TLEF Project – Final Report

Report Completion Date: (2023/04/21)

1. PROJECT OVERVIEW

1.1. General Information

Project Title:	An online and open-source textbook and homework system for symbolic logic using semantic tableaux		
Principal Investigator:	Dave Gilbert		
Report Submitted By:	Dave gilbert		
Project Initiation Date:	01/04/2020	**Project Completion Date:**	01/04/2023
Project Type:	☐ Large Transformation ☒ Small Innovation ☐ UDL Fellows Program ☐ Hybrid and Multi-access Course Redesign Project ☐ Other: [please specify]		

1.2. Project Focus Areas – *Please select all the areas that describe your project.*

☒Resource development (e.g., learning materials, media)

☒ Infrastructure development (e.g., management tools, repositories, learning spaces)

☒ Pedagogies for student learning and/or engagement (e.g., active learning)

☐ Innovative assessments (e.g., two-stage exams, student peer-assessment)

☒ Teaching roles and training (e.g., teaching practice development, TA roles)

☐ Curriculum (e.g., program development/implementation, learning communities)

☒ Student experience outside the classroom (e.g., wellbeing, social inclusion)

☐ Experiential and work-integrated learning (e.g., co-op, community service learning)

☐ Indigenous-focused curricula and ways of knowing

☐ Diversity and inclusion in teaching and learning contexts

☒ Open educational resources

☐ Other: [please specify]

1.3. Final Project Summary – *What did you do/change with this project? Explain how the project contributed toward the enhancement of teaching and learning for UBC students.*

This project created a free, open-source, web-based, and interactive logic text along with an accompanying homework system that automated the marking of student homework assignments. It also built an open-source, in-browser widget that allows tableau proofs for propositional logic to be constructed and evaluated. It built upon two, extant open educational resources: Professor Jonathan Ichikawa's UBC version of *forallx*, an open-source logic text; and *Carnap*, a framework designed to facilitate the development of in-browser formal reasoning applications, which was developed by Graham Leach-Krouse (Kansas State University). Using the free text/homework package, we eliminated the non-tuition costs imposed by the Philosophy Department's distance education logic course (in sections taught be the PI). The automated marking allowed for teaching assistant hours to be reallocated, shifting the focus of the TA role from marking to more pedagogically fruitful interactions with students (particularly, engagement in the online Q&A forum and office hours).

To these ends, our project also developed LTI 1.3 integration for Carnap and a new, streamlined build system for Carnap, allowing alternate instances to be more easily set up.

1.4. Team Members – *Please fill in the following table and include **students**, undergraduate and/or graduate, who participated in your project.*

Name	Title/Affiliation	Responsibilities/Roles
Dave Gilbert	Assistant Professor of Teaching (UBCV Philosophy)	Principal Investigator
Tristan MacKinlay	UBCV Undergraduate	Undergraduate Research Assistant
Kyle Mas	UBCV Undergraduate	Undergraduate Research Assistant
Kamal Deowra	UBCV Undergraduate	Undergraduate Research Assistant
Max Becker	UBCV Undergraduate	Undergraduate Research Assistant
Jade Lovelace	UBCV Undergraduate	Undergraduate Research Assistant

1.5. Courses Reached – *Please fill in the following table with **past** and **current** courses (e.g., HIST 101, 2017/2018) that have been reached by your project, including courses not included in your original proposal (you may adapt this section to the context of your project as necessary).*

Course	Academic Year
PHIL 220	W21 (x 2)
PHIL 220	W22 (x 2)
PHIL 220	W23 (x 2)
PHIL 220	S23
PHIL 220	ongoing

2. OUTPUTS AND/OR PRODUCTS

2.1. *Please **list** project outputs and/or products (e.g., resources, infrastructure, new courses/programs). Indicate a URL, if applicable.*

Output(s)/Product(s):	URL (if applicable):
Online, interactive version of forallx, UBC by Professor Jonathan Ichikawa.	https://carnap.philosophy.ubc.ca/shared/dave/forallxUBCFrontPage.pandoc
Abridged, slightly edited, version of the above text (used in online-only versions of the course)	https://carnap.philosophy.ubc.ca/shared/dave/AbridgedforallxUBC.pandoc
LTI 1.3 integration for Carnap	https://github.com/ubc-carnap-team/Carnap, merged upstream into https://github.com/Carnap/Carnap
NixOS build system for Carnap	https://github.com/ubc-carnap-team/Carnap, merged upstream into https://github.com/Carnap/Carnap
Rudolf (in-browser widget for constructing and verifying semantic tableaux)	https://github.com/ubc-carnap-team/Rudolf
Homework question banks for verified instructors using the forallx, UBC online text.	(Available to registered instructors only.)

