Competency-Based Education/Training (CBE/CBT) in Data Services: Data Service Continuing Professional Education (DSCPE) and Learning Outcomes

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ABSTRACT

In this paper, we report the findings of the evaluation data from the Data Services Continuing Professional Education (DSCPE) program. Using the Competency-Based Education/Training (CBE/CBT) approach, the DSCPE program fills a much-needed gap in data services training of working librarians. Our analysis focuses on the Knowledge, Skills, and Abilities (KSAs) as learning outcomes expressed by students via a pre-program survey and personal statement, and learning outcomes achieved based on students' post-program survey, the focus group session, and their capstone presentation. Seventeen KSAs identified by participants pre-program matched the KSAs that participants reported they obtained through DSCPE. There were four matched items between mentors' feedback and students expected or achieved KSAs. The focus on competencies is one of the key factors that led to the success of DSCPE, and specific program evaluation data zero in on KSAs also helped to highlight the matched learning outcomes and identify areas where the DSCPE can improve for future cohorts.

ALISE RESEARCH TAXONOMY TOPICS

education; curriculum; education programs/schools; students; pedagogy.

AUTHOR KEYWORDS

competency-based education; data service training; knowledge, skills and abilities (KSA); pre-program and post-program learning outcomes; comparative analysis.

DOI: https://doi.org/10.21900/j.alise.2023.1276

INTRODUCTION

In this paper, we outline the findings of the evaluation data from the Data Services Continuing Professional Education (DSCPE) program that ran from October 6 to November 30, 2022. With the increasing federal mandates from funding agencies in recent years (Kaiser & Brainard, 2023), including the National Institutes of Health (NIH), National Science Foundation (NSF), and White House Office of Science and Technology Policy (OSTP) on data management and sharing, library and information professionals are taking on a key role in providing research data services. To support their research community, the existing LIS workforce needs to be retooled with hands-on experience in the area of research data services (RDS). The DSCPE program fills a much-needed gap in its endeavor to enhance LIS professionals' competencies in RDS.

Using a competency-based education/training (CBE/CBT) approach (defined in the next section), DSCPE content delivery involves a combination of online live sessions, remote self-paced learning, guest speakers, and capstone site mentors. The 2022 pilot cohort included 15 early- to mid-career professionals currently working in a library or information-centric institution across the U.S. In this paper, we use the term "DSCPE students" or "students" to represent the 15 members of the 2022 cohort. The cohort participated in a synchronous online workshop on Collaboration and Leadership, worked through the remote self-paced learning modules on RDMLA (Research Data Management Librarian Academy), and completed a 70-hour capstone program hosted by partners, such as NIH/NLM, Stanford Lane Medical Library, Brown University Library, Health Sciences and Human Services Library at the University of Maryland, and more.

With the purpose of examining the knowledge, skills, and abilities (KSAs) that the DSCPE cohort had hoped to gain prior to joining the program and the actual KSAs that they reported having obtained at the conclusion of their program, this paper reports on which particular learning outcomes were achieved through the program. Our research questions were:

RQ1. What KSAs, topics, and experiences did the DSCPE students indicate that they wished to gain prior to joining the program?

RQ2. What KSAs did the DSCPE students report that they actually obtained through DSCPE?

RQ3. What KSAs did the capstone mentors indicate as essential for a successful capstone?

RQ4. What areas of data services KSAs were successfully matched? What are the gaps? What are unexpected competencies obtained?

CBE, DATA COMPETENCY, & DATA SERVICES TRAINING

Competency-based education is an innovative educational paradigm that promotes equity and empowers learners by enabling them to advance based on what they know and can do with high flexibility and individualized pathways to learning (Gervais, 2016; Sturgis & Casey, 2018). According to EDUCAUSE (2014), "CBE is built around clearly defined competencies and measurable learning objectives that demonstrate mastery of those competencies." Focusing on competencies as learning outcomes, CBE is "often seen as having the potential to address accessibility, affordability, transparency, and improved learning outcomes, all relevant to graduates' employability and strengthening of the workforce" (Book, 2014, pp. 2-3). A recent series of Horizon reports noted that with changing student demographics, new educational models such as micro-credentials, bite-sized certification, and CBE or CBT (Horizon Report, 2020, 2022) have been increasingly implemented as sustainable alternatives.

