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Scaling Up: Value-added Cognitive Assessment Redesign Network for the Development of Higher-order Thinking Appendix

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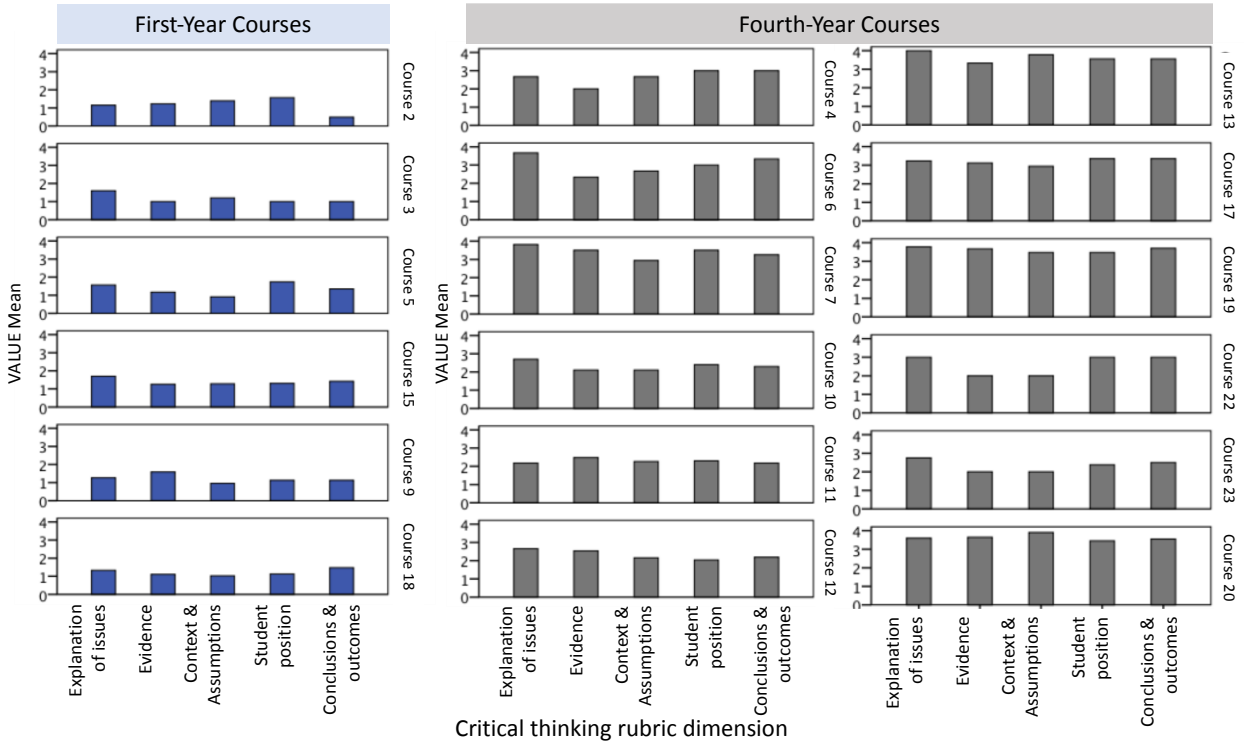
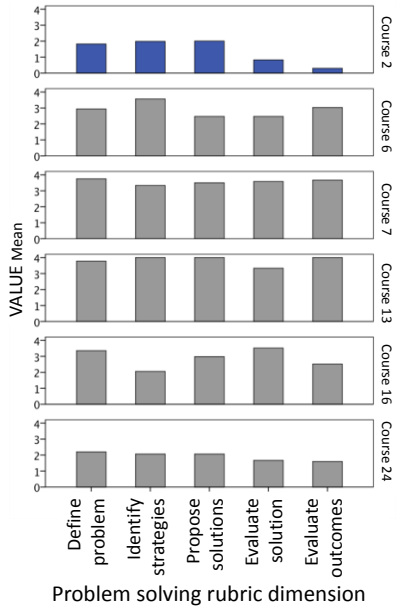
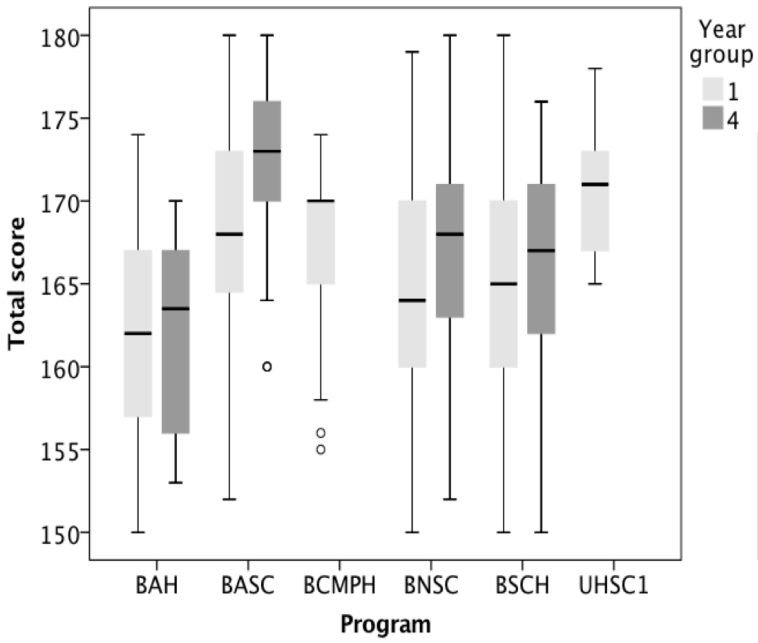
Appendix 1: VALUE Outcomes by Course





