Assessing Computational Thinking and Data Literacy: Designing the Callysto Computational Thinking Test (CCTt)

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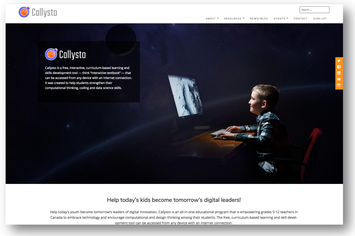
The Callysto Project

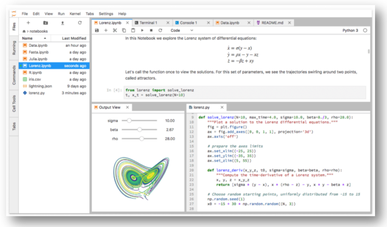
Project Overview

The Callysto Project is a collaborative project by Cybera and the Pacific Institute for Mathematical Sciences (PIMS), with funding from the Government of Canada. It involves the development and assessment of modules that promote data literacy and computational thinking.

Using the Jupyter notebook platform, users can create and share modules, assignments, and reports using a single platform. Jupyter notebooks also provide easy integration of open data sources to promote data literacy development during curricular activities.

Teachers and students can also incorporate multimedia, infographics, and audio recordings while experimenting with live programming code simultaneously. Our target group consists of Grade 5-12 students and teachers across Canada.

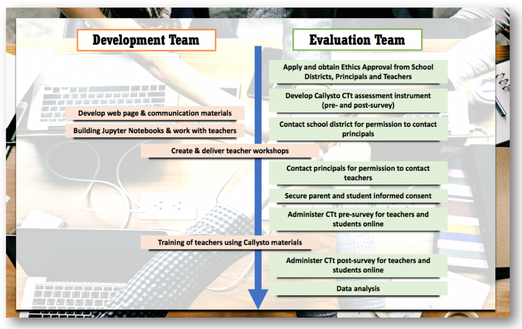




Team Collaboration & Objectives

The Callysto Project involved planning and action-oriented objectives that required the dedicated work of two main teams: (a) the development team and (b) the evaluation team. The Development Team focused on creating marketing materials, building Jupyter notebook resources with teachers, and providing teacher workshops and training.

Our role as part of the Evaluation Team involved handling the ethical procedures at the university and school district level, developing the Callysto CTt assessment instrument, contacting the schools, teachers & other stakeholders to administer a pre-survey and follow-up post-survey, and conducting data analyses of the results.



Development Process

Creating the Callysto CTt Assessment Tool

Based on the adaptation of the CTt test (González, 2015), our team developed the Callysto CTt assessment tool and made considerations with regards to:

- Categories and skills used in the original CTt test
- Scope of questions (attitudinal, spatial, and open-ended)
- Reading level and comprehension
- Time considerations and test fatigue
- Validity and reliability
- Representation of code (directions, block scripts)
- Scoring results; making analytical comparisons

The scope of the assessment tool also needed to cover a range of Computational Thinking Concepts, Practices, and Perspectives. These include the use of algorithmic notions of flow control (including complex if/else statements, conditional logic), iterative, recursive & parallel thinking, repeated loops, symbol systems & representation, directions & sequences, etc.

The items also needed to be scaffolded in difficulty level so that participants of various backgrounds and skill levels would be able to complete the test without unnecessary confusion or fatigue throughout the process.

Callysto CTt Assessment Items

Computational Thinking Concepts, Practices, and Perspectives

The Callysto CTt assessment tool focuses primarily on CT Concepts and Practices, and consists of items surveying:

Digital Literacy (4 Likert-scale items) with statements such as "I find it easy to use technology" and "People ask me for help with their computer".

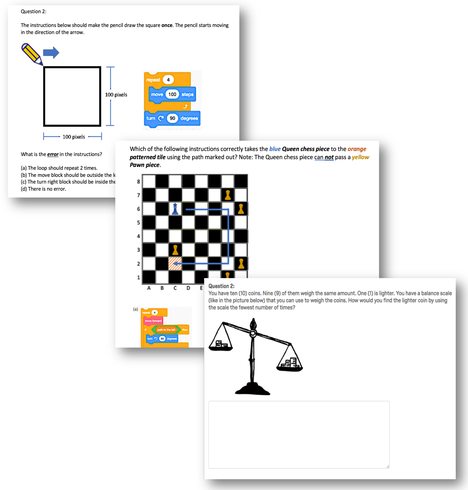
Computational Thinking (5 Likert-scale items, 4 teacher-specific Likert items) with scenario-based context and statements such as "When I am solving a complex problem, I try to break it up into smaller problems" and "When I am solving a complex problem, I think about what makes my solution better or worse than other solutions".

Previous Coding Experience (4 Likert-scale items, Open-ended question) with statements such as "I am comfortable writing code to solve problems" and "Describe your experience with coding and/or computational thinking. Please list what languages and/or tools have you used…"

Data Literacy (3 Likert-scale items) with statements such as "I would rather explore data myself than have someone tell me what it means".

Spatial CT Items (10 Multiple Choice items)

Problem Solving Items (3 Open-ended questions)



Community Participation

WORKSHOPS

288 Students

150 Teachers

52 School Boards across Canada

DELIVERABLES

1 Assessment Tool

Community Partnerships

ACKNOWLEDGEMENTS

We would like to thank the Callysto Project and the Government of Canada (Innovation, Science and Economic Development Canada) CanCode Program for funding our research.

<CanCODE> The CanCode program supports educational initiatives that foster coding and digital-skill development for K-12 teachers and students across Canada.

cybera — Alberta's not-for-profit technology accelerator. Cybera is a not-for-profit organization that supports Alberta's economic growth through the use of digital technology and cyber-infrastructure network systems.

Pacific Institute for the Mathematical Sciences. The Pacific Institute for the Mathematical Sciences (PIMS) is a collaborative university network supporting research advancement and awareness in mathematical sciences.

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