Abstract

Course-based undergraduate research experiences (CURE) can improve student skills, views toward research, and identity as a scientist. Many barriers exist for implementing program-wide CUREs, including assessment of these programs. This paper addresses the direct assessment of a required senior CURE in one high-volume (400+ students per year) academic program. Research groups (45-50 groups per semester, four-six students each) design, implement, and analyze data in a research study culminating in a poster symposium and paper write-up. This paper discusses the iterative process of developing the assessment procedures tied to program-level student learning outcomes, including suggestions for implementation at other institutions. Programs that wish to create an assessment of CURE should include the collaboration of key stakeholders in developing processes and tools to ensure findings guide course content and teaching strategies.

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Developing an Assessment of a Course-Based Undergraduate Research Experience (CURE)

Introduction

Student research, particularly at the undergraduate level, is considered a High Impact Practice (HIP) (National Survey of Student Engagement, 2007; Kuh & Association of American Colleges & Universities [AAC&U], 2008). According to the Association of American Colleges and Universities (AAC&U), the goal of undergraduate research is to "involve students with actively contested questions, empirical observation, cutting-edge technologies, and the sense of excitement that comes from working to answer important questions" (Kuh & AAC&U, 2008, para 7). It can broadly be defined as scholarship, creative activities, or scientific inquiry that leads to the production of original work (Kinkead, 2003). The benefits of participating in research as an undergraduate student are numerous and include increased interest in pursuing graduate education, viewing themselves as scientists, improved writing skills, ethical conduct, understanding others' research, inquiry and analysis, independence, communication, and teamwork (Hunter et al., 2007; Lopatto, 2010; Russell et al., 2007). In particular, faculty-mentored research experiences have the potential to increase students' identities as scientists in their field (Auchincloss et al., 2014). Typical mentoring activities involve honors projects and independent studies with faculty mentoring one or a few students. These types of experiences require students to apply, and oftentimes high-performing students or those with a greater understanding of the university system, self-select into these opportunities. This can exacerbate inequities in access to mentored research (Bangera & Brownell, 2014).

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Whereas HIPs have the potential to positively impact all students in terms of learning outcomes, retention, and graduation, research has indicated they are particularly impactful for historically underrepresented students (see for example Collins et al., 2017). Unfortunately, studies show these groups are less likely to participate in HIPs, such as student research, for a variety of reasons (Kinzie, 2012). According to the 2019 annual results of the National Survey of Student Engagement, research with faculty is among the least common HIPs among most Carnegie Classifications. Additionally, inclusivity in such activities differs by student characteristics, including race/ethnicity and non-traditional, first-generation, or transfer student status. Barriers to engaging in traditional individual faculty-mentored research experiences for underrepresented students include lack of awareness of research opportunities and their benefits, perceived barriers of interaction with faculty, and personal and financial barriers (see Bangera & Brownell, 2014 for a review). However, given that the positive outcomes of engaging in research are numerous, it is important to consider how to remove barriers and increase access to research opportunities. One example is course-based undergraduate research experiences (CURE) which provide the opportunity for many students to access mentored research with faculty while gaining course credit, rather than needing to apply or spend time outside of class (Auchincloss et al., 2014).

Given that the positive outcomes of engaging in research are numerous, it is important to consider how to remove barriers and increase access to research opportunities.

Given research demonstrating the benefits of CUREs and increased accessibility to students, it is important to consider how they may be assessed at the course or program level (Auchincloss et al., 2014). Most assessments of undergraduate research rely on self-report data that measure advances in skills, such as collaboration, written and oral presentations, and conducting research studies (Corwin et al., 2015; Weston & Laursen, 2015), as well as others related to their attitudes toward science (Hanauer et al., 2016). In a review of over 60 articles published on the impact of undergraduate research, fewer than 10% had direct measures of student learning despite calls for better assessments (Linn et al., 2015). Shortlidge and Brownell (2016) suggest that direct assessments of CURE should align with course learning outcomes and could potentially use existing 'off-the-shelf' assessments of skills, such as data analysis, experimental design, scientific reasoning, and scientific literacy.

