Zero Textbook Cost (ZTC) Acceleration Grant Collaboration Cohort Data Science Final Report

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INTRODUCTION

The Data Science Collaboration Cohort consisted of a relatively small number of colleges developing ZTC pathways in a discipline that is actively growing. As a discipline without Course Identification Numbering System (C-ID) descriptors or model curricula to establish course or pathway comparability, determinations of similarity for courses in the discipline were not readily apparent, but there were courses in the pathways for which C-ID descriptors were available. While the initial data collection and analysis was complicated by the lack of a shared curricular structure, the courses in the various programs were able to be divided into groupings to facilitate discussion.

COLLABORATION COHORT PURPOSE

The Academic Senate for California Community Colleges (ASCCC) Open Educational Resources Initiative (OERI) facilitated the work of the ZTC Acceleration Grant Data Science Collaboration Cohort. Although this process was introduced to prevent the duplication of effort, it also provides a means to ensure the awareness of available OER and other sustainable means of achieving ZTC status, share OER development plans, and identify opportunities for collaboration across colleges. At the conclusion of the cohort process, the OERI will provide a report to the California Community Colleges Chancellor's Office (CCCCO) that will document the work of the cohort, verify the absence of duplicative plans, and/or delineate how duplication will be prevented or minimized.

DATA SCIENCE COLLABORATION COHORT – MEMBER COLLEGES AND ZTC PATHWAYS

The Data Science Collaboration Cohort consisted of the following colleges working on the indicated pathway:

- City College San Francisco (CCSF) - Data Science Associate of Science (AS)
- De Anza College – Fundamentals of Data Science Certificate of Achievement (CoA)
- El Camino College (ECC) - Data Science CoA
- West Valley College - Data Sciences AS

The ASCCC OERI collected course-level data for each of the pathway courses including current ZTC status, adopted resources, and plans to convert a course to ZTC to identify overlap and areas of potential collaboration. Since all colleges in the cohort were converting a local degree or certificate, courses were grouped by discipline to identify commonalities. The groupings were as follows:

- Computer Programming
- Data-Focused and Data Science Courses
- Math

Many of the programming and math courses have C-ID designations and OER are often available for these courses. In some instances the colleges had courses that already had ZTC options available, but there was an expressed interest in expanding the number of sections available.

Computer Programming Courses

College	Language	C-ID or Local Title	Status
CCSF	C++	Programming Concepts and Methodology I (C-ID COMP 122)	Currently ZTC (ZTC)
ECC	Java	Object-Oriented Programming in Java	ZTC
ECC	Java	Programming Concepts and Methodology I (C-ID COMP 122)	ZTC
West Valley	Java	Programming Concepts and Methodology I (C-ID COMP 122)	Starting point to be determined (TBD)
CCSF	Java	Programming Concepts and Methodology II (C-ID COMP 132)	ZTC
ECC	Java	Programming Concepts and Methodology II (C-ID COMP 132)	ZTC
ECC	Python	Intro to Programming with Python	Adopting existing OER
De Anza	Python	Introduction to Programming in Python	ZTC. Creating new ancillaries and adapting book to quarter system
CCSF	Python	Programming Fundamentals: Python	ZTC
West Valley	Python	Python Programming	TBD

Data-Focused and Data Science Courses

College	Course Title	Status
ECC	Data Driven Persuasion	ZTC
De Anza	Data Science for All	Adapting and supplementing existing OER
De Anza	Data Visualization Methodology and Tools	TBD
De Anza	Database Management Systems	Adapting existing OER
CCSF	Foundations of Data Science	ZTC
ECC	Foundations of Data Science	ZTC
West Valley	Foundations of Data Science	ZTC
ECC	Practical Data Science	Creating new OER
De Anza	Support for Data Science	Adapting and supplementing existing OER