Appendix 2: HEIghten Total Score First- to Final-year Distributions by Program (box-plots displayed quartiles)



	Year group n	
	First-year	Final-year
Bachelor of Arts Honors (BAH)	99	6
Bachelor of Applied Science (Engineering) (BASC)	616	65
Bachelor of Science Honors (BCMPH)	13	
Bachelor of Nursing Science (BNSC)	79	62
Bachelor of Science Honors (BSCH)	714	14
Bachelor of Health Science (UHSC1)	9	

Appendix 3: HEIghten "First-year" Report

Queen's University
Kingston, ON
CAN
Test: **HEIghten® Critical Thinking Assessment**

REPORTING GROUP:

Cohort: Combined
Close Date: Combined
Students Tested: 1,349
Records Excluded: 166
Students Included in Report: 1,183
(See bottom of report to view filters applied)

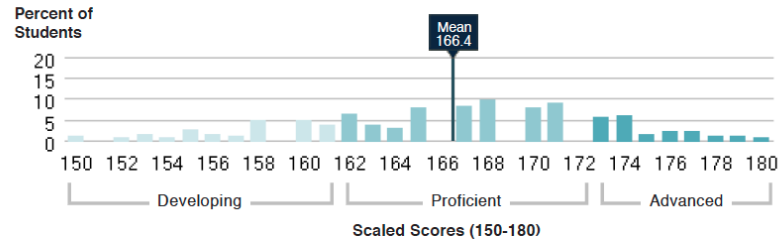
COMPARISON GROUP:

Comparison Group: All Institutions
Institutions: 29
Students Included in Report: 2,520

INDIVIDUAL STUDENTS' OVERALL SCALED SCORES

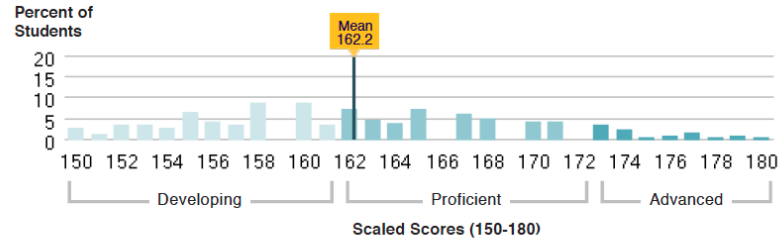
The histograms below show the distribution of individual students' scaled scores within the Reporting Group and the Comparison Group. The dark line indicates the overall mean score for that group.

REPORTING GROUP



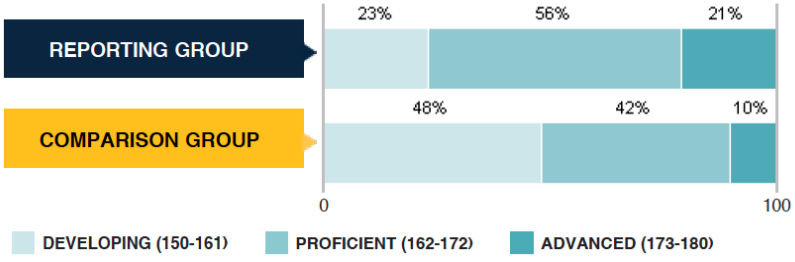
Different students take different forms of this test. On each form, some numbers in the score range are not possible scores. Consequently, the score distributions are not smooth, even for large groups of students.

