

LXD Principles in Action

"Learning experience design...is the process of creating learning experiences that enable the learner to achieve the desired learning outcome in a human centered and goal-oriented way"

> Niels Floor, 2007 Interaction Designer

At Onlea, every course we develop is rooted in Learning Experience Design (LXD) principles. These principles are drawn from instructional design, cognitive science, experiential learning, interaction design, and UX design. Each of our designers at Onlea puts their experience from each of these disciplines in the practice of making an engaging experience for our learners.





More than a set of principles, LXD is a philosophy grounded in the understanding that teaching is no longer the realm of a single subject matter expert on a pedestal. Teaching has now made the jump into the realm of digital media, and as such, it requires a **multidisciplinary approach** that brings the learnings from different realms into the development of value and knowledge for the learner.

With this in mind, the following case study developed by the team at LX Labs showcases the use of LXD for one of our transformative courses at Onlea, the **Data Science** course developed for the <u>Callysto program</u>.

Data Science and Callysto

About Callysto

Callysto is a free, online learning tool that supports grade 5-12 teachers and students to learn and apply data science skills, including data analysis, visualizations, and computational thinking. The Callysto program is facilitated by the not-for-profit organizations Cybera and the Pacific Institute for the Mathematical Sciences. It's funded under the national CanCode program.

Their online courses, developed by Onlea, are available for free to teachers across Canada: <u>https://www.callysto.ca/distance-learning/</u>



About Callysto's Data Science Course



Data science skills are becoming important for students to learn in order to be competitive in the future workforce. This course, developed by Onlea, provides tools to bring these in-demand data science skills, including data analysis, into the classroom of teachers across Canada.

In this hands-on, self-paced Callysto course, teachers learn several skills, including how to incorporate a data science exercise into their classroom and teach students the "how's" and "why's" of data science.

This course was developed last year and it launched in October, 2020. It consists of five (5) different modules, taking teachers that might not have any previous programming or data science experience and introducing them to the practical application of teaching data science in their classrooms.

The modules within the course included illustrated content and voice over. Interviews and presenter videos were incorporated into the modules, all of which were filmed and edited by our team. Interactive elements and knowledge checks were also incorporated throughout the course, including quizzes, puzzles, surveys and reflective questions, in order to increase engagement and reinforce learning.



Using LXD in Callysto's Data Science Course



To understand the use of LXD principles in practice, let's go through each of the key steps our team took to bring this course to life:

- 1. Identify and empathize with the learner
- 2. Build on the learner's existing knowledge
- 3. Pick the best learning approach and format for the learner
- 4. Advocate for the learner in decision making
- 5. Ensure course is inclusive and accessible
- 6. Enable flexibility of time, place, choice, and information format
- 7. Make navigation familiar, easy, and intuitive
- 8. Apply evidence-based best practices
- 9. Pick the best tool for the job, not the tool first
- 10. Gather feedback early
- 11. Iterate, test, improve



Let's go through each of these principles in more detail.

1. Identify and empathize with the learner

Specifically for Callysto's Data Science, we started with a learner persona workshop in order to better understand the challenges that Canadian teachers would experience when taking this course.

Below is a sample of the target learner personas: Mitchel and Nicole



Our learner persona and journey workshops help stakeholders get on the same page about who the learner is, and their challenges and motivations. We have also conducted learner research using our workshops as a starting point, which includes surveys and interviews to validate learner priorities. Not every client we work with has time/budget to support in-depth research and usability testing. However, with clients who have hired us for this service, it has helped our team distribute our efforts more effectively and know what works and what doesn't.

2. Build on the learner's existing knowledge

Beyond learner personas, the stakeholders at Callysto gave our LX Labs team the opportunity to conduct **learner interviews**. Although the primary learner for the course, Mitchel, did not have a coding background, they were expected to learn and apply the basics using an advanced programming notebook.





@TeachingSTEM @EdCanNet #edtech

In May 2020, Callysto and Onlea looked for volunteer teachers that were representative of the target learners. Between May and July 2020, our team conducted 12 testing sessions with the 4 sponsored learner participants.

Below is an excerpt from the first sponsor learner session and the lessons learned:

Test content: Module 3: Introduction to Jupyter Notebooks

In the first round, we tested content from the *Callysto Computational Thinking 101* in order to see whether that approach would be useful for the Data Science course.

The click-through simulation was seen as both unfamiliar (interactive video is uncommon) and too granular. Even the least experienced sponsored learner was looking for ways to speed up the content. The simulation was viewed as redundant and slowing down the time before the learner could get hands-on with the notebooks. Some learners thought this was a good thing as it forced them to learn slowly and they could see potential benefits of the simulation with students (on rails). We also learned that there were many pitfalls--where the learner was confused by the content in the sample Jupyter notebook (viewing it as important lesson content), knowing when they had finished a section of the simulation and cue points along the way.

General:

- Interactive video was unfamiliar (not part of their digital literacy)
 - "Most youtube videos are not interactive so I was surprised when I discovered this video was interactive" ...
 - "I would say the video doesn't even need to necessarily be interactive, if you can get everybody working in the notebook on a separate... if you can show people how to pop-out that notebook on a split screen... then they can watch the tutorial and practice at the same time"

Onlea - LXD Principles in Action - Confidential White Paper.



