TOWARDS THE DESIGN OF A COMMUNITY-ENGAGED DATA VISUALIZATION COURSE

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ABSTRACT

Educational action research bridges the gap between theory and practice; where the learning design is the proposed hypothesis and the classroom is where it is field-tested by the teacher as researcher (McKernan, 2007; Stenhouse, 1975). Through this lens we see inquiry as a deepened understanding of one's own practice. The purpose of this study was to critically evaluate the design of an introduction to data visualization course with community-engaged learning as its core pedagogy. Results show that many of the core elements of community-engaged learning were achieved at the exemplary level, based on the assessment matrix developed by Dahan and Seligsohn (2003). Several recommendations emerged, both situational and generalizable, which could enhance the redesign and improve the experience for practitioners who use community-engaged learning as a core pedagogy.

KEYWORDS: Community-engaged learning, educational action research, reflective practice, higher education pedagogy, learning design

INTRODUCTION

There is, potentially, a point where the academic practitioner makes a decision to concentrate upon knowledge production or pedagogy, seeing little possibility of pursuing both well; often with the latter being at the subordination of the former. As for community service itself, this function runs a poor third in the higher education race. However, this does not have to be the case. It is possible to engage simultaneously in research, in pedagogy and in community service if the research is itself about forms of teaching and learning in tertiary settings that more widely engage the community (Groundwater-Smith & Mockler, 2016, p. 161).

Educational-action research gives voice to the academic practitioner seeking to integrate knowledge production *and* pedagogy. This methodology serves the dual role of directly benefitting the primary stakeholders –the learners and the broader community of practice to whom the research is directed. The purpose of this study was to determine the degree to which the core elements of community-engaged learning have been successfully integrated into an introduction to data visualization course and to identify deficiencies using gap analysis in order to improve the learning design for the next iteration of the course. In doing so, this study achieves the elusive goal of engaging simultaneously in research, in pedagogy and in community service. This study addresses several key areas of educational research: action research, reflective practice, pedagogy, and lessons learned to improve design and development approaches in pursuit of Kurt W. Clausen’s, current Editor-in-Chief of CJAR, exhortation to stay vigilant and true to one’s vision (Clausen, 2018).

ORGANIZATION OF THIS PAPER

This paper begins with definitions of *community-engaged learning* followed by a discussion of the *educational action research* methodology. Next, each of the four phases of the educational action research model is applied to the course under review for this study. Reflection and several recommended changes to the learning design are provided, accompanied by their rationale. The dual role of teacher as researcher, which introduces methodological concerns are addressed. Issues of veracity bias and accuracy, which might confound the findings are addressed by a discussion on limitations of action research, as it applies to this study, with evidence to counter these concerns. The paper concludes with a summary of the study and its contributions to the community-engaged learning praxis.

DEFINING COMMUNITY ENGAGED LEARNING

Community-engaged learning (CEL), also referred to as service-learning is “a teaching and learning strategy that integrates *meaningful community service* with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities” (National Service-Learning Clearing House, 1993). Or more simply, “[s]ervice-learning is a pedagogical method wherein students apply what they learn in the classroom and work with community groups to address *real-life problems*” (“Learn and Serve America Community-Wealth.org,” n.d.). Finally, we look to Bringle and Hatcher (1995) who define CEL as:

[C]ourse-based, credit-bearing educational experience that allows students to (a) participate in an *organized service activity* that meets identified community needs and (b) *reflect* on the service activity in such a way as to gain further understanding of *course content*, a broader appreciation of the discipline, and an enhanced sense of civic responsibility. (p. 112)

This current study uses the broader, more contemporary and inclusive understanding of *community-engaged learning* to capture the breadth of engagement with communities beyond the traditional civic-oriented, “social action for a public purpose in a local community” (Langseth & Plater, 2004, p. 10). Why present multiple definitions? One reason is that CEL is multidimensional (Clayton, Bringle, & Hatcher, 2013); elements such as

connections to academic learning objectives, engagement with a community to meet real-life needs, reciprocity, and reflection are well-established in the literature (Clayton et al., 2013; Hou, 2014; Jatana, Brennan, & Eggermont, 2017; Mcrae & Johnston, 2016; Ventures, 2013) and provide a suitable set of criteria with which to evaluate the design of the data visualization course reviewed in this study.