Given the need to better assess student research experiences, and the benefits of using CURE to reduce barriers to access, this case study presents the recurring, iterative systematic assessment of student research outcomes in a faculty-mentored and course-based undergraduate research experience at a large public university located in the central Atlantic region of the United States. This paper will first describe the course, followed by the assessment process at the institution and the specific development of the assessment process for the CURE. The paper ends with a discussion of challenges and suggestions for implementation.

Description of CURE

First, it is important to understand the context in which the CURE described in this case study exists. The institution is a large public 4-year master's-granting university located in the central Atlantic. The vision of the institution-James Madison University-is to be "the national model of the engaged university," including engaged learning, civic engagement, and community engagement. Engaged learning is defined as "developing deep, purposeful and reflective learning, through classroom, campus, and community experiences in the pursuit, creation, application and dissemination of knowledge" (James Madison University, 2021).

The department in which the CURE is required, the Department of Health Sciences, offers a Bachelor of Science degree that prepares students to pursue entry-level, non-clinical health careers, or to apply to graduate programs in a variety of health fields, including but not limited to, athletic training, dentistry, medicine, occupational therapy, physical therapy, physician assistant studies, and public health. The anticipated growth in these career fields, and the flexibility of the curriculum within the degree, helped to make the program the largest producer of graduates at the university. There are approximately 1,600 students majoring in this program with 450 students graduating each year (of which 20% are minority race/ethnicity identified). Given the size and nature of the program, in 2016, the faculty re-envisioned the curriculum and subsequently aligned the assessment of the program objectives when the curriculum was implemented in 2018.

Through collaborative processes guided by the departmental curriculum and instruction and assessment committees, with the support of the department head and the university assessment center, the faculty affirmed that the inclusion of HIPs, particularly undergraduate research, was critical to achieving student learning outcomes of the program and supporting the vision of the university. Inclusion of HIPs was added as a source of evidence for excellence in teaching within the annual evaluation and tenure and promotion guidelines of the department to acknowledge the contributions of faculty teaching the course. During program modification, the faculty generated 10 program objectives and mapped the curriculum to these program objectives. Two of the program objectives related to research and communication were mapped to a senior-level research methods course required of all majors in the program (see description below). As noted in the introduction, close mentoring from a faculty member is a critical component of a CURE. Therefore, the prioritization of the HIP within the curriculum required that the class size be limited relative to most other courses offered within the department to ensure high-quality mentoring that meets the diverse learning needs of students. Teaching two sections of the research methods course would comprise half of a faculty member's teaching load per semester.

The course serves more than 400 students per year in faculty-guided Institutional Research Board (IRB)-approved research projects. Early iterations of this project were described previously in Peachey & Baller (2015). Enrollment for the course is typically capped at 25 students per section and student research teams are comprised of four-six students (see Table 1). Each student completes human subjects' ethics training (CITI training). Teams then select a topic, develop research questions and instrumentation for data collection, submit a proposal to the IRB for approval, collect and analyze data, present findings at a bi-annual research symposium, and prepare a final written report of the research project. The research poster symposium is a shared experience across all sections of the course where students can see the breadth and scope of peer accomplishments, as well as present their own group work in a quasi-professional setting. Departmental faculty and other university administrators regularly attend the symposium to discuss the research projects with student groups. In some semesters, judges provided feedback to top-performing teams, leading to award recognition for students. During the COVID-19 pandemic, adjustments were made to the course and project, including exclusion of the poster symposium. The symposium is scheduled to resume fall of 2021.

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Table 2
Student enrollment and faculty teaching committed to undergraduate research course.

Semester	Students Enrolled in HTH 408	Course Sections (n)	Faculty	FTE	Average Class Size	Student Projects (n)
Fall 2017	186	8	4	1	23.3	38
Spring 2018	253	10	5	1.25	25.3	50
Fall 2018	181	8	4	1	22.6	39
Spring 2019	258	11	5	1.25	23.5	55
Fall 2019	203	10	5	1.25	20.3	44
Spring 2020	254	11	5	1.25	23.1	n/a*
Fall 2020	203	10	5	1.25	20.3	52
Spring 2021	243	10	4	1	24.3	43
TOTAL	1,781	78	-	-	-	321
Average	223	10	5	1	22.8	46

**Student projects were not assessed the first semester of the COVID-19 pandemic*
FTE = Full-Time Equivalent for tenure line faculty teaching a 4/4 course load

Because each student in the program completes the research project as a member of a research team, it can be used to assess two of the program-level objectives. The poster presentation serves as a health-specific communication tool to convey the methods, analysis, and results of public health research questions.