With the demand for RDS provision from libraries, a number of LIS associations have developed RDM or data services competencies. This includes, but is not limited to, MLA's "Data Services Competency" (Federer et al., 2020), PLA, ALA's "Data Competencies" (Chen et al., 2018), ARL's "Librarian's Competencies Profile for Research Data Management," (Schmidt & Shearer, 2016), and IFLA's "Concept Data Science Framework for Libraries" (IFLA, 2018). These competency frameworks outlined various areas of competencies in RDS or RDM, ranging from "establishes and advances data services" to "advocacy and support of managing data" and "communicating data to inform decision." These competency frameworks provide timely and valuable guidelines for LIS educators to rethink data science education in our programs.

Meanwhile, numerous professional associations have offered a variety of professional development programs and training. For example, the National Network of Library of Medicine (NNLM) offers an "Introduction to Research Data Services" program in 2023, and MLA established its "Data Services Specialization" in 2021. Nevertheless, with the emergent training programs in data services, formal LIS programs primarily have been offering data science education through a formal set of curricula centering on data science theories, algorithms, approaches to data mining, text analysis, machine learning, and analytics. Competency-based education on data services KSAs rarely appears in the formal LIS curriculum. The DSCPE program that we report here fills a gap by using the CBT approach for data services training.

METHODOLOGY

For evaluation purposes, multiple points of data were collected at various stages of the DSCPE program:

(1). Pre-program students' expectation data, collected through both a student survey and students' application personal statements;

(2). Mid-term performance data, collected through both students' and capstone mentors' surveys;

(3). Post-program feedback data, collected through a post-program survey to both mentors and students, a focus group session with the students and the students' capstone presentation.

For this study, we focused on relevant responses to questions and statements from (1) and (3), with an intent to match and compare students' pre-program expectations with their post-program stated outcomes. For point (1), we coded responses to several questions in their pre-program survey, including a open-ended question asking students to "list any specific skills you hope to learn upon the completion of the DSCPE," and another open-ended question asking students to "briefly note any specific topics you hope will be discussed and explored in the DSCPE." The coding involved three authors on the research team with one author analyzing and proposing initial coding categories, and two other authors met with the initial coder to review, discuss and finalize the themes through consensus. We also examined students' responses to a question asking them to specify what opportunities/experiences they hoped to gain from participating in the DSCPE. We also analyzed part of students' personal statements revealing which KSAs they expected to gain from DSCPE. For point (3), we coded and analyzed students' responses to post-program survey and focus group session questions, as well as their capstone project presentation regarding the KSAs obtained. For their capstone presentation, we focused on specific KSAs gained from the capstone, as well as career-changing outcomes as reported by students during the presentation.