THE EVALUATION FRAMEWORK

Dahan and Seligsohn developed a matrix based on the foundational work by Howard (2001) for assessing the quality of service-learning courses for faculty at Rutgers-Camden, however the criteria are applicable to CEL designs as well. The framework consists of eight core elements or criteria and three levels of performance indicators: *developing*, *effective* and *exemplary* as well as sample artefacts and activities to achieve those criteria. The eight elements are listed below while the full matrix is found in Figure 1.

1. Integration of experience with learning goals and other course elements;
2. Opportunity for analysis of and/or reflection on experience;
3. Substantial experiential or community-focused component in which all students are required to participate;
4. Appropriate student preparation for experiential activity (e.g. training, orientation, etc.);
5. Appropriate partnership;
6. Appropriate distribution of benefits;
7. Integration of the engaged civic learning component into student assessment;
8. Sharing of information or findings with community partners and/or others. (Dahan & Seligsohn, 2013)

This study used Dahan and Seligsohn's matrix to assess the learning design within the context of CEL and identify areas for improvement as part of the researcher/educator's reflective practice

ASSESSING THE QUALITY OF ENGAGED CIVIC LEARNING COURSES				
ECL Element	Developing	Effective	Exemplary	Evidence
Integration of experience with learning goals and other course elements	Course's stated learning goals do not directly address the experiential component of course or are not related to the expectations for the experiential component	At least one stated learning goal addresses the experiential component of the course and relate to the expectations for the experiential component	Multiple stated learning goals address the experiential component of the course and are deeply embedded into the expectations for the experiential component	<ul style="list-style-type: none"> • Learning Goals/Objectives
Opportunity for analysis of and/or reflection on experience	Faculty member's assignments do not directly require students to actively reflect on the experiential component of the course or opportunities for reflection in other stated assignment are not actively sought	At least one assignment requires students to reflect on experiential component of the course or reflection is encouraged in many or all assignments. Opportunities to reflect include in-class discussion, online discussion boards, written assignments, or creative expression	All assignments are designed with reflective opportunities used to reinforce experiential learning and provide students with multiple forms for reflecting on experience through in-class discussion, online discussion boards, written assignments, and/or creative expression	<ul style="list-style-type: none"> • Learning Goals • Assignment List • In-class Discussion • Online Discussion Boards • Journals / Field Notes • Reflective Essays
Substantial experiential or community-focused component in which all students are required to participate	Experiential component is less than 10 hours over the semester and/or has no pedagogical relationship to the learning goals of the course OR experiential component is not a required component of the course	A required experiential component is between 10 and 15 hours over the semester and has a pedagogical relationship to the learning goals of the course	A required experiential component is more than 15 hours over the semester and is substantially related to the learning goals of the course	<ul style="list-style-type: none"> • Learning Goals • Assignment List • Description of ECL Assignment

Appropriate student preparation for experiential activity (e.g. training, orientation, etc.)	No expectations for students to participate in any preparatory activities or expectations are limited to community partner requirements	Faculty member considers the expectations of community partners' needs for students prepared for their community experience. To that end, the expectation is explicit for students' participation in preparatory activities	The faculty member, community partner, and Office of Civic Engagement collaborate to prepare students for engaged civic learning as part of the clearly outlined expectations of a course	<ul style="list-style-type: none"> • Description of ECL Assignment • Class Policies • Discussions between Faculty member and Community Partner
Appropriate Partnership	Ideal partner types are identified by the faculty member and shared with the students who must identify their own partners; or faculty identifies partners and students are expected to arrange their own scheduling	Faculty member collaborates with Office of Civic Engagement to identify partner(s) (or identifies partners separately) and works directly with partner(s) to develop scheduling that reasonably meets the needs of students and partner(s)	Faculty member collaborates with Office of Civic Engagement to identify partner(s), provides opportunities for partner(s) to act as co-educators within classroom and during work that is scheduled with the needs of the partner(s) and students in mind	<ul style="list-style-type: none"> • Description of ECL Assignment • Instructor Information • Discussions between Faculty member and Community Partner
Appropriate distribution of benefits	Little consideration of the benefits for students or partner(s) is considered before placement	Benefits for community partners and students are considered as part of the placement process	Consideration of benefits is recognized through selection of placements, in collaboration with partner(s), and detailed through well-designed learning goals	<ul style="list-style-type: none"> • Description of ECL Assignment • Learning Goals • Discussions between Faculty member and Community Partner