COMPARISON GROUP



PROFICIENCY LEVELS

This chart shows the percentage of students at each proficiency level within the Reporting Group and the Comparison Group.



PROFICIENCY LEVEL DESCRIPTIONS

DEVELOPING (150-161)

A typical student at the **developing** level may:

- make inferential connections between two explicitly related points
- follow the logic of an explicitly structured argument
- mistake evidence that is broadly related to a topic for evidence that is relevant to a specific assertion
- identify evidence that directly supports or undermines a claim
- have difficulty distinguishing causation from correlation

PROFICIENT (162-172)

A typical student at the **proficient** level has demonstrated the ability to:

- make inferential connections
- follow the logic of an argument
- understand logical relationships between assertions/arguments and supporting information
- identify implicit assumptions and evidence that supports or undermines a claim
- distinguish causation from correlation

ADVANCED (173-180)

A typical student at the **advanced** level has demonstrated the ability to:

- extrapolate implications
- describe the logic of complex arguments
- understand subtle logical relationships between assertions/arguments and supporting information
- identify needed evidence and implicit assumptions
- identify possible alternative causes or explanations

See www.ets.org/heighten/ctproficiency for the complete descriptions.

Appendix 4. Correlations between Course, VALUE and HEIghten Outcomes

VALUE rubric	Dimension	Assignment grade	Course percentage	Sessional GPA	Cumulative GPA	HEIghten		
						Total score	Analytic	Synthetic
Critical thinking	Explanation of issues	.315** 401	.341** 523	.170** 695	.031 695	.190** 460	.153** 460	.183** 460
	Evidence	.643** 400	.333** 522	.100* 657	-.001 657	.109* 423	.109* 423	.088 423
	Context & assumptions	.465** 399	.319** 522	.086* 693	-.009 693	.137** 459	.136** 459	.113* 459
	Position	.265** 344	.286** 522	0.04 637	-.049 637	.202** 403	.189** 403	.171** 403
	Conclusions & outcomes	.221** 340	.236** 461	.111** 633	.000 633	.159** 456	.128** 456	.153** 456
Problem solving	Define problem	.426** 343	.500** 292	.344** 393	.198** 393	.175** 284	.120* 284	.172** 284
	Identify strategies	.784** 339	.429** 289	.286** 390	.127* 390	.193** 281	.160** 281	.173** 281
	Propose solution	.252** 342	.487** 292	.319** 393	.265** 393	.273** 284	.196** 284	.263** 284
	Evaluate solution	.386** 338	.531** 287	.398** 387	.253** 387	.213** 279	.142* 279	.216** 279
	Implement solutions	.880** 70	.461** 71	.409** 78	0.184 78	.577* 14	.427 14	0.527 14
	Evaluate outcomes	.658** 343	.602** 279	.408** 379	.192** 379	.232** 273	.171** 273	.230** 273

Note: Numbers in small font display the pair-wise sample size

Appendix 5: Qualitative Outcomes

Course	Assignment (re)design	Description	Outcome
ANAT 100	Case study-applying anatomical knowledge	This foundational anatomy course is designed to introduce basic structure and functional relationships of the human body. The development of cognitive skills (problem solving and decision making, integrative learning, critical thinking and reasoning) was undertaken through development of a series of case studies.	The original intention of the redesign was to introduce critical thinking into the quizzes, but after some effort it was determined that these tests are focused on anatomical knowledge and do not align with the criteria on the critical thinking dimensions of the VALUE rubrics. Efforts were re-focused in the following term toward the assessment of problem solving. The resulting rubrics were effective in evaluating the majority of the problem-solving dimensions.
APSC 100	Mars Colony feasibility report	The course instructor has been making ongoing improvements to the course for many years. Based on evidence from previous years' investigations of student learning, refinements were made to the assignment to include aspects of creative thinking. One of the observations here was that first-year engineers can only be creative within certain boundaries.	The APSC 100 course trialed implementing HEIghten and using the score for course grading (1%). This significantly increased motivation ($F(1,1600)= 29.44$ $p<.001$). The effect of *making the test* count was $d=.28$. i.e., the first-year engineering ($n=635$) test effort was greater than 1/4 of a standard deviation higher the remainder of the first-year ($n= 966$) test effort. Paper (peer-reviewed) presented at Engineering Education conference.[1, 2]
BIOL 103	Critical thinking lab & Research report	This course is part of the introduction to many life sciences degrees, encouraging the development of cognitive skills through the continued development of critical thinking in the labs with students. A rubric was developed for the assessment of the critical thinking lab for the purpose of formative student feedback.	The HEIghten test was embedded in the course with 3% course credit committed to the completion of the test. This gave the students incentive to complete it, but also a clear message to them that critical thinking is a valued part of the course.