- "... if you show them how to do the split screen kind of thing... then only way to force them to do that is to take the interactivity off of the video"
- "... so then you can see it on there... but then you have to go and find it on your own screen"
- While it allowed for granular hand-holding, even the sponsored learner with least coding experience was looking for ways to skip content. **"Time is precious [for teachers]"**
- Important cues were missing in the interactive to communicate that the learner had finished and could move on

During content development we used the lessons learned from the previous course and from the learner personas in order to gradually build on previous learnings. The goal was that even the most inexperienced teacher would be able to get started in the basic concepts of data science. As such, the lessons were scaffolded as follows:

- Module 1: Why Data Science
- Module 2: Using Data
- Module 3: Using Python for Data Science
- Module 4: Creating Data Visualizations using Jupyter Notebooks
- Module 5: Analyzing and Interpreting Data
- Module 6: Final Project & Next Steps

This provided a gentle introduction into the world of data science. Teachers who already had been introduced to the basic principles were able to go directly into Module 3 and start learning the programming basics in Python to manipulate data.

A principle that was encouraged throughout the course was: **You don't need to know** everything. It's ok to learn alongside your students!

3. Pick the best learning approach and format for the learner

To understand the different Learning Design approaches used in this course during content development and production, let's use the format provided by **Clark and Mayer**. The table below shows simple examples of how the Clark and Mayer principles led our team to make learning design choices in favour of a cohesive and engaging learning experience:



Clark and Mayer Principles	Demonstrated examples		
Multimedia Principle: The use of a combination of words and images creating a fuller and more structured representation.	Key principles were explained through the combination of narration, text, videos, and graphics. <u>How to use Callysto Video</u> <u>Step by step demonstration using GIFs</u>		
Contiguity Principle: The presentation of graphics next to the text mentioned in order to decrease cognitive load.	<text><text><text><text><image/><image/><image/><image/><image/><text><text><text><text><text></text></text></text></text></text></text></text></text></text>		
Modality Principle: The presentation of the words as an acoustic narration rather than as a visual text on the screen.	Interactive demonstrations with voice narration were used to guide the learner through the use of Jupyter notebooks: <u>https://360.articulate.com/review/content/5f034149-0034-486b-b1ed</u> <u>-e26000efd2b8/review</u>		
Redundancy Principle: Supporting the narrative presentation with graphics, rather than graphics and narration and text on the screen	This is a second example of the use of narrated tutorials where redundant text on screen is avoided in order to achieve the desired learning outcome: <u>https://youtu.be/rRNybWC1q6E</u>		











4. Advocate for the learner in decision making

Through all the phases of course development, Mitchel (the fictitious learner persona) and the volunteer sponsor learners were used to test assumptions around how to better present the information.

Learner Persona	name: Mitchel	0
	Market segment:	About/Background What is their education, life/work experience, job title, hobbies?
	Age (or range): 29	 Job: Teacher (Grades 7-12), 5+ years teaching at a rural school Personality: wanting evidence, curious Hobbies: biking, reading
	Location: Canada, rural	
		Favorite TV show: Marvelous Mrs. Maisel

5. Ensure course is inclusive and accessible

As per Onlea's Creative Success Factor #2: Design for Accessibility, this course complies with WCAG 2.1 AA and AODA standards.

For our team, accessibility is about empathy and the drive to remove the barriers that learners experience on a daily basis. Onlea is the only eLearning provider with a clear commitment to developing learning experiences that are accessible to a variety of learners.

For example, as this course included many graphs and data-formed imagery, complex image descriptions were written and included as alt-text throughout the course so that those with visual impairments could reach the same conclusions as sighted learners.

6. Enable flexibility of time, place, choice and information format

This online course is available for free to teachers across Canada: <u>https://www.callysto.ca/distance-learning/</u>

The course is fully asynchronous and self-paced as it provides the ability for the target audience personified by Mitchel and Nicole to fit it within their busy teaching schedules. This format also allows teachers in remote locations to access the knowledge they need when they need it.



Teachers are also encouraged to share this course with their colleagues and students in order to create a community of learners.

7. Make navigation familiar, easy and intuitive

We draw on our expertise in UX design to ensure that navigation is in line with heuristic principles, so that all of the learner's cognitive energy is spent on the content, rather than getting around.



In addition to consistent and intuitive controls, the iconography for this course was designed to facilitate wayfinding. It followed the guidelines from the previous course to ensure that learners were familiar with the patterns and were able to navigate throughout the course with ease.

8. Apply evidence-based best practices

We are constantly learning and evolving, and have developed a series of best practices based on the most current research in the field. Our approach builds on leading research in active learning and motivation, and applies proven techniques to improve retention and transfer.

A few examples of these best practices in the Calysto course include:

- Learning outcomes based on relevant, practical competencies
- Content tied to practical learning outcomes to foster intrinsic motivation
- Empathy and storytelling to create "social presence"
- An inclusive learning environment, representing a diversity of backgrounds, cultures, and needs
- Frequent practice opportunities, so that learners can check their own understanding, apply abstract concepts to real examples, and reinforce learning.