Integration of ECL component into student assessment	Little evidence of ECL component in student assessment strategies and student grading	The ECL component has a clear assessment strategy linking one or more learning goals to one or more graded assignments	Strategies for both formative and summative assessment of student learning related to the ECL component are clearly outlined in the syllabus and addressed in the classroom	<ul style="list-style-type: none"> • Assignment List • Description of ECL Assignment • Assignment Grading Rubrics • Grading System
Sharing of information or findings with community partners and/or others	Little or no evidence of plan to share findings or new knowledge with community partners or their clients	Plan to share information is separate from learning goals of the course or is an incidental benefit of the course	Sharing information with community partner and/or its clients is a form of summative assessment; or is planned outside of the learning goals of the course but is a shared expectation between faculty member and community partner.	<ul style="list-style-type: none"> • Description of ECL Assignment • Assignment List • Discussions between Faculty member and Community Partner

Figure 1. Dahan and Seligsohn's assessment matrix. Reprinted from *Engaged Civic Learning Course Design Workbook* (p. 3), by T. Dahan and A. J. Seligsohn, 2013, Camden-Rutgers: New Jersey. Copyright 2013 by Dahan and Seligsohn. Reprinted with permission.

METHODOLOGY

McKernan (1996) suggests that curriculum is “educational proposal, or hypothesis, which invites a critical response from those who implement it” (p. 4). Action research, in education, is “a process of systematic inquiry into a self-identified teaching or learning problem to better understand its complex dynamics and to develop strategies geared towards the problem’s improvement” (Hamilton, 1997, p. 44). It is, essentially, an educational proposal, that invites classroom testing. This is also the link that makes the relationship between teaching and research clear. In order to test his or her curriculum practice, the teacher must adopt a research stance. Educational action research may be viewed as research conducted by the educator as researcher to understand the impact of an educational intervention situated in the classroom context and to improve some aspect of the learning experience. This study uses *educational action research* to assess the design and implementation of a data visualization course at a Canadian university. This course was designed to integrate community-engaged learning as the primary pedagogical model.

The primary purpose of educational action research is to improve one’s practice (Gall, Borg, & Gall, 2003, p. 579). “Asking questions about one’s students’ learning; gathering and analyzing evidence to help answer those questions; trying out and exploring new insights about learning in one’s teaching; and making what one has found public, so that it can be reviewed, critiqued, and built on by others are the defining features of the scholarship of teaching and learning” (Hutchings, Ciccone, & Huber, 2011). Continuous pedagogical improvement is an acknowledged goal for post-secondary educators, who must occupy the dual role of teacher and researcher. Educational action research provides a methodology for this duality in which ‘no separation need be made between the design and delivery of teaching, and the process of researching these activities, thereby bringing theory and practice closer together’ (Riding, Fowell, & Levy, 1995). Various forms of action research have evolved since Kurt Lewin’s pioneering work (1946, p. 150). All derivations of Lewin’s model share a similar cyclical application of problem identification, action planning,

implementation, evaluation, and reflection.

Figure 2. *Action research cycle adapted from Lewin (1946).*

McKernan (1996) classified action research into three types: Scientific-technical (instrumental); Practical-deliberative; and Critical-emancipatory. The research design of this current study uses the practical-deliberative type, which “seeks to improve practice-and-service delivery” (Berg, 2001, p. 196; Kemmis, 2006; Newton & Burgess, 2008). The design follows the iterative design cycle. Numerous representations of the action research

process have been developed (McKernan, 1996, pp. 21-26). This study most closely aligns with the Kemmis and McTaggart (1988) Action Research Spiral/Cycle. However, the model has been updated for this study to reflect the pedagogical context of educational action research shown in Figure 3.