RESULTS

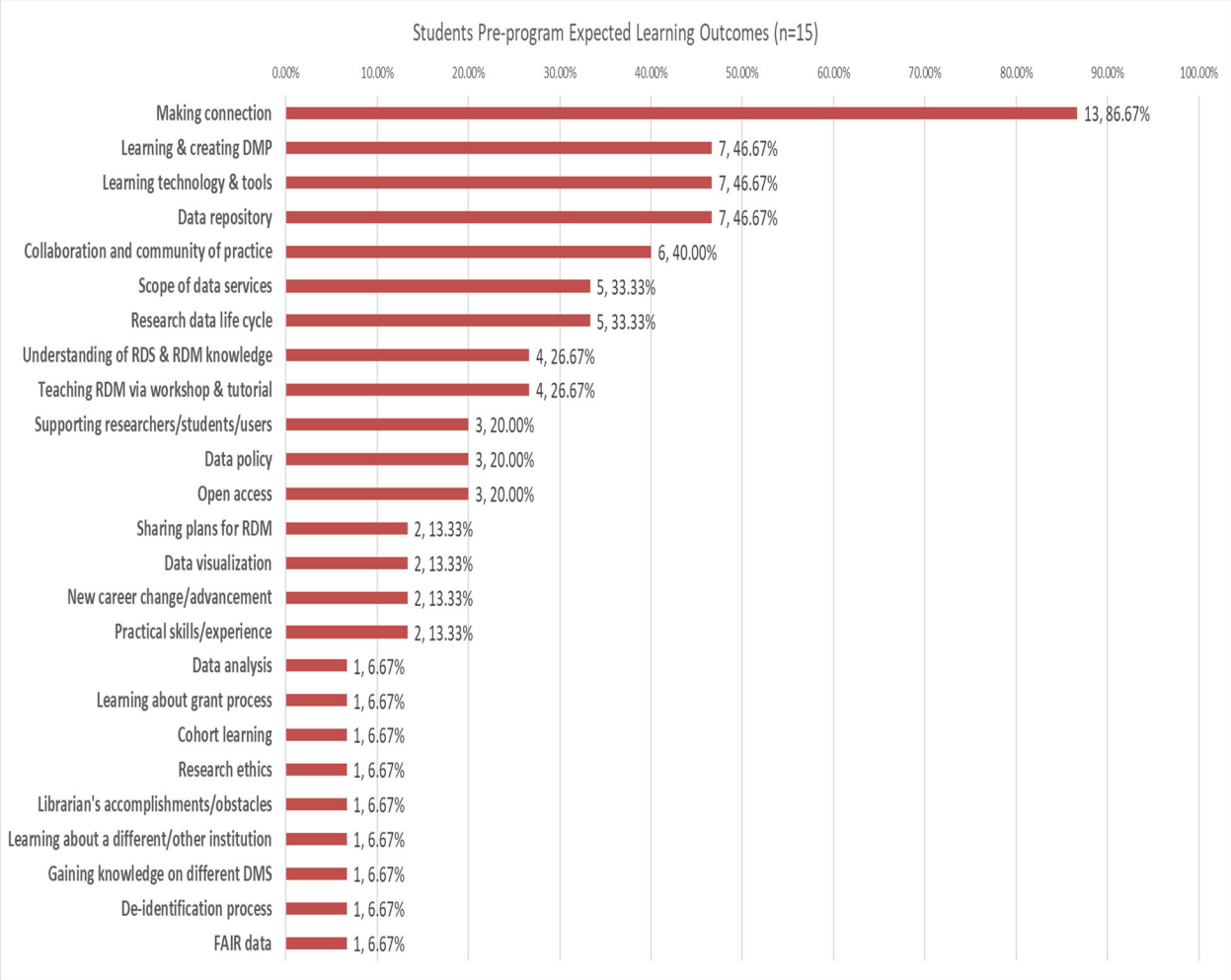
Results are presented in the pre-program evaluation, post-program evaluation, and comparative analysis sections below.

Pre-program evaluation.

Pre-program survey responses. For specific skills and topics to be learned and experience to be gained from DSCPE, the DSCPE cohort mentioned a total of 25 items, with 16 of themes being mentioned repeatedly among students, whereas 9 items were mentioned by only one participant across multiple participants. The most common expected learning outcome was "making connection" (n = 13, 86.67%), followed by "learning & creating DMP" (n = 7, 46.67%), "learning technology & tools," (n = 7, 46.67%), "data repository," (n = 7, 46.67%), "collaboration and community of practice," (n = 6, 40.00%), and more. Examples of unique items were "data analysis" (n = 1, 6.67%), "learning about grant process" (n = 1, 6.67%), "cohort learning" (n = 1, 6.67%), and "research ethics" (n = 1, 6.67%). Figure 1 lists all the items that students mentioned in their pre-program survey.