2.2. Item(s) Not Met – *Please list intended project outputs and/or products that were not completed and the reason(s) for this.*

Item(s) Not Met:	Reason:
Full first-order functionality for Rudolf. (Propositional component completed.)	The primary student working on this graduated. Unfortunately, COVID-19 slowed things down for him at a vital point. Significant work has been started, however, and the code for this is open-source, and merged upstream into the main repository, allowing this work to continue.

3. PROJECT IMPACT

3.1. Project Impact Areas – *Please select all the areas where your project made an impact.*

☒ Student learning and knowledge

☒ Student engagement and attitudes

☒ Instructional team-satisfaction

☐ Teaching practices

☐ Student wellbeing, social inclusion

☐ Awareness and capacity around strategic areas (Indigenous, equity and diversity)

☐ Unit operations and processes

☒ Other: Impact beyond UBC

3.2. Please provide details on each of the impact areas you selected in 3.1. – *For example, explain in which ways your teaching practices changed; how student wellbeing was impacted; how students wellbeing benefited from your project, etc.*

Student learning and knowledge: with the interactive, online text, students were able to complete practice problems that were automatically marked immediately, thus giving them instant feedback on their work and learning. This also helped them focus their studies. Moreover, many students expressed their preference for the online text over the PDF and printed versions.

Student engagement and attitudes: This is related to the first point. In addition, because homeworks were also automatically marked without the need for TA hours, the TAs for the course could devote almost all of their allotted hours to interactions with students, including office hours and online forum engagement. Importantly, the new online text and homework package replaced the previous, proprietary package. In just the first term that the new package was used, approximately $14,152 was saved by students. (Of course, these savings are ongoing.) Lastly, having the book and homeworks embedded into Canvas (via the LTI 1.3 integration developed by the project) made life easier for students, and the course easier to manage by instructors, by making Canvas the only portal to the coursework.

Instructional-team satisfaction: TAs enjoyed interacting with students rather than just marking homework. Also, as noted, the Canvas integration made running the course much easier than it had been when we were using the proprietary package.

Other: the LTI integration developed as part of the project is now being used by at least seven universities, worldwide. The online texts, as well as the Rudolf widget, is open and freely available to anybody with internet access.

3.3. How do you know that the impacts listed in 3.1/3.2 occurred? – *Describe how you evaluated changes/impacts (e.g., collected survey data, conducted focus groups/interviews, learning analytics, etc.) and what was learned about your project from the evaluation. You are encouraged to include graphical representations of data and/or scenarios or quotes to represent and illustrate key themes.*

Student learning and knowledge/Student engagement and attitudes: Student feedback on course evaluations commented on both the value of the software and the book. They also regularly acknowledged the financial savings.

Instructional-team satisfaction: The TAs in the course regularly reported preferring the new structure, as did the instructors.

4. **TEACHING PRACTICES** – *Please indicate if **your** teaching practices or those of **others** have changed as a result of your project. If so, in what ways. Do you see these changes as sustainable over time? Why or why not?*

   The primary effect on teaching practices has been the way in which teaching assistants are used in sections of PHIL 220. As mentioned above, most of their hours have been reallocated to allow for more interaction with students and less time devoted to marking.

   Another obvious change is the use of the new text/software package, which is free for students, in PHIL 220 sections, and the online-only ones in particular.

5. **PROJECT SUSTAINMENT** – *Please describe the sustainment strategy for the project components. How will this be sustained and potentially expanded (e.g., over the next five years). What challenges do you foresee for project sustainment?*

   The Department of Philosophy will continue to make use of the tools developed as part of this project. The server costs are now paid for by the department. The online resources developed are going to be used in at least one summer course this year, and in at least two courses next year. (This will be ongoing.)

   Additionally, all of our code is online (at GitHub, see above) and merged upstream to the original Carnap repository, allowing anybody in the world to improve and build upon it. This understanding of sustainment and dissemination is a key part of the open source philosophy.

6. **DISSEMINATION** – *Please provide a list of scholarly activities (e.g., publications, presentations, invited talks, etc.) in which you or anyone from your team have shared information regarding this project. Be sure to include author names, presentation title, date, and presentation forum (e.g., journal, conference name, event). These will be included on the TLEF scholarly output page.*

   As mentioned, everything produced by the project (online text, Rudolf widget, LTI 1.3 integration, NixOS build system) is online and open source. https://github.com/ubc-carnap-team/Carnap

   "An Open-Source Logic System with trees", an invited talk at the *Open Scholarship in Practice* event, held at UBC on October 25, 2019. (Presenters: Dave Gilbert and Kyle Mas.)

   "Homework Activities: A logical extension of forallx using Carnap", BCCampus blog post.