Figure 3. *Educational action research iterative model adapted from Kemmis and McTaggart (1988)*

This *practical* form of action research aims not only to improve the educator as researcher's practice in functional terms but also to disseminate the results to a community of educators (Kemmis, 2001, p. 92). Put simply, "Educational Action Research involves teachers making and creating educationally worthwhile changes in their classrooms and other learning environments" (Elliott, 2010, p. 1).

RESEARCH QUESTIONS

The study's design began with a pedagogical issue framed as a set of questions either specific to the immediate context or transferable to CEL practices in general:

- To what extent has the pedagogical design of a data visualization course achieved the core elements of community-engaged learning? (specific)
- How does one measure a successful CEL learning experience? (general)
- How does one design and develop a course that addresses all the defining characteristics of community-engaged learning? (general)
- What are the lessons learned from implementing a community-engaged learning project into an introduction to data visualization course? (specific)
- What strategies will facilitate the successful implementation of a CEL experience? (general)

DESIGN (PLANNING A COURSE OF ACTION)

CEL pedagogy was chosen for the learning design of the course. A 15-week introduction to data visualization course was taught by a single instructor to 20 students enrolled in the course as part of their computer science program of study. The major learning outcomes were to introduce tools and methods for creating effective visualizations based on complex and varied data. The specific course objectives were to:

- Understand the role of human cognition and visual system as it relates to designing visualizations.
- Understand the role of visualization and interactivity with respect to reporting and visual analysis.
- Critically evaluate existing visualizations.
- Design effective visualizations using a variety of tools.
- Evaluate current visualization products with respect to the principles learned in this course.

Course Design

There are two forms of CEL experience –curricular and co-curricular. Co-curricular CEL typically occurs outside of the classroom with little or no academic structure and is not for credit. Examples include voluntarism, co-ops, or internships. The other form of CEL is classroom-based with substantial academic structure that integrates service to the community with a specific course curriculum. Students complete a placement, and/or a project defined by a community organization to advance their mission as part of the requirements of earning course credit. The course used the curricular form of CEL.

Instructional Methods

Lectures, teacher-led demos, in-class activities, individual lab assignments and course project were selected for use in the design of the course.

Lecture Topics

Two textbooks were selected for the course, *Visualization Analysis and Design* by Tamara Munzner (2015) and *Communicating Data with Tableau* by Ben Jones (2014). The Munzner text provided the theoretical foundations of data visualizations and the Jones text provided tips and tutorials for Tableau Public, the interactive data visualization software used to complete the lab assignments and the major course project. The course topics were divided into lectures or labs based on the contents of the textbooks.

TEACH (IMPLEMENTING PLANS)**Project Orientation**

A presentation was given by the Office of Experiential Learning prior to the kick-off meeting with community partners to educate students about CEL and to provide strategies for preparing for the kick-off meeting, professionalism, communication, teamwork and accountability throughout the project. Students signed team contracts and non-disclosure agreements at this time.

Business Understanding

The course was delivered in the 2019 winter semester with 20 computer science students enrolled. Prior to the start of the course, five non-profit organizations were recruited from the local community with the assistance of the Office of Experiential Learning. Each community organization provided a profile of their organization –including history, mission, activities, and goals. They also provided details about what would they wanted to learn from their data –for example, “What is the retention rate of conference attendees year over year?” Students, working in teams of two, reviewed the profiles and selected an organization as their community partner. Each team signed a non-disclosure agreement prior to accessing the organization’s data.

Data Understanding

The next step was to prepare for a kick-off meeting by writing a set of follow-up questions to learn more about project needs and expectations. Teams also reviewed the data sets and prepared questions to clarify ambiguities and issues with the data sets such as missing data, clarification of terminology, data collection methods, and data structure. Student teams met with their community partners for a kick-off meeting to make introductions, learn more about the organization, the data, project needs, and to manage expectations around communication, deliverables, partners’ roles and responsibilities, and general expectations about project activities and outcomes. Partners included community and social services, heritage and culture funding agencies, and family-based non-profit organizations

Students reviewed the results of their kick-off meeting and drafted a set of research questions to guide the analysis and visualization of the organization’s data set and establish the data visualization goals. The instructor reviewed the draft questions and the revised questions were sent to the community partners for feedback and/or approval. Examples of final research questions were:

- What was the regional reach of different kinds of grants over the years?
- What percentage of first-time grant applicants failed in their first year?
- What are the family attendance and attendance retention rates of the family conference?
- How have trends in finding out about the conference changed over time?
- How does cost affect conference attendance?