Figure 1

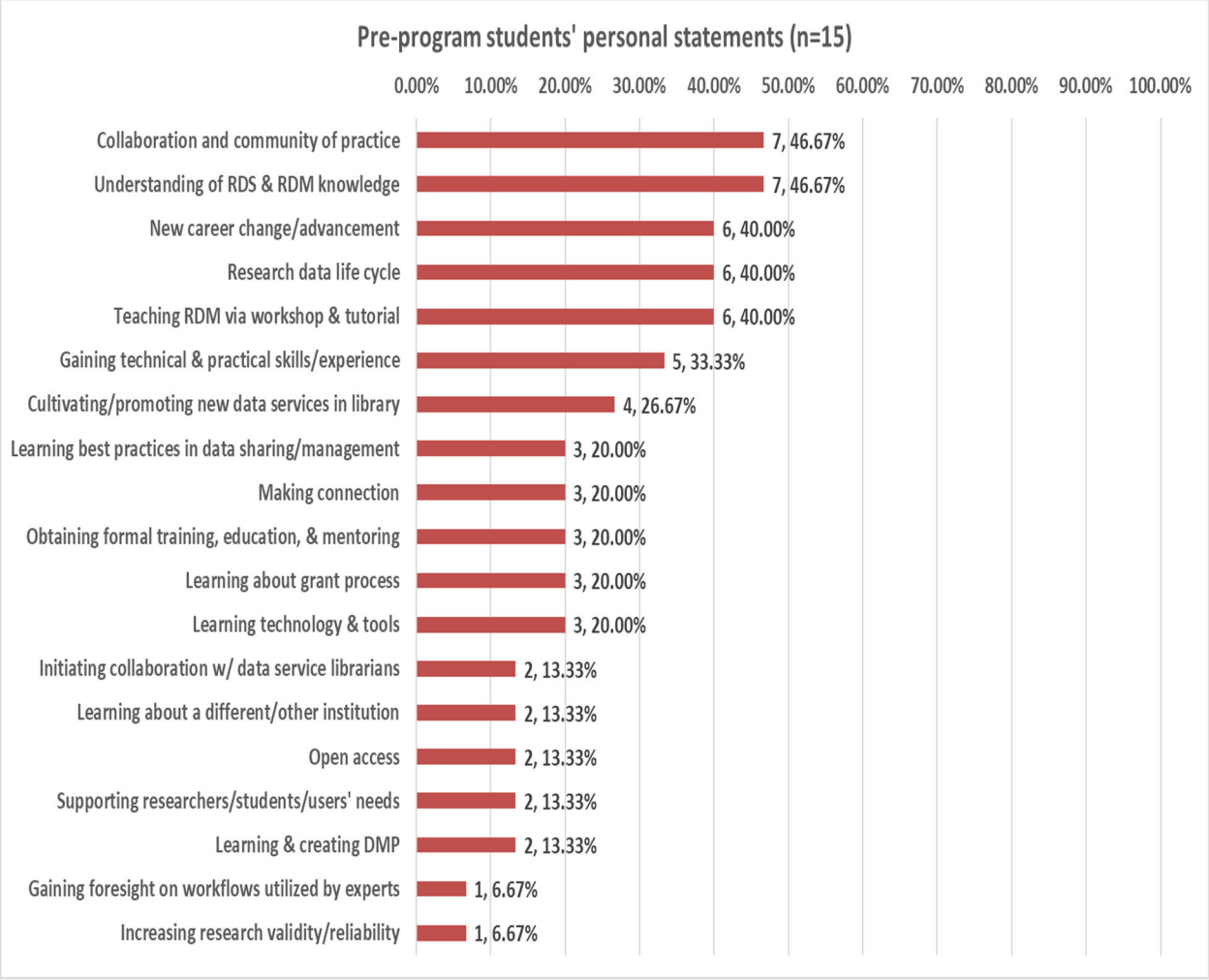
Pre-Program Survey Concerning Learning Outcomes



Personal statements. Regarding the KSAs that the students wished to gain, 19 themes emerged from students' personal statements. The most common themes were "Collaboration and community of practice" (n = 7, 46.67%), "Understanding of RDS & RDM knowledge" (n = 7, 46.67%), "New career change/advancement" (n = 6, 40.00%), "Research data life cycle" (n = 6, 40.00%), "Teaching RDM via workshop & tutorial (n = 6, 40.00%), "Gaining technical & practical skills/experience" (n = 5, 33.33%). Figure 2 lists all the items that students mentioned in their personal statements.

Figure 2

Pre-program Personal Statement Concerning Learning Outcomes



Post-program evaluation.

Post-program evaluative ratings. When asked to indicate their agreement level on a seven-point scale regarding whether the student made valuable contributions to the capstone institution, the average rating of 14 mentors was 6.21, with a range from 4-7, 1 neutral and 13 in the agreement zone. Mentors all indicated that they were interested in hosting a future DSCPE student.