Math Courses

College	C-ID	C-ID or Local Title	Status
CCSF	MATH 110	Introduction to Statistics	ZTC
De Anza	MATH 110	Introduction to Statistics	ZTC
ECC	MATH 110	Introduction to Statistics	Creating problem sets
West Valley	MATH 110	Introduction to Statistics	Adapting existing OER
CCSF	MATH 160	Discrete Mathematics	ZTC
West Valley	MATH 160	Discrete Mathematics	TBD
CCSF	MATH 210	Calculus I	TBD
West Valley	MATH 210	Calculus I	ZTC
CCSF	MATH 220	Calculus II	TBD
West Valley	MATH 220	Calculus II	ZTC
West Valley	MATH 230	Multivariable Calculus	ZTC

College	C-ID	C-ID or Local Title	Status
CCSF	MATH 250	Intro to Linear Algebra	ZTC
West Valley	MATH 250	Intro to Linear Algebra	ZTC

CONCLUSIONS

This cohort benefitted from resource sharing during a Zoom meeting on April 22, 2024. Following the meeting, additional information was gathered regarding the plans of each of the colleges. No opportunities for collaboration were identified and colleges were informed of the identified resources for their target courses.

Despite the lack of a curricular framework for the various pathways the four colleges were focused on, there were commonalities across the programs and no lack of courses that had already achieved ZTC status. All colleges indicated that they will be adapting existing resources to meet the needs of their local courses.

APPENDIX 1 – RESOURCES IN USE OR IDENTIFIED BY DATA SCIENCE COLLABORATION COHORT COLLEGES

Resource	Course(s)	College(s)
Statistics OpenStax (CC BY)	Intro to Statistics (C-ID MATH 110)	De Anza
Probability & Statistics Carnegie Mellon	Intro to Statistics (C-ID MATH 110)	CCSF
Computational and Inferential Thinking: The Foundations of Data Science (CC BY-NC-ND)	Introductory Data Science	CCSF, El Camino, West Valley
Think Python, 2nd edition (CC BY-NC); Think Python 2e – LibreTexts (CC BY-NC)	Python Level 1	De Anza
How to Think Like a Computer Scientist: Learning with Python 3 Documentation (GNU License)	Python Level 1	CCSF
How to Think Like a Computer Scientist: Interactive Edition (GNU License)	Python Level 1	CCSF
Python for Everybody (CC BY-NC-SA); Python for Everybody – LibreTexts	Python Level 1	CCSF

APPENDIX 2 – ANTICIPATED NEW OPEN EDUCATIONAL RESOURCES

College	Course(s)	New OER to be Developed
De Anza	Python I	Creating new ancillaries and adapting book to quarter system
De Anza	Data Science for All	Adapting and supplementing existing OER
De Anza	Database Management Systems	Adapting existing OER
De Anza	Support for Data Science	Adapting and supplementing existing OER
El Camino	Practical Data Science	Creating new text
El Camino	*Statistics	Creating problem sets in PrairieLearn
West Valley	*Statistics	Creating problem sets in MyOpenMath

*Currently available openly-licensed homework options can be found at Open Educational Resources and Math under C-ID MATH 110.

APPENDIX 3 – SAMPLE OER FOR COURSES IN DATA SCIENCE PATHWAYS

Additional OER available at [Open Educational Resources and Computer Science](#) and [Open Educational Resources and Math](#). Relevant resources may also be found at [Open Educational Resources and ITIS (Information Technology and Information Systems](#)).

Programming Concepts and Methodology I ([C-ID COMP 122](#))
- [A Byte of Python](#); [A Byte of Python – LibreTexts](#) (CC BY-SA)
  This book serves as a guide or tutorial to the Python programming language. It is mainly targeted at newbies.
- [Introduction to Computer Science and Programming in Python (CC BY-NC-SA)](#)
  This is part of MIT's OpenCourseWare website. It includes a course syllabus, reading list, lecture videos, Powerpoint slides and code, in-class questions and video questions as well as assignments – all available for download.
- [Python for Everybody](#); [Python for Everybody – LibreTexts](#) (CC BY)
  An excellent book on introductory computer programming topics. The book's website has a great deal of additional information and resources. The book itself has great vocabulary words, it has exercises, and includes the use of Jupyter Notebooks, where you can edit and run code right in the LMS environment. The material has been translated into several different languages, see the book's website for a complete list.
- [Think Python 2e](#); [Think Python 2e – LibreTexts](#) (CC BY-NC)
  Think Python is an introduction to Python programming for beginners. It starts with basic concepts of programming and is carefully designed to define all terms when they are first used and to develop each new concept in a logical progression.