Data Preparation

Raw data (unstructured, unformatted, and/or incomplete) had to be optimized prior to analysis and visualization. Pre-processing involved data cleaning, data integration, data transformation and data reduction (Al-taie, Kadry, & Lucas, 2019; Danubianu, 2014). The stage ensured the quality of the data for analysis and visualization.

Exploration and Analysis

The suitability of different visualization types (i.e. line plot, map, or bar chart) in communicating the results of the analyses was tested using preliminary analyses and

Figure 4. Project proposal submitted to community partner (excerpt)

visualizations on the data to test. Project proposals that included the organization's profile, project goals and research questions were submitted to each community partner as tentative solutions as shown in Figure 4. The proposal marked the midway point of the project and provided an opportunity for teams and community partners to check-in with an on-site visit for feedback and to discuss next steps.

Final Report

Community partners attended a final presentation of the project's results in which students discussed the results of the research questions, shared insights from the analysis, and provided recommendations for future analytics projects. The presentation was accompanied by a final report.

ASSESS

Evaluate the Action

Lewin refers to the third step of action research (AR) as the reconnaissance or fact-finding step, which fulfills 4 functions:

1. Evaluate the action;
2. Gather new insights;
3. Planning next steps;
4. Modifying overall plan (Lewin, 1946, p. 38).

This stage requires systematic documentation of the results of the learning design (the planned course of action) using "appropriate methods and techniques agreed upon beforehand" (Heydenrych, 2001, p. 43). Critical thematic analysis using Dahan and Seligsohn's assessment framework was selected, as shown in Table 1.

Gap Analysis

Gap analysis is an evaluation technique, common in managerial literature to identify deficiencies between current performance and the target performance. The elements in Dahan and Seligsohn's framework provide the performance indicators against which the learning design of this course is compared as shown in Figure 5. Five of the eight core elements met the *Exemplary* level, two were *Effective*, and one was *Developing*, as shown in Figure 1.

Figure 5. *Integration of action research and gap analysis methodologies*

Table 1

Comparison of the implementation against the core elements of CEL proposed by Dahan and Seligsohn, (2003)

Core element	Observation	Level
Integration of experience with learning goals and other course elements	Multiple stated learning goals address the experiential component of the course and are deeply embedded into the expectations for the experiential component: Understand the role of visualization and interactivity with respect to reporting and visual analysis. Critically evaluate existing visualizations. Design effective visualizations using a variety of tools. Evaluate current visualization products with respect to the principles learned in this course.	Exemplary
Opportunity for analysis of and/or reflection on experience	Some students completed an optional post-project survey about their experience with the course.	Developing
Substantial experiential or community-focused component in which all students are required to participate	The project was the major course component weighted at 60% of the course grade. Each team partnered with a local non-profit organization to analyze and discover insights in their data.	Exemplary
Appropriate student preparation for experiential activity (e.g. training, orientation, etc.)	Pre-flight presentation on CEL, professionalism, email etiquette, communication strategies, teamwork and accountability.	Exemplary
Appropriate partnership	Instructor worked with Office of Experiential Learning to identify partner(s) and worked directly with partner(s) to develop scheduling that reasonably meets the needs of students and partner(s).	Effective
Appropriate distribution of benefits	Benefits for community partners and students were considered as part of the placement process. The instructor reviewed the community organization's profile with the Office of Experiential Learning to ensure that	Developing

Core element	Observation	Level
	business needs could be met. The importance of student learning outcomes was communicated to the community partner. Students selected their partner organization based on personal or professional preference. Project outcomes met the Community partners' goals as expressed in their organizational profiles –primarily to answer specific questions about some aspect of their organization.	
Integration of the engaged learning component into student assessment	The project was the major course component weighted at 65% of the course grade.	Exemplary
Sharing of information or findings with community partners and/or others	Community partners attended a final presentation of the results of the data analyses and given a written report including recommendations for future analytics projects.	Exemplary