Course	Assignment (re)design	Description	Outcome
BIOL 402	Research design and lab report	The purpose of the course is to develop laboratory skills by conducting experiments. The lab reports were an area of concern for the instructor. A lab leader/ researcher was employed to provide ongoing feedback to the students. A rubric was developed with the aim of improving the depth of thinking in the lab work.	The rubric on its own did not enable better performance in the students, but the researcher was able to provide insight into some of the issues that had not previously been communicated to the course instructor. The students had not had many opportunities to be self-directed or think deeply about the subject material. Department conversations about this led to the instructor being funded to attend a symposium on problem-based learning for Biology. She subsequently developed eight scenario-based problems for directing learning in the large first-year biology course.
BMED 173	Series of critical thinking blogs (Animal experimentation)	This fully online course deals with the history and philosophy of healthcare. It is a multidisciplinary course organized around five major fields of scientific endeavor: anatomy, physiology, pathology, pharmacology, and population and global health. The course was already designed in a highly engaging manner, the assessment most closely aligned with critical thinking was the series of blog posts and discussions on various controversies encountered within each field.	Assignment Instructions were rewritten to be more explicit about the learning goals, and an associated rubric was refined to allow performance levels to apply to a number of different blog topics. It is the intention of the instructor to engage students in the development of the rubric in the future.
CHEE 470	Environmental hazards report	Considerable work was undertaken to develop a detailed assessment rubric for Front End Engineering Design (FEED) for industrial process design. Previous assessment materials did not provide criteria for the quality of specific competencies demonstrated. There were training materials for this area but no quality performance indicators. The instructor wanted to include all of the desired content reflected in the assessment rubric.	The resulting rubric was rather long, but highly valued. The instructor who took over the course this year, refined the rubric, reducing the content to a manageable number of dimensions and is using it in the next iteration of the course.

Course	Assignment (re)design	Description	Outcome
CIVL 500	Research thesis & poster	The redesign of the assessment guidelines for the research thesis was augmented by the introduction of a poster session. The rationale for the posters was to enable the student to explain their conceptual understanding and how their research fits into the larger literature base.	At the networking meeting, many of the attendees realized how universal a research thesis is, and how easily the CIVL500 rubric could be adapted for their course.
DRAM 439	Performance process reflection and peer feedback	This course examined the theoretical underpinnings of "authenticity and the real," applying critical models to a variety of contemporary reality-based Canadian performances. Students' reflections and peer reviews were utilized to engage students metacognitive and critical thought. The groups identified the creative problem and explored them through performance "experiments." This was motivated by the question of how one might better grade performance-based work in a liberal arts educational context.	Student-centered learning was not new to this instructor, but the performance "experiment was new," and critical thinking had not been specifically assessed in the past. Instructor and Facilitator presented work at STLHE and the Teaching Showcase.[3, 4]
ENGL 100	Final essay-Analyzing a poem	The course relies on different pedagogical environments, including lectures which present overarching concepts in literary study and illustrative readings of a range of texts and tutorials. One of the challenges for the redesign was initiating assessment through the learning management system. A critical thinking self-learning module was developed for the students to support them in critically analyzing a play for the final deliverable (an essay).	The instructor had not previously used rubrics, and was apprehensive about the time and processes required for implementing them. There were also concerns about how the "context and assumptions" criteria is interpreted in an English course. The work is ongoing following some piloting of the rubric use, the rubric will be implemented in the next iteration of the course.
ENGL 442	Reflection and critical essay	This initiative translated an assignment that was previously assessed subjectively into a multi-stage assignment with structured feedback, coaching notes and a criterion-based assessment rubric for each of the three phases of the essay assignment.	The initiative has provided a rich professional development opportunity for the instructor, who is conducting her own qualitative investigation of the pathway for student learning. She presented this work in a poster at the Scholarship of Teaching and Learning in Higher Education conference.[5]

