learners in mastering geospatial analytics concepts?
10. How do you perceive the employee's proficiency in geospatial analytics after completing the group training? What areas that the employee gained training in do you feel most confident in, and where do you think further development is needed?

11. On a scale of 1 to 5, with 1 being low proficiency and 5 being high proficiency, based on your observation of the job role, how would you rate the employee's proficiency in geospatial analytics before undergoing the training?
12. On a scale of 1 to 5, with 1 being low proficiency obtained and 5 being high proficiency obtained, based on your observation, how would you rate the employee's proficiency in geospatial analytics using ESRI technology after undergoing the training? Please consider their ability to apply the concepts and tools in their day-to-day job roles. Could you provide specific examples or outcomes that illustrate this proficiency?"

Thank them again for participating in the study and invite them to follow up with you if they have any questions or thoughts later. Tell them also that at some point in the future, you might get back in touch with them with any short follow-up questions, clarification, or to ask for their input on the draft of the paper.

Final goodbye and sign-off.