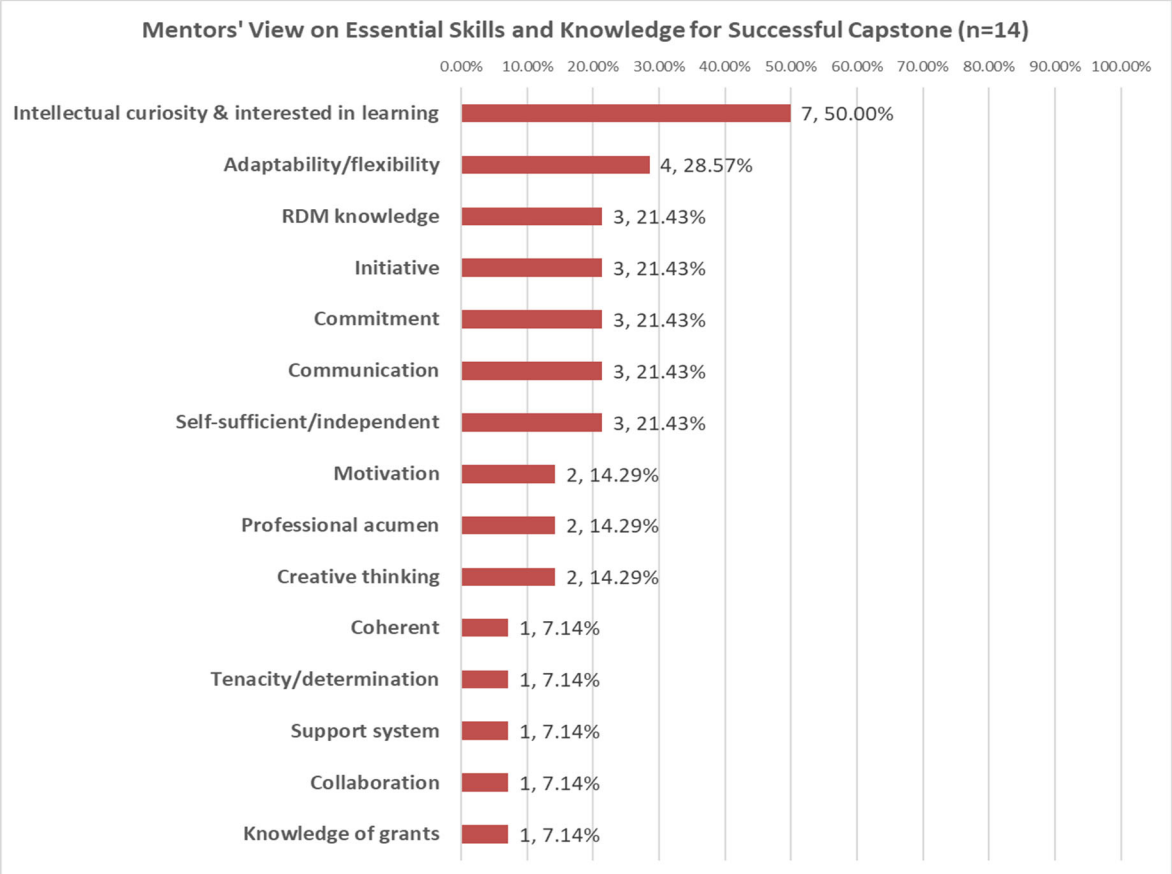
During the focus group session and in the survey, students were asked about their overall satisfaction with the capstone experience and the DSCPE program on a seven-point scale. The average rating for the capstone was 5, and for the DSCPE program was 5.8. The ratings from both the mentors and students were indicators of a successful program, though there were some problems with the capstone program.

Students' satisfaction and appreciation of the DSCPE program are evident from their comments. One student indicated that they "sincerely appreciated the larger vision of this program. … I haven't seen many of these types of programs around, and I appreciate the role of this program in helping to create a community of practice around an emerging field." Another student echoed: "I gained what I felt like was a sense of true camaraderie and shared goal-setting with an academic librarian for the very first time. … A truly invaluable experience for me." A third student found the DSCPE gave a "fantastic overview of basic topics as well as understanding of current issues/potential solutions. I entered into this as a novice. I have a much better understanding and appreciation of the landscape and skills required of this side of librarianship."

Post-program survey responses. In responding to the question of examples for "the skills, knowledge, or qualities of the student that are essential for a successful capstone embedding experience," the mentors pointed to 15 varying skills, which were mostly soft skills rather than data-specific skills. The most commons skills identified were "Intellectual curiosity" (n = 7, 50.00%), "Adaptability/flexibility" (n = 4, 28.57%), "RDM knowledge" (n = 3, 21.43%), "Initiative" (n = 3, 21.43%), "Commitment" (n = 3, 21.43%), "Communication" (n = 3, 21.43%), and "Self-sufficient /independent" (n = 3, 21.43%). Figure 3 lists all the KSAs mentioned by mentors.