Course	Assignment (re)design	Description	Outcome
ENGL 487	Close reading response- various topics	This was a special topics seminar in speculative fiction, with the goal of breaking down boundaries between serious literature and science fiction. The redesign involved replacing traditionally unstructured (or loosely structured) group/class discussions with something that was more clearly targeted towards the development of critical analysis and discussion skills and evaluate secondary-source scholarship that comments directly on the primary source texts.	Having never used rubrics before, the developed rubrics were provided to students in advance of the discussions, enabling transparency of expectations for the group presentation work in class, and providing guidance to improve the quality of those discussions.
ENGL 489	Using discussion to inform secondary sources paper	In this course, students interrogated the role of hockey in supporting and disrupting discourses of Canadian nationhood. The weekly discussions focused on Canadian identity, characterized representations of gender, sexuality, nationalism, embodiment, play, mentorship, economics, regionalism, environmentalism, militarism and violence. The assessment goal was to speed up grading for the instructor by requiring students to conform to a specific organizational structure.	The grading process was streamlined because students utilized a template to flesh out their individual expression. The additional benefit of this was that students were able to more easily evaluate their peers.
GEOE 447	Research Report	Students consulted with a management board comprising geological engineering faculty, to produce an engineering design report. A rubric was developed for the project deliverable.	There was no existing rubric for the fourth-year design reports; they had previously been graded using qualitative judgement. The result of the project made expectations clear to students with explicit performance criteria.
GPHY 402	Food Systems Analysis Project	This honors seminar is devoted to examining the geographies of sustainable food systems. The redesign focus was a shift to student-centered inquiry-based learning. The students collectively researched food in schools from an international perspective, honing in on the Ontario school system, with individual contributions collected and scored using the VALUE rubrics.	The final product of the redesign was a policy recommendation document, submitted to relevant stakeholders, demonstrating the comparative standing of the Ontario school system with key recommendations for bringing it in line with international standards. Involvement in the project was a transformative experience for the students and instructor. This was a substantial shift in perspective about teaching for the course instructor, who went on to become a mentor (assessment coach) for the large first-year course.

Course	Assignment (re)design	Description	Outcome
GS&GE ePort-folio	Summation and reflection documents	A guideline document was drafted and implemented in a special course comprised of geological science and geological engineering students. The pilot operated as a repository for thinking and learning, a collection of the student's best work, an extension to a CV/résumé. The students were to be partnered with alumni for feedback on the ePortfolio's participating students also completed the HEIghten test for inclusion of the test report as part of the ePortfolio.	The D2L ePortfolio module was not as flexible as the students had hoped, and the artifacts collected within the secure module were externally visible. There were no consequences for the students for not completing the reflections, and with their busy schedules, none of the students got to the point of uploading their finished ePortfolio. Important lessons were learned from this, as Queen's University continues to explore the feasibility of the ePortfolio format for the purpose of showcasing students' skills and expertise.
HLTH 102	Evaluation of sources of evidence	The critical thinking assignment was designed to help students evaluate the quality of health-related sources of information. The rubric was oriented toward the critical appraisal of information, and significant effort was invested in training teaching assistants (TAs) to recognize levels of performance in student work samples for consistent assessment between the eight TAs marking the assignment.	The course instructor recognized the primary benefit of training the TAs for capacity building (several of the TAs teach for multiple years in the course) but also the secondary benefit of detecting gaps in student knowledge and ways to improve the rubric in the future.
MECH 495	Workstation design	This course provides an overview of ergonomic problems that are addressed in engineering design; including biomechanical, physical and physiological issues. The case studies range from the design of vehicle cockpits to process control rooms, from industrial manual materials handling tasks to human directed robots, and from domestic tools to biomechanical devices. The previous assessment guide provided a detailed list of requirements and a score matrix for the students (but no quality indicators).	The rubric that was adapted for the assignment ended up being very detailed; so much so that it was unwieldy for course TAs to use. The rubric was not implemented through the learning management system. This may have made the rubric more user friendly. Such a detailed rubric would have been more useful for the summative assignment, but as the summative was a group project, level of individual achievement would have been difficult to determine. Presented a panel at the Teaching Development Day.[6]
MEDS 112	WIKI Med edit and referencing project	The WIKI Med editing project was one of the most interesting of the initiatives presented at the fall meeting. An existing assignment was changed to become a course-long assignment where students edit a medical page on Wikipedia. Medical residents were engaged to mentor the student groups and provide	There was substantial pushback from students about the Wikipedia project. The instructor conducted her own qualitative study and found that students were frustrated by the amount of effort required for what they perceived as little impact. They also found it challenging to deal with feedback from public. The instructor realized that such demands actually built persistence and professionalism skills. Such skills are very difficult to