Programming Concepts and Methodology II ([C-D COMP 132](#))
- [C++ reference](#) ([CC BY-SA and GNU Free Documentation License](#))
  A complete online reference for the C and C++ languages and standard libraries, i.e. a more convenient version of the C and C++ standards.
- [CISC 187 Course Reader (Parillo) (GNU Free Documentation License)](#)
  Any user should ensure they read the [GNU Free Documentation license](#) in its entirety.
- [Open Data Structures (in C++) (CC BY)](#)
  This resource is a well-written text that covers the material quite well. It is a bit older than other material, but it is still a very valid resource.

Introduction to Statistics ([C-ID MATH 110](#))
- [OpenIntro Statistics (Diez, Barr, and Cetinkaya-Rundel) (CC BY-SA)](#); [OpenIntro Statistics (Diez et al) – LibreTexts](#) (CC BY-SA)
- [Introductory Statistics (OpenStax)](#) (CC BY 4.0); [Introductory Statistics (OpenStax) – LibreTexts (CC BY 4.0)](#)
- [Introductory Statistics (OpenStax)](#) (CC BY 4.0)
- [Foundations in Statistical Reasoning (Kaslik) – LibreTexts (CC BY-SA-NC)](#)

Discrete Math (C-ID MATH 160)
- [Mathematics for Computer Science (Lehman, Thomson Leighton, and Meyer, 2015) (CC BY-SA)](#)
- [A Spiral Workbook for Discrete Mathematics (CC BY-NC-SA)](#)
- [Discrete Mathematics (Levin) – LibreTexts (CC BY-NC-SA 3.0)](#)
- [Mathematical Reasoning and Proof (Sundstrom) (CC-BY-NC-SA)](#)
- [Introduction to Proofs, an Inquiry-Based approach (Heffron) (CC-GNU)](#)

Single Variable Calculus I Early Transcendentals (C-ID MATH 210)
Textbooks
- [Contemporary Calculus I (Hoffman) (CC BY)](#)
- [Community Calculus (Guichard) (CC BY-NC-SA)Active Calculus (Boelkins et al.) – LibreTexts](#) (CC BY-SA)
- [Calculus Vol 1 (Strang, Herman) – OpenStax](#)
- [Calculus (OpenStax) – LibreTexts](#) (CC BY-NC-SA)

Course Templates (Instructor account required)
- [Applied Calculus (Calaway/Hoffman) – MyOpenMath](#) (CC BY 3.0)

Single Variable Calculus II Early Transcendentals (C-ID MATH 220)
Textbooks
- [Contemporary Calculus I (Hoffman) (CC BY)](#)
- [Community Calculus (Guichard) (CC BY-NC-SA)](#)
- [Active Calculus (Boelkins et al.) – LibreTexts](#) (CC BY-SA)
- [Calculus Vol 1 (Strang, Herman) – OpenStax](#)
- [Calculus (OpenStax) – LibreTexts](#) (CC BY-NC-SA)

Course Templates (Instructor account required)
- [Applied Calculus (Calaway/Hoffman) – MyOpenMath](#) (CC BY 3.0)

Multivariable Calculus (C-ID MATH 230)
Textbooks
- [Active Calculus (Boelkins et al., 2017)](#)
- [Active Calculus (Boelkins et al.) – LibreTexts](#) (CC BY-SA)
- [Calculus Volume 3 (Strang and Herman, 2022) – OpenStax (CC BY-NC-SA)](#)

Course Templates (Instructor account required)
- [MultiVariable Calculus OpenStax (California ZTC Project) – MyOpenMath](#) (CC BY-NC)

Introduction to Linear Algebra (C-ID MATH 250)
- [Linear Algebra (Heffron) (CC BY-SA 2.5)](#)
- [Linear Algebra Bookshelf (LibreTexts) (CC BY-NC-SA 3.0)](#)
- [A First Course in Linear Algebra (Kuttler, 2022) – LibreTexts (CC BY)](#)