Figure 3

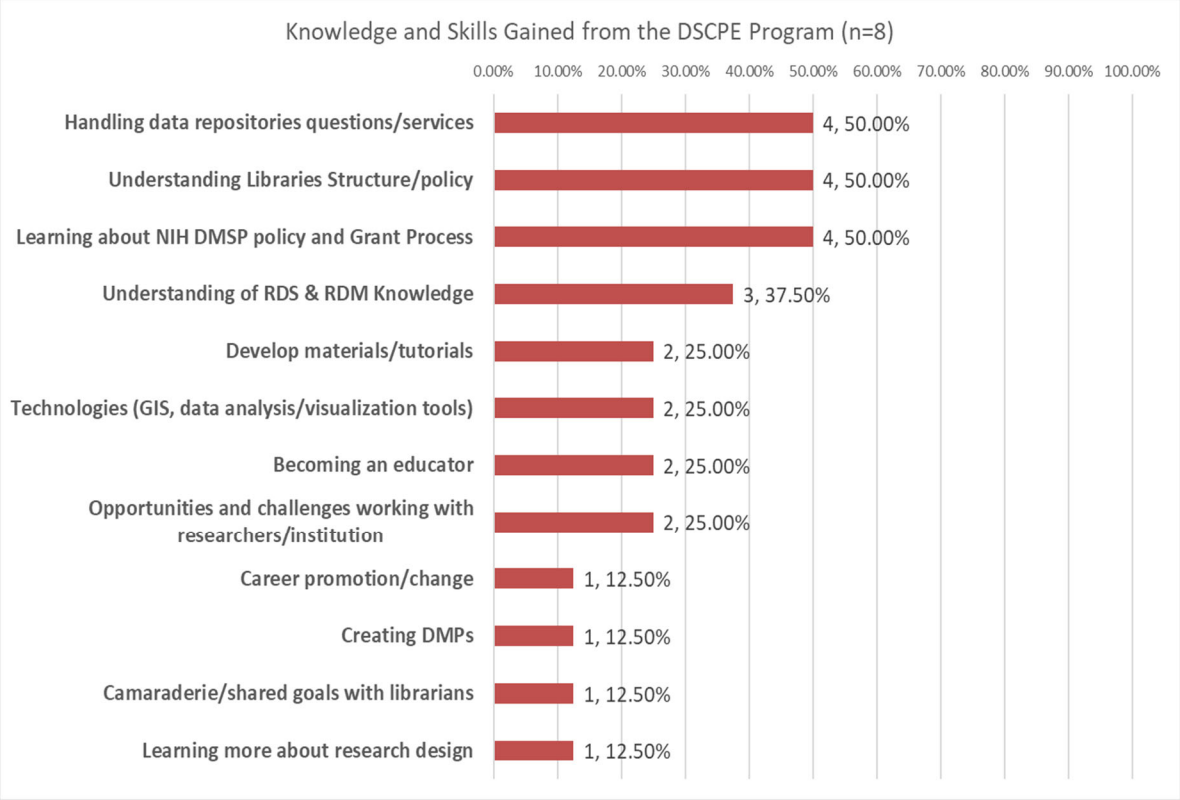
KSA expected from mentors for successful capstone



Meanwhile, eight students commented on a variety of knowledge and skills they gained from the DSCPE program. Among the 12 KSAs mentioned, the most common ones were "Handling data repositories questions/services" (n = 4, 50.00%), "Understanding Libraries Structure/policy" (n = 4, 50.00%), "Learning about NIH DMSP policy and grant process" (n = 4, 50.00%), "Understanding of RDS & RDM Knowledge" (n = 3, 37.50%). Figure 4 lists all the KSAs mentioned by the students in the survey and focus group sessions.