Course	Assignment (re)design	Description	Outcome
		feedback. The assignment was integrated throughout the term, culminating in critical analysis of a Wikipedia page on a topic from the area of complementary and alternative medicine.	teach directly and are required for medical accreditation. The instructor, and the team from medicine presented this work at a number of conferences.[7, 8, 9]
NURS 101	Critical reflection-Indigenous health	The course developed cognitive skills through two primary assessments: a term paper and practice labs. Indigenous health is a keen concern for the nursing profession, so a text was chosen that prompted students to critically engage with the issues involved. A rubric was developed to guide the students toward their learning goals for the written paper.	The nursing instructors from first and fourth year collaborated to provide evidence of the value that a nursing program provides to the critical thinking of its students. The instructors developed similar critical reading assignments, the course rubrics developed for the project enabled a consistent format for evaluating improvement across the program. The HEIghten test was also embedded in both courses.
NURS 401	Critical reflection-health related issues	The focus of the redesign was the development of cognitive skills through communication in discussion posts, analyzing their nursing practice through the quality assurance assignment and a rubric was developed to evaluate the quality in which the students critically analyzed a current nursing issue, submitted in the form of a term paper.	
OT 871	Novice-expert patient consultation reflections	To develop advanced clinical reasoning skills for occupational therapy practice, students were immersed in experiential learning opportunities, contrasting their own performance longitudinally (standardized patient interviews from their first-year were recorded) with an expert in the field. Students' wrote their comparative papers through the lens of expert-novice literature.	The newly developed rubric for the novice-expert assignment was refined to improve effectiveness for student feedback. The instructor was very knowledgeable about rubric design and was very collaborative. In the following year she shared her expertise in mentoring (assessment coach) for another health-related course. Presented a panel at the Teaching Development Day.[6]
PSYC 100	Three-stage critical thinking lab	The initiative explored the use of repetitive prompts to trigger critical thinking transfer. The psychology team employed a research assistant to evaluate a sample of each of the three-part lab responses to test their hypothesis that the method can support significant improvements in critical thinking.	The research was included in the PSYC100 sample-pool group of studies. This privilege is usually reserved for psychology thesis study participation. Project involvement has prompted "a larger discussion about the nature of assessment in PSYC100 labs. We have yet to come to a resolution, but the discussion is rich and important." Megan Norris. Presented at the Teaching Showcase.[10]

Course	Assignment (re)design	Description	Outcome
PSYC 450	Multi-part critical thinking response	Critical discussion was the pedagogical approach for targeting conceptual understanding of various facets of brain development. The redesign involved development of questions to effectively focus on the major themes of the course.	Review of questions led into the development of rubrics for the major course assessments including the seminar-led group presentation and the final take-home exam. This was a new approach to assessment for the course instructor who had not previously used rubrics.
PSYC 453	Critical response and research proposal	This course focused on developing conceptual understanding of social-cognitive development during infancy. With a student-centered approach, the challenge for the redesign was to develop a rubric that was able to be applied a range of topics chosen by the students.	The rubrics streamlined the feedback process, based on common criteria for specific assessment of critical thinking.
SOCY 424	Power, inequalities and social justice-poser and presentation	The initiative broke new ground for many of the students enrolled in the course. The community component of this initiative combined the authenticity of real people, and real problems within the scholarly genre of an academic poster. Students were asked to: Use academic theories and source material to develop a solution to a real-world problem; Consult with community organizations to ensure that their solutions were appropriate for the group they sought to assist.	Following the very successful poster session, the Dean invited students to post them in the faculty hall (some of the students did this). The task was challenging for students, for many it was a transformative experience, but there were those who pushed back on the unstructured, open-endedness.

Project references

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