REFLECTION AND RECOMMENDATIONS

In this stage, the teacher-researcher critically and thoughtfully interprets the documented results using the questions, which originally guided the research. The action research process itself may also be critically reviewed to identify the study's limitations. Action research is intended to be iterative, which enables researchers to not only "suggest appropriate lines of action, but also to investigate the actual effects of such actions" (Blichfeldt & Andersen, 2006, p. 2). Two areas for improvement emerged from the analysis of the learning design: 1) the *design* of a CEL experience, based on Dahan and Seligsohn's (2013) matrix and 2) effective CEL *project management* to improve the learning experience. The research questions that guided the study are restated and accompanied by recommendations for the next iteration of the course.

Question 1: How does one design and develop an introduction to data visualization course, which addresses all of the defining characteristics of community-engaged learning?

Recommendation 1

Systematically design the course based on the elements identified in Dahan and Seligsohn's (2013) framework with the goal to achieve the Exemplary level of the matrix. Results show that the project's learning design achieved most of the core elements of CEL as evidenced in Table 1. However, modifications to the learning design for the next iteration could improve the experience for both students and community partners. The design of the next iteration will address missing or inadequate elements. For example, the inclusion of 1) structured reflection activities, 2) CEL learning objectives added to the project description, 3) more in-depth and interactive CEL training/orientation session. An inventory of the recommended modifications shown in Table 2 are designed to enhance the efficacy of the CEL experience for both students and community partners. These recommendations, although intended for situational application, are also transferable to the design of CEL experiences in general. Designing learning experiences that include the CEL elements identified by Dahan and Seligsohn (2013) extend the results of this study beyond the immediate situation to the broader CEL community.

Table 2

Recommended modifications to the learning design

Key element	Observation	Modification
Integration of experience with learning goals and other course elements	Multiple stated learning goals address the experiential component of the course and are deeply embedded into the expectations for the experiential component: Understand the role of visualization and interactivity with respect to reporting and visual analysis. Critically evaluate existing visualizations. Design effective visualizations using a variety of tools. Evaluate current visualization products with respect to the principles learned in this course.	Add learning goals specifically for CEL in addition to domain specific learning goals.
Opportunity for analysis of and/or reflection on experience	Students completed an optional post-project survey about their experience with the course.	Build more reflective activities throughout the duration of the project such as: At least one assignment requires students to reflect on experiential component of the course. Opportunities to reflect include in-class discussion, online discussion boards, written assignments, or creative expression.
Substantial experiential or community-focused component in which all students are required to participate	The project was the major course component weighted at 65% of the course grade. Each student was part of a team partnered with a local non-profit organization to analyze and discover insights in their data.	No changes for next iteration
Appropriate student preparation for experiential activity	Pre-flight presentation on CEL, professionalism, email etiquette, communication strategies, team work and accountability.	Provide an in-depth and interactive orientation to CEL as one of the course's preliminary learning activities.

Key element (e.g. training, orientation, etc.)	Observation	Modification
Appropriate partnership	Instructor worked with Office of Experiential Learning to identify partner(s) and worked directly with partner(s) to develop scheduling that reasonably meets the needs of students and partner(s).	No changes for next iteration
Appropriate distribution of benefits	Benefits for community partners and students were considered as part of the placement process. The instructor reviewed the community organization's profile with the Office of Experiential Learning to ensure that business needs could be met. The centrality of student learning outcomes to the project were communicated to the community partner. Students selected their partner organization based on personal or professional preference. Project outcomes achieved the Community partners' goals as expressed in their organizational profiles –primarily to answer specific questions about some aspect of their organization.	No changes for next iteration
Integration of the engaged learning component into student assessment	The project was the major course component weighted at 65% of the course grade.	Include structured critical reflection as part of course assessment.
Sharing of information or findings with community partners and/or others	Community partners attended a final presentation of the results of the data analyses and given a written report including recommendations for future analytics projects.	Broader dissemination of results is restricted to due non-disclosure agreements.

Question 2: What are the lessons learned from implementing a community-engaged introduction to the data visualization course?