Figure 4

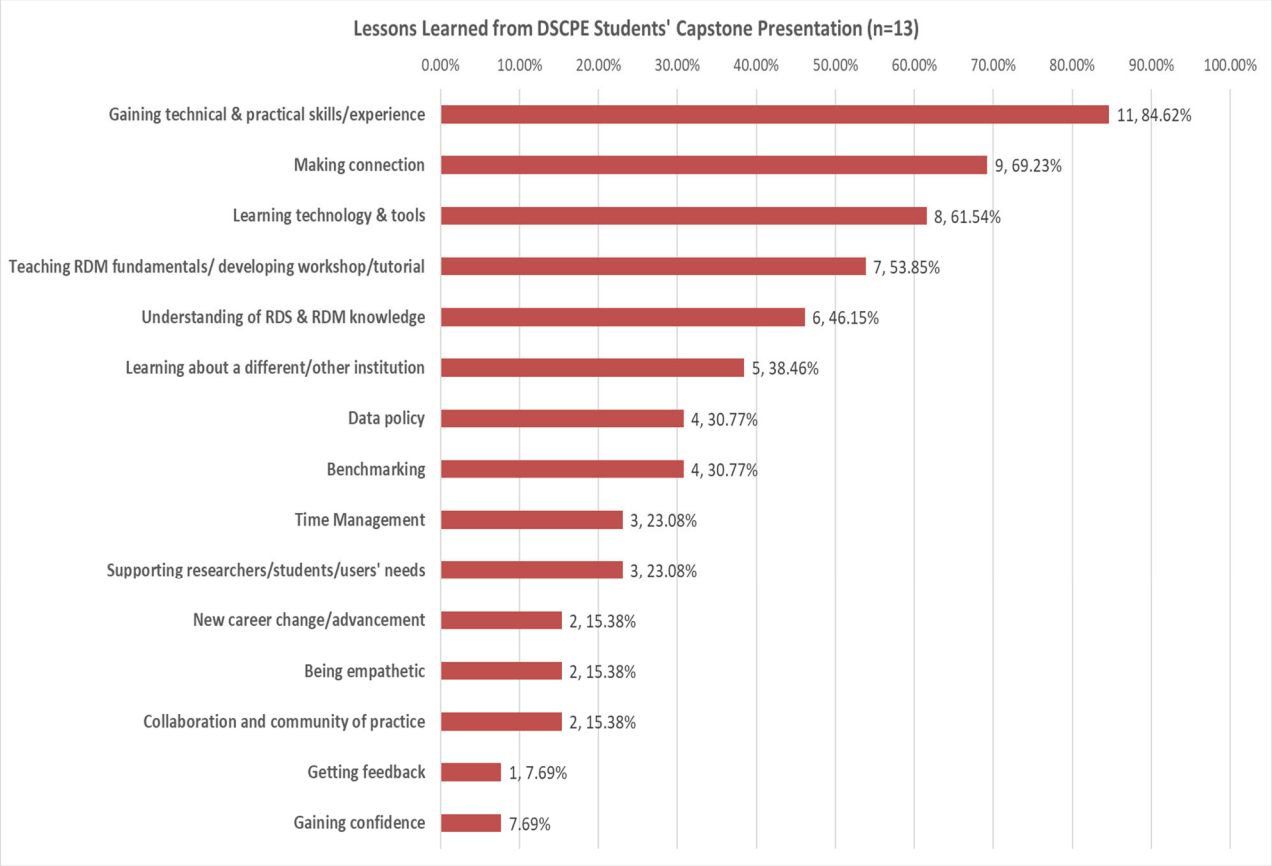
KSAs gained from DSCPE program



Post-program capstone presentation responses. Through their capstone presentations, students reflected on the KSAs gained from their capstone projects. Of the 15 items mentioned, the most common KSAs were "Gaining technical & practical skills knowledge" (n = 11, 84.62%), "Making connection" (n = 9, 69.23%), "Learning technologies/tools" (n = 8, 61.54%), and "Teaching RDM fundamentals & developing workshop/tutorials" (n = 7, 53.85%). Figure 5 below lists all the KSAs mentioned by the students in their capstone project presentation.

Figure 5

KSAs gained from capstone program



Comparative analysis.

Learning outcomes by students versus essential KSAs by capstone mentors. In comparing mentors' comments on essential KSAs with students' indication of the KSAs they expected or reported having gained, we found four matching items: "RDM knowledge," "Communication," "Collaboration," and "Knowledge of grants." Most of the KSAs mentioned by mentors are soft skills, whereas students focused on data-specific skills such as "Learning & creating DMP," "Data policy," "Teaching RDM fundamentals/develop workshop/tutorial," or "Gaining technical & practical skills/experience."