Assessment of CURE

A four-person committee, three of whom do not teach the research methods course, in consultation with the department head and the university assessment center, conducts the assessment activities for the program. All committee members are tenure-track faculty who regularly conduct and publish research requiring statistical analysis and interpretation. The assessment committee works closely with university assessment center staff in developing, analyzing, and interpreting assessment data. The assessment committee chair also attends extensive university-required assessment and measurement training. The committee is charged with conducting the required annual assessment of the program's student-centered learning outcomes (SLOs). Assessment activities across the institution contain a variety of indirect and direct measures of student learning. For example, in the Department of Health Sciences, the majority of SLOs in the department are assessed with a pre- and post-test of majors in their first major course and last semester within the program, respectively. Given that all students complete the research methods course, it provides the opportunity to assess two program-level, higher-order SLOs beyond the level of knowledge recognition and comprehension as indicated by Bloom's taxonomy in cognitive domain of educational goals (Bloom et al., 1956; Huitt, 2011). As stated above, these SLOs broadly cover a variety of topics related to the research methods course:

Given that all students complete the research methods course, it provides the opportunity to assess two program-level, higher-order SLOs beyond the level of knowledge recognition and comprehension.

As a result of participating in the Department of Health Sciences curriculum, graduating students will be able to:

> **SLO1.** Utilize the basic concepts, methods, and tools of public health science data collection, analysis (statistics), and evaluation,
>
> **SLO2.** Utilize basic concepts of public health-specific communication, including technical and professional writing, and the use of mass media and electronic technology.

These two SLOs are stated with clarity and specificity by including rich descriptions of the content and skills that are required in the CURE. Clear and specific SLOs can aid the design of instructional courses, clarifying what students should comprehend and teachers should evaluate (Bloom et al., 1956). In addition, SLOs can promote the development of assessment tools by providing guidelines about the student population to be assessed, the type of assessment to be used, and the type of inferences to be made from results (Kuh & Ewell, 2010). For example, the two SLOs mapped to the CURE indicate that a performance assessment that evaluates students' skills and behaviors, as evidenced through certain products or performances (e.g., research posters), is the most appropriate approach. Therefore, a rubric that articulates the criteria to address the expectations of the performance tasks, as well as the specification of different levels of success for each criterion, is often selected as the instrument to evaluate students' mastery levels of the desired knowledge and skills (Andrade, 2000; Arter & Chappuis, 2007; Moskal, 2002; Stiggins, 2001). In assessment, the rubric is also considered a direct measure, since students must explicitly demonstrate their ability to conduct important research-related processes and communicate practical findings to a lay audience (Allen, 2003, p.88; Suskie, 2018). The poster evaluation rubric was developed by the committee in conjunction with the university assessment center using the poster instructions and rubrics used for grading by the instructors of this course (see Figure 1, for example). The next section describes the iterative process of rubric development.

Development of Poster Assessment

Based on initial discussions, the committee developed a rubric that assessed 15 criteria covering research elements (e.g., quality of research questions, appropriate statistical analysis) and writing and style elements (e.g., grammar, writing quality, and layout) of the

Figure 1
Example of faculty-provided course poster rubric used in poster assessment rubric development.