Line chart

The steps to create a line graph using the **plot** function are very similar to the steps in the last two tutorials.

In your Jupyter notebook, try creating a line plot from our *Var1* and *Var2* lists.

Click to reveal the solution

9. Pick the best tool for the job, not the tool first

Our initial idea for helping teachers develop data science skills was to simulate the software and provide helpful hints and detailed guidance through a click-through Storyline experience.

Through testing of this solution we learned that even the least experienced learner was looking for ways to speed up the simulation and preferred hands-on learning first over the simulated tutorial. Without this feedback, we would've continued to use that intervention, missing our mark.

Below is an excerpt from Round 2.

Round 2: Callysto Data Science Module 2&3

Test content: Introduction to Jupyter Notebooks, Series and Data Frames

The second round of testing focused on similar material in the Data Science course. We took insights from the first round of testing and used a simple video with screen capture to reinforce instruction. We also included the same steps below the video to offer a different learning modality. In every test, as soon as the learner played the video, they started following along on their own... opening a notebook in a second tab/window. The video was popular and they liked how they could see the expected result. Some thought including the steps was good but would like a *skip to next section* option. Challenges came up in tests with inconsistent instruction--when the copy/paste direction was absent, they were



unsure whether they were supposed to add the code/step. They also had many questions about undefined items included in the code such as libraries, but we're really pleased when the *int64* fun fact showed up right when they were wondering what it was in the output. In one of the sessions, the topic of 'copy/paste or type' came up and the learner said other data science courses they had taken emphasized typing out the code for 'muscle memory' and a deeper understanding. All of the learners made simple mistakes in the Jupyter notebooks and while they were able to mostly deduce the problem that occurred, it became clear that there is an opportunity to suggest common troubleshooting steps e.g. *Did you spell everything correctly? Is capitalization used appropriately? Are you missing a bracket or a comma?*

General:

- Add: **Copy/paste or Type** so there's a prompt to practice muscle memory
- They love the fun-fact int64 (that shows up right when they are wondering what it is)
- Consistency of directions/code on-screen (if an example is shown, make it easy to grab the code--end of one of the tutorials) and code to grab vs your screen should look like this... are important
- At some point in most of the tests, they mispel or misformat something in the notebook and get an error... could we have a little FAQ with common issues at the bottom of the page... if you are getting an error e.g. 1) check the formatting 2) check if any words are misspelled 3) compare with the example
- They really like the video for showing the expected result (and the stages in between the instruction that are unsaid)... most start following along before the video is finished
- A jupyter notebook cheat sheet would be helpful to explain some of the quirks/formatting that are not covered

Specific observations:

Sponsored Learner D

• Really liked the video+text instruction but wondered whether we could include a **skip to next section** link after

Sponsored Learner C



- When sharing the data frames a question that has come up in most tests is, **why not use excel?** this might be an opportunity for a callout
- Pandas is not explained in the test content
- Can you save Jupter notebooks on your computer?

10. Gather feedback early

Basic usability testing focuses on the Minimum Viable Product (MVP) phase. Testing often and early allows us to find usability flaws and areas for improvement early enough in the process that changes can actually be implemented. The following diagram outlines the states leading Usability Testing at the MVP stage used for the Callysto Program:



UX Testing Phase 1 Process Diagram

Process Outline for MVP Usability Testing:

- A. Personas
- B. Recruit Participants based off of personas



- C. Screening Survey to determine if those chosen to fit the target audience
 - a. Screening survey questions are created internally
 - i. Should take less than five minutes to complete for participants
 - ii. Should focus just on determining if the possible participant is in fact part of the target audience
 - iii. Will be created via Google Forms
 - b. Screening survey is approved
 - c. Screening survey is sent to possible participants
 - d. Participants are selected

D. Interviews

- a. Interview questions are created
 - i. These should be open ended enough to collect information that would help understand the target audience and validate personas.
 - ii. The interviews should not take more than half an hour.
 - iii. Interview questions should not give out too much information about the final project so that participants can also be used for rounds of testing.
- b. Interview questions are approved.
- c. Interviews are performed over Zoom (or specified video conferencing tool)
- d. Findings are reported and Personas might be updated.

E. MVP Testing Round 1

- a. Testing questions are created.
- b. The test is run internally with one staff member who is not on the project (to test the test).
- c. The test is run with 5 to 8 participants.
- d. A UX testing report is created.
- e. MVP revisions are made.

F. MVP Testing Round 2

- a. Testing questions are updated.
- b. The test is run internally with one staff member who is not on the project (to test the test).
- c. The test is run with 5 to 8 participants.
- d. A UX testing report is created.
- e. MVP revisions are made.

11. Iterate, test, improve



Each course offers an opportunity to learn and improve. As such, we always request feedback from our clients and our team at the end of each development cycle.



We hope that this case study gave you new insights into how LXD principles can be applied to the development of accessible and engaging learning experiences.