Pre- and post-program learning outcomes comparison. In comparing pre-program and post-program themes related to competency areas of knowledge, skills, and attitudes (abilities), we found 17 items that achieved a match (see Figure 6). Among them, there are six items that appear in all four measuring points; six appear in three measuring points, and five appear in two measuring points with one point in pre and one point in post. The six items appearing in all four

points are: “Learning technology and tools”; “Teaching RDM Fundamentals/developing workshop/tutorial”; “Understanding the creation of RDS”; “Making Connection”; “Collaboration and community of practice,” and “Learning about a different/other institution.” A specific matched outcome “New career change/advancement” achieved by the students was that three DSCPE students either received a new position as a data services librarian in a different library or were promoted within their own library into a data services role.

Figure 6

Comparative analysis of pre-program and post-program competency themes

Pre-program Expected Learning Outcomes					Post-program Reported Learned Outcomes
Pre-program survey	Pre-program personal statement	Themes	Capstone Presentation	Post-program survey/focus group	
✓	✓	Learning technology and tools	✓	✓	
✓	✓	Teaching RDM fundamentals/ developing workshop/tutorial	✓	✓	
✓	✓	Understanding of RDS & RDM Knowledge	✓	✓	
✓	✓	Making connection	✓	✓	
✓	✓	Collaboration and community of practice	✓	✓	
✓	✓	Learning about a different/other institution	✓	✓	
✓	✓	Learning & creating DMP		✓	
✓		Data policy	✓	✓	
✓	✓	Supporting researchers/students/users		✓	
✓	✓	Gaining technical & practical skills/experience	✓		
✓	✓	Learning about grant process		✓	
	✓	New career change/advancement	✓	✓	
✓		Data repository		✓	
✓		Data visualization		✓	
✓		Data analysis		✓	
✓		Refreshing/updating professional skill sets	✓		
✓		Cohort learning		✓	

Pre-program only expected learning outcomes. Nine expected learning outcomes were expressed through either students’ pre-program surveys or personal statements (See Figure 7). These include “Research data life cycle,” “Learning about conducting RDS interviews,” and “Open access.” These items were mentioned in the pre-program but not achieved in the post-

program. Note that topics such as research data life cycle are covered in RDMLA Unit 1, but students did not mention this specific knowledge item in their post evaluation comments.

Figure 7

Pre-program only expected learning outcomes

Appeared only in Pre-program Evaluation	Pre-program survey	Pre-program personal statement
Research data life cycle	✓	✓
Designing effective RDS interviews	✓	✓
Open access	✓	✓
Sharing plans for RDM	✓	
Scope of data services	✓	
De-identification process	✓	
Research ethics	✓	
Gaining foresight on workflows utilized by experts		✓
Increasing research validity/reliability		✓

Post-program only achieved learning outcomes. Six achieved learning outcomes were reported through either students' capstone presentations or post-program surveys or focus group sessions (See Figure 8). These include “Gaining confidence,” “Being empathetic,” “Time management,” and more. For instance, one of the students pointed out in their capstone presentation, “Overall I gained confidence... Some of it was validation; confirmation that I'm on the right track.” Another discovered the importance of empathy and reported in the presentation, “Really the empathy is key, because I think it's really easy to brush off some of these researcher concerns as ... librarians.” These are the skills that could be valuable in their career that students did not anticipate obtaining but were unexpectedly gained.

Figure 8

Post-program only realized learning outcomes

Appeared only in Post-program Evaluation	Capstone presentation	Post-program survey/focus group
Benchmarking	✓	
Time management	✓	
Being empathetic	✓	
Getting feedback	✓	
Gaining confidence	✓	
Learning more about research design		✓

DISCUSSION & CONCLUSION

As an example of using the CBE/CBT approach for data services training, the comparative analysis of feedback from the DSCPE students and mentors showed a meaningful and concrete way to underscore the KSAs from pre-program expectations to post-program achievements. The 17 matching items of the pre- and post-program indicate the strength of DSCPE, whereas the nine unmatched pre-program items might suggest areas we could improve, such as more content in open access practices. Moreover, the six unmatched post-program outcomes suggest good unexpected outcomes such as "Gaining confidence" and "Empathy" that turned into useful long-term competencies for students.

The DSCPE 2023 cohort will take place in Fall 2023; the analysis of the competencies and outcomes of the 2022 cohort helped to improve the design of the 2023 cohort program. The 2022 program was also our first attempt at using CBE/CBT to structure the data services training; with the process of experimenting with this approach and using the pre- and post-program KSAs data to advance our future teaching and learning in this area, we are progressing steadily towards delivering successful and practically valuable programs in the future.

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