	Excellent	Good	Satisfactory	Unsatisfactory
Information Presented /8	All required information is included. No unneeded information is included. 8	Most of the required information is included. Minor edits (included more or remove unneeded) only. 6.5	Much of the required information is included but could need more than minor edits (include more or removed unneeded). 5.5	Missing a lot of required information or includes a lot of unneeded information. 0
Layout/ Presentation /7	Poster is visually appealing, organized well, made good use of graphics/tables/figures. Font, headings, and spacing is consistent throughout. 7	Minor errors in poster formatting. Could use some minor editing or re-formatting of headings, fonts, spacing, and graphics/tables/figures. 5.5	Major errors in poster formatting. Could use some major editing or re-formatting of headings, fonts, spacing, and graphics/tables/figures. 5	Poster is disorganized and inconsistently formatted. 0
Writing Style /5	Easy to read. Used 3rd person and past tense. Minimal spelling/grammatical errors. 5	Minor errors with flow, spelling, grammar or writing style. Used mostly 3rd person and past tense. Should use shorter sentences in some places. 4	Major errors with flow, spelling, grammar, or writing style. Used incorrect tense or 1st person. Needed much shorter sentences. 2	Poster was very difficult to understand. Use of incorrect tense throughout. 0
TOTAL				/20

poster (see Figure 2). Initially, rubric elements were scored on a three-point scale from 'Poor,' which earned zero points, to 'Excellent,' which earned two points, for a maximum score of 30 points. This rubric was piloted using 20 posters from spring 2018. All posters were independently scored by assessment committee members involved in the development of the rubric and who did not teach the research methods course. Initial inter-rater reliability analysis showed inconsistencies in how the three raters assessed each poster.

Figure 2
First iteration poster assessment rubric.

Rater: _____

Poster IRB # _____	**Excellent (2)**	**Good (1)**	**Poor (0)**
Title Represented major purpose of study including variables in RQ			
Purpose of the Study Provided a clear and concise rationale for the study based on previous literature and/or theory			
RQ/Hypotheses RQ are stated and measurable			
Procedures Described sampling and data collection procedures			
Instruments/Measures Identified instruments that measure the variables			
Analysis Selected appropriate information for each analysis			
Results Presented appropriate information for each analysis			
Discussion: Limitations Identified obvious limitations regarding procedures			
Layout: Graphics Used appropriate graphs/tables; well organized			
Layout: Text Used appropriate amount of text			
Layout: Organization Well organized			
Writing Quality: Formality Used formal, concise language			
Writing Quality: Grammar/Spelling/Tense Was free of any grammar or spelling errors			
Writing Quality: Consistency Used a consistent style			
Overall Quality			
Total			/30
Notes:			

As a result of this analysis, the rubric elements were refined to address issues identified in the rating *process* (see Figure 3). The committee identified that ratings were potentially subjective. What one rated as 'excellent' may have been viewed as 'good' by another rater. Therefore, ratings were shifted to reflect the perceived understanding of the process of research, rather than the subjective rating of the research project itself. Elements were rated as 'Absent' if they did not meet the description of the element or if important information was missing, 'Not Clear' if the poster met the description of the element but required improvement, and 'Present' if the poster met the description of the element. For example, a poster title that represented the overall purpose of the study, including major independent and dependent variables, would be scored as 'Present.' A poster that lacked a title would be scored as 'Absent.'

Figure 3
Second iteration of the poster assessment rubric.

Rater: _____

Poster IRB# _____	Present (2)	Not Clear (1)	Absent (0)
Title Represented major purpose of study including variables in RQ			
Purpose of the Study Provided a clear and concise rationale for the study based on previous literature and/or theory			
RQ/Hypotheses RQs are stated and measureable			
Procedures Described sampling and data collection procedures			
Instruments/Measures Identified instruments that measure the variables			
Analysis Selected appropriate information for each analysis			
Results Presented appropriate information for each analysis			
Discussion Results tied back to literature and identified obvious limitations regarding procedures			
	Excellent (2)	**Good (1)**	**Poor (0)**
Layout: Graphics, Text, Organization Used appropriate graphs, tables, appropriate amount of text. Well organized			
Writing Quality: Formality, Grammar/Spelling/Tense, Consistency Used formal, concise language. Was free of any grammar or spelling errors, used a consistent style.			
Total			**/20**
Overall Quality:			
Notes:			

Additionally, presentation elements related to layout and writing initially carried equal weight as research elements. Therefore, a poster that was well presented, but had major methodological issues, could obtain the same score as a well-done research study with sub-standard layout and writing. The six elements for layout and writing were combined into two criteria and continued to be rated on the 'Poor' to 'Excellent' scale, reflecting the subjective nature of those elements. While the committee felt it was important to include an overall rating of the poster, they recognized it should not be scored as other elements. Rather a rating of the overall quality without points should provide a way to check if the subjective perception of the quality of a poster aligned with the score it received.