Recommendation 2

Preparation emerged as a pervasive theme for project success. Prepare for the project by selecting a community partner several weeks before the start of the course. This will provide enough time to:

- Select suitable community partner
- Understand community partner's needs
- Obtain non-disclosure agreements if needed
- Complete ethics review if needed
- Confirm kick-off meeting and final presentation dates
- Provide CEL orientation session/s

Community Partner Selection. If possible, work with the Office of Experiential Learning –or a similar resource, in the selection process. Ensure that the community partner understands that students' evaluation is based on the project's success and they must commit to the project and fully participate as required. Request and sign non-disclosure agreements, if needed, prior to the kickoff meeting. Obtain approval from the Research Ethics Board to collect data from students and community partners.

CEL Orientation Session/s. Student preparation for experiential activity (e.g. training, orientation, etc.) was minimal. Preparation consisted of a 15-minute presentation by the Office of Experiential Learning (OEL) that focused on pragmatic issues such as communication strategies, email etiquette, teamwork, and professionalism. CEL is not a ubiquitous pedagogy in higher education and therefore its structure, features and purpose are unfamiliar to those students who have no prior experience with this pedagogical approach. A session to educate students about its capacity to contribute to professional development, community connections and sense of social responsibility may enhance motivation. Framing the project within the university's overall community engagement strategy provides a broader context and purpose for CEL beyond the course. An in-depth information session should be provided by the OEL to educate students about CEL.

Recommendation 3

Include structured critical reflection. One element common to the definitions referenced here and in Furco (1996) and Eyler, Giles, Schmeide, and the U.S. Corporation for National Service (1996) is structured student reflection. This was not included in the project's design, therefore the next iteration will include critical, reflective thinking activities (Dahan & Seligsohn, 2013; Jeffery Howard, 2001; Kleinhesselink et al., 2015; Yoder, 2006) to help students "understand the personal, societal, and academic significance of their experiences based on the premise that reflection helps learners derive meaning from their experiences" (Trudeau & Kruse, 2014, p. 14).

Recommendation 4

Managing communication expectations between teams and community partners is an important contributor to a successful CEL project. Community partners were advised that there would be a mandatory midpoint check-in via email and an optional on-site visit, but all other communication would be on an as-needed basis. Feedback from one partner organization expressed disappointment at the lack of communication throughout the project despite the advisement. It would be beneficial for teams to establish a communication protocol at the start of the project based on the individual needs and expectations of the community partner.

LIMITATIONS

Critics of educational action research cite limitations in the reliability and validity of findings. Veracity and accuracy may be confounded by methodological issues (Andreson & Herr, 2007; Gibbs et al., 2017; Mckay & Marshall, 2001; Newton & Burgess, 2008). This course was designed by the educator/researcher and as such, it is characterized by “the active and deliberate self-involvement of the researcher in the context of his/her investigation” (Mckay & Marshall, 2001, p. 47). Educational action research is inherently bounded by the immediate situation; using self-reported data, which is rarely verified by an objective third party. However, Anderson and Herr (1999) proposed several validity criteria that can mitigate the methodological concerns of action research. These criteria are: outcome, process, democratic, catalytic, and dialogic (p. 15). Table 3 shows each of the five types of validity and evidence indicating if the learning design met these criteria.

Table 3

Types of evidence to support methodological rigor of this study

Criteria	Description	Indicator
Outcome	The extent to which the outcomes of the research match the intended purposes of the research (Newton & Burgess, 2008). Furthermore, rigorous practitioner research leads to new questions as part of the spiral/cycle process.	The purpose of this study was to determine the degree to which the core elements of CEL have been successfully integrated into an introduction to data visualization course. Results indicate while some elements were achieved some parts of the learning design should be changed. New research questions guide the next iteration in the action research cycle.
Process	The efficacy of the research design to address the research problem.	Educational action research was chosen as a way to bridge the gap between practice and theory; a method for the researcher to gain an