APPENDIX 4 – ZTC ACCELERATION GRANT DATA SCIENCE COLLABORATION COHORT MEMO

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SUBJECT: Data Science ZTC Acceleration Grant Collaboration Cohort
ASCCC OERI FACILITATOR: Suzanne Wakim, ASCCC OERI Project Facilitator

Cohort Participants and Data Collection
The following colleges participated in the Data Science Collaboration Cohort:

- City College San Francisco (CCSF) - Data Science Associate of Science (AS)
- De Anza College - Data Science Certificate of Achievement (CoA)
- El Camino College - Data Science CoA (previously awarded)
- West Valley College - Data Sciences AS

The ASCCC OERI collected course-level data for each of the pathways including current ZTC status, adopted resources, and plans to convert a course to ZTC to identify overlap and areas of potential collaboration. Since all colleges in the cohort were converting a local degree or certificate, courses were grouped by discipline to identify commonalities.

The groupings were as follows:

- Computer Programming
- Data Science
- Math
- Other

Cohort Convening
The Data Science Collaboration Cohort convened synchronously via Zoom on April 22, 2024. The ASCCC OERI presented the group with the results of the data collection process and asked for clarity where data were missing. In addition, the ASCCC OERI presented available OER for the cohort's consideration. A follow-up meeting was held on May 15 to discuss potential collaborative efforts.

Findings
The following summarizes similar courses included in two or more colleges' pathways. Additional distinct local courses were reported and will be included in the final report.

Computer Programming Courses

CCSF, El Camino, and De Anza all reported having a Java course in their pathway. However, all three colleges indicated that they will not be converting their Java courses since they are not as popular as other programming courses in their pathway.

- De Anza: C++ Programming I, II, and III – Adapting and supplementing existing OER
- CCSF: Python I – Currently ZTC
- De Anza: Python I – Currently ZTC. Creating new ancillaries and adapting book to quarter system
- El Camino: Python I – Adopting **Python Programming OpenStax (CC BY)**
- West Valley: Python I – Plan pending. Most likely adopting existing OER.
- De Anza: Python II and III – Adapting and supplementing existing OER
- West Valley: Python II – Creating or adapting OER

While both De Anza and West Valley have a level II Python course, the scope of the courses is distinct since De Anza is a quarter system college. All other OER creation is non-duplicative.

Data Science Courses

Each college reported an entry level Data Science course. Additional Data Science courses were reported but course content is distinct. Additional information on local courses will be included in the final report.

- CCSF: Foundations of Data Science – ZTC
- De Anza: Data Science for All – Adapting and supplementing existing OER
- El Camino: Foundations of Data Science – ZTC
- West Valley: Foundations of Data Science – ZTC

The course outline for DeAnza college is being finalized and much of the OER will be written and compiled from course notes and documentation created by faculty. No other colleges intend to create OER for the foundational data science course in their pathway.

Math Courses

CCSF, De Anza, and West Valley College are all converting a math pathway as well and have participated in the Math Collaboration Cohort. Additional math courses including Calculus and Linear Algebra were discussed as part of the Math Cohort.

- CCSF: Statistics – ZTC
- De Anza: Statistics – ZTC
- El Camino: Statistics – Creating problem sets in PrairieLearn
- West Valley: Statistics – Adapting **Introductory Statistics OpenStax (CC BY)** and creating problem sets in MyOpenMath
- CCSF: Discrete Math – ZTC
- West Valley: Discrete Math – Plan pending

El Camino and West Valley have distinct plans for how to convert their statistics course to ZTC. CCSF's Discrete Math course is currently ZTC so any work done by West Valley will be non-duplicative.

Conclusions

Alignment between the degree pathways was limited. While the ASCCC OERI was able to identify broad categories of potential alignment, the courses within each category were distinct and any proposed creation was targeted at the college's unique population. The ASCCC OERI recommends that the cohort participants share any resources that they are using to begin their efforts along with any frameworks for new OER creation that might be useful to other participants. There is no evidence for duplication of efforts amongst the proposed plans and no similarity between projects to warrant collaboration.