Each time the poster assessment rubric is revised, it is shared with the instructors of the research methods courses.

Despite the change to fewer evaluative ratings, issues with inter-rater reliability persisted when the next set of posters was rated during the fall 2018 semester. The committee identified the need to provide in-depth descriptions of poster criteria and each of the ratings with examples that raters may refer to when assessing each poster. The rubric currently utilized to assess the posters (see Figure 4) includes 10 elements (i.e., title, purpose of the study, research questions/hypotheses, procedures, instruments/measures, analysis, results, discussion, layout, and writing quality). Posters are scored on a scale from 'Present' to 'Absent' for all research elements and from 'Good' to 'Poor' for layout and writing elements with two points possible for each element. Each time the poster assessment rubric is revised, it is shared with the instructors of the research methods courses.

Figure 4
Current iteration of poster assessment rubric.

Poster Letter# _____	Present (2)	Not Clear (1)	Absent (0)
Title Represented major purpose of study including variables in RQ	Contains all major variables, can determine general purpose of the study from the title.	Contains some but not all major variables OR hard to understand purpose of the study from the title/doesn't match major variables used in the study.	Title is absent OR not connected to the major purpose of the study.
Purpose of the Study Provided a clear and concise rationale for the study based on previous literature and/or theory	Presents a concise review of previous literature that is connected to the purpose and RQ for the study.	Presents a summary of previous literature; the purpose of the study is not completely connected to the previous literature in terms of importance and need OR summary of previous literature is not complete in terms of making a case for the study.	There is no connection between the study background and purpose of the study (i.e., variables in background do not match variables in the study).
RQ/Hypotheses RQ are stated and measurable	Clear which variables are being examined and the direction of predicted association (if applicable).	Direction of predicted association not clear (if applicable) OR variables are unclear OR wording is unclear.	No measurable RQ OR hypotheses stand (i.e., RQ implies bivariate relationship but only one variable is included).
Procedures Described sampling and data collection procedures	Describes major characteristics of sample (e.g., JMU students, 18+), method of data collection, and sampling strategy.	Missing one or two requirements from "present".	Missing all three requirements from "present".
Instruments/Measures Identified instruments that measure the variables	Described how they measured all the major variables in the study (e.g., instrument names, cut-offs).	Not clear how each variable was measured OR names of measures not clearly identified OR identified for some but not all variables.	No instruments identified OR measurement not described.
Analysis Selected appropriate analysis for RQ	Analysis is clearly identified either in methods, or in the results by proper reporting procedures AND is correct based on their data. Variables are operationalized clearly enough so proper analysis can be determined.	Analysis is mentioned, but it is not clear if it is correct because variable(s) operationalization is unclear.	No statistics are mentioned OR they are incorrect given the operationalization of the data.
Results Presented appropriate information for each analysis	Presented ALL necessary information including test statistics, degrees of freedom, and p value. Results answer RQ.	Some of the necessary information was presented, but not all (e.g., report F statistic without degrees of freedom). Some results answer RQ but not all are presented.	Results not presented OR do not answer RQ.
Discussion Results tied back to literature and identified obvious limitations regarding procedures	Discusses most salient findings based on results; relate findings back to previous literature; includes most salient limitations.	Missing one or two requirements from "present".	Missing all three requirements from "present".
	Good (2)	**Fair (1)**	**Poor (0)**
Layout: Graphs, Text, Organization Used appropriate graphs/tables, appropriate amount of text, well organized			
Writing Quality: Formality, Grammar/Spelling/Tense, Consistency Used formal, concise language, was free of any grammar or spelling errors, used a consistent style			
Total:			/20
Notes:			

Poster Assessment Process

Each semester, a committee member (who does not take part in rating the posters) uses a list of research methods posters identified by IRB numbers and instructors to randomly select 10 posters for assessment using a random number generator. The number of posters selected is proportional to the number of sections of research methods each instructor teaches. For example, if there are 10 sections of the course in each semester, and an instructor teaches two of them, then two posters will be randomly drawn from all the posters from their sections. This ensures that all instructors are proportionally represented in the posters that the committee assesses. Instructors are asked to download posters from their classes into a folder on a shared network drive with student and instructor names removed. Only this committee member knows from which instructor the posters were drawn.