Criteria	Description	Indicator
		in-depth understanding of particular phenomena in real-world setting (Blichfeldt & Andersen, 2006).
Democratic	The extent to which research is done in collaboration with all parties who have a stake in the problem under investigation.	The efficacy of the learning design was exclusively the object of inquiry by the educator-researcher in this first iteration.
Catalytic	"The degree to which the research process reorients, focuses, and energizes participants toward knowing reality in order to transform it" (Lather, 1986, p. 272). The practitioner researcher must be open to reorienting their view of reality as well as their view of their practitioner role.	Results of the inquiry lead to a re-conceptualizing of the role of students and community partners as direct contributors to the data gathered to address the research questions. The inclusion of their feedback in the form of critical reflection (students) and surveys would support triangulation of data and strengthen the validity of the interpretations of that data (Andreson & Herr, 2007; Winter, 2010).
Dialogic	The "goodness" monitored through a form of peer review. Research reports must pass through the process of peer review in order to be disseminated through academic journals.	A draft manuscript will be submitted to a peer-reviewed academic journal. Its acceptance and subsequent publication will serve as on form of evidence of dialogic validity.

Furthermore, educational action research is exploratory and intended to investigate a phenomenon primarily of interest to the teacher. McKernan (1988) observes, "the validity of the concepts, models and results it generates depends not so much on scientific tests of truth as on their utility in helping practitioners to act more effectively, skillfully and intelligently" (p. 173). As such, concerns such as generalizability, objectivity and, replicability, while a consideration, are less problematic relative to other methodologies. Nevertheless, this study incorporated validity criteria to enhance methodological rigor.

SUMMARY

"Conceiving curriculum as a research proposal, or educational plan, that needs to be field-tested, the task of those who implement it is to determine its worth and utility" (McKernan, 2007, p. xiv).

The purpose of this study was to critically evaluate the design of an introduction to data visualization course with community-engaged learning as its core pedagogy for the purpose of continuous improvement and to offer those insights as recommendations to the

community of educators working in the CEL space. There were two lines of inquiry: first, the extent to which the design met the core elements of CEL (situational) and second, how to design and implement a course with CEL as the central pedagogy (generalizable). Results show that many of the core elements of CEL were achieved at the *exemplary* level based on the assessment matrix developed by Dahan and Seligsohn (2013) while the remaining were *effective*, and one –*reflection*, was developing. Several recommendations emerged –both situational and generalizable, which could improve the outcomes of courses that use CEL as a core pedagogy. These include:

- Systematically design the course based on the elements identified by Dahan and Seligsohn (2013) and shown in Appendix A.
- Add learning goals specifically for community-engaged learning in addition to domain specific learning goals.
- Build more reflective activities into the project as part of course assessment.
- Provide an in-depth and interactive orientation to CEL as one of the course’s preliminary learning activities.

Educational action research allows the teacher-as-researcher to field-test their pedagogical designs and develop strategies to improve some aspect of the learning experience. Future work will involve implementing the recommendations into the next design and implementation of the course.

CONTRIBUTION OF THIS RESEARCH TO THE CEL SPACE

Educational action research bridges the gap between theory and practice, where the learning design is the proposed hypothesis and the classroom is where it is field-tested by the teacher as researcher (McKernan, 2007; Stenhouse, 1975). Through this lens, we see inquiry as deepening one’s understanding of one’s own practice. Nevertheless, the results of inquiry into one’s own practice may also bear fruit for others. This study provides the following insights to the community of CEL practitioners:

1. The importance of preparation when designing and implementing a CEL experience and recommendations for how to avoid issues that result from a lack of preparation.
2. Use of a design and assessment framework like Dahan and Seligsohn’s (2013) to guide the development of a CEL experience that includes the core elements of this pedagogy.
3. Include learning goals specifically for CEL in addition to course learning outcomes.
4. Build reflective activities into the project as part of course assessment.
5. Provide an in-depth and interactive orientation to CEL as one of the course’s preliminary learning activities.

We conclude this paper by affirming Groundwater-Smith & Mockler’s (2016) proposition that it “is possible to engage simultaneously in research, in pedagogy and in community service if the research is itself about forms of teaching and learning in tertiary settings that more widely engage the community” (p. 161). Perhaps the most useful contribution of this applied research is a path forward to guide other reflective practitioners looking to combine teaching with research in service to the broader community through the pedagogy of CEL and action research.

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