Each semester, a committee member (who does not take part in rating the posters) uses a list of research methods posters identified by IRB numbers and instructors to randomly select 10 posters for assessment.

The assessment committee members independently evaluate each poster using the rubric and enter their scores into online survey software. The results are downloaded and the raters then meet to adjudicate their scores. Inter-rater reliability has improved over time as the rubric has improved. Average scores are calculated for the posters and each of the elements. The program sets minimum scores for successful average poster ratings (14/20 points) which reflects a satisfactory grade. Thus far, poster ratings have exceeded the cut-off, with an average score of 16.3/20 over four semesters of poster assessment (prior to the COVID-19 pandemic). This information is provided in the department's program assessment report, as required by the institution, and is reported to faculty who teach the research methods course so that they may adjust course content and teaching practices as necessary.

Considerations for CURE Implementation and Assessment

Undergraduate academic programs are different in their vision, mission, and student learning outcomes. Therefore, there can be no one-size-fits-all strategy for implementing a program-wide CURE. However, it is useful to identify the barriers and facilitators for the successful administration of these experiences so that programs may tailor practices to meet

their needs. In addition, given that there are limited examples of direct assessment of CURE, it may be useful to identify how these considerations may impact the assessment process.

As is the case in many universities, the Institutional Review Board (IRB) requires that all research projects with human or animal subjects be reviewed for a preliminary determination of review status (i.e., exempt, expedited, or full board review) (United States Department of Health and Human Services, 2021). Completing approximately 90 undergraduate research projects involving over 400 students annually requires pronounced efficiency of implementation. While nearly all projects typically meet the exempted or expedited review levels, the proposal is lengthy, requires specificity and advanced knowledge of terminology, can only be completed by one student in the group, and may impact the IRB turnaround time. Given the one-semester timeline constraint, the number of projects submitted simultaneously to the IRB as a result of a CURE may result in delayed feedback for some student groups given institutional capacity. To reduce the need for extensive edits, it is suggested that each faculty member assist in the revision process. Not surprisingly, inconsistency across IRB reviewers' comments and suggestions occurred within and across semesters, which created additional challenges in students receiving timely approval. Some student groups failed to grasp the importance of timely and thorough revisions, which delayed approval and limited the time available for data collection and analysis. As a result, it is suggested to have an open line of communication with one's IRB to facilitate this process, especially if the volume of applications will increase drastically. Furthermore, it is important to become familiar with the IRB review process at one's institution and determine whether a course-wide application is permitted and feasible.

The CURE is tied to a program level assessment; therefore, students must acquire certain skills from pre-requisite courses to be able to plan, propose, and conduct a research project within one semester.

The CURE is tied to a program level assessment; therefore, students must acquire certain skills from pre-requisite courses to be able to plan, propose, and conduct a research project within one semester. This is an important consideration in developing an assessment of a CURE at the program level. Adding or modifying content and skills within pre-requisite courses may require buy-in from all program faculty (Rawle et al., 2017). Depending on the class size of pre-requisite courses (e.g., ~ 45 students per section), fostering the development of writing skills may be a challenge. While the research methods course is offered as a three-credit course, it would more ideally be offered as a two-semester course sequence or for four credits with a lab component. If the course is not adequately resourced, faculty who teach the course will incur unofficial loads of work during office hours or additional one-on-one student/group meetings. It is important to ensure the pre-requisite skills are included in the early curriculum and to appropriately resource the CURE course to ensure high-quality mentoring from faculty. This helps to ensure the assessment of the CURE maps to the program curriculum and not just to the one course.

As a major without a secondary admissions process, gating option, or progression standards, there are significant differences in preparation, interest, and motivation to conduct research among students in the program. This may pose challenges in using the CURE as a program-level assessment if students do not have buy-in to the major and the need to understand research in this particular discipline. Additionally, students have a wide array of health topics that interest them, some of which are less adaptable to the one-semester timeline and available methodologies. As team-based projects, the differences, particularly in motivation, have resulted in tension between some students within groups that have necessitated intervention by the faculty member (Wallace & Walker, 2017). The team formation process is essential to the success and effectiveness of the team-based learning experience (Connerley & Mael, 2001) and offers the potential to prepare students to collaborate in diverse teams in their future careers (Lang et al., 2017). The students in the presented CURE are not assigned specific roles within the group. All work is completed cooperatively (with the exception of required individual research ethics training) and thus students must sometimes use conflict resolution skills such as communication and compromise. Naturally, some students within groups informally step-up into a leadership role by reminding others of due dates, reviewing all work for completeness and accuracy, or taking responsibility for turning work in on time.

There are several ways to address problematic team dynamics. For instance, the faculty member may have students complete a self-assessment regarding their individual strengths, weaknesses, and personality to assist in identifying partners who may work well together (Parmelee & Michaelsen, 2010; Steger et al., 2011). Randomly assigning students to teams (rather than self-assignment) has been found to positively impact group dynamics, attitudes toward the overall experience, and performance outcomes (Chapman et al., 2006; Parmelee & Michaelsen, 2010). An alternative approach is student-selected teams with significant instructor guidance in identifying necessary skills needed for an assignment and suggesting those students who may have the right fit of personality and talent (Steger et al., 2011). Such team creation can result in diversity of gender, age, function, culture, and ethnicity (Stahl et al., 2010; Troster et al., 2014; Watson et al., 2002).

Finally, it is important for instructors to recognize that sometimes not all students within a group will participate at the same level. For example, one group member may not complete their required work leaving it to others to complete or correct so that the group is not penalized during grading. As such, instructors may want to consider employing rules about appropriate group engagement. For instance, some instructors require that students submit an author contributions summary which professors use to determine which students did not contribute adequately and should be penalized.

Covid-19 Considerations

Two primary challenges to offering inclusive, rigorous HIP opportunities are both the resources to support writing-intensive courses as well as the student perception of the difficulty of such courses.

Several changes were made to the research methods course project in response to the barriers imposed by the COVID-19 pandemic. Because of university policies limiting in-person meetings, most research courses were administered with online instruction for the 2020-2021 academic year. IRB limited in-person human subjects data collection, necessitating that data be virtually collected. Rather than allow students to develop their own surveys and independently collect data (which was prohibited by IRB), faculty instructors modified the project by developing a common survey covering many health-related topics that all students in the research methods course, as well as students in other courses, completed for extra credit. Students then had access to this anonymous data on which to base the development of their topics, research questions, and analyses. All other research procedures remained the same (literature review, methodology write-up, analysis, interpretation). Though the symposium was canceled, students were still required to create a poster for their projects, allowing for the continued assessment of the relevant program objectives. This may be an option for programs to consider where traditional data collection may not be feasible.

Given the success of the most recent assessment within this program, two primary procedures will be maintained for future iterations of the assessment. First, student posters will be required to contain all necessary sections of the project (i.e., introduction/literature review, methodology, results, and discussion/conclusion). For instance, during previous poster assessments, some faculty members required students to include references while other faculty members did not impose this requirement. Consistency is key in ensuring an effective assessment of student learning outcomes (Gosselin & Golick, 2020; Summers, 2005). The second established procedure involves the use of a standard rubric in the evaluation of randomly assigned student posters from various sections of the research methods course, which again, is vital to ensuring consistency in poster assessment (Gosselin & Golick, 2020; Kishbaugh et al., 2012).

Two primary challenges to offering inclusive, rigorous HIP opportunities are both the resources to support writing-intensive courses as well as the student perception of the difficulty of such courses. Students frequently do not appreciate their experiences until they progress into their careers or graduate school. In addition, the potential negative impact such a course may have on student evaluations of teaching (SET) is yet another challenge (Vevere & Kozlinskis, 2011), particularly when college students typically do not enjoy working in teams with other students, largely due to collective grading and the perceptions of unequal distribution of effort (LaBeouf et al., 2016; Shimazoe & Aldrich, 2010). The intensity of

teaching effort, delayed student appreciation, and the potential impact on SETs warrant a further discussion about the benefits and challenges of offering an applied research course.

In terms of student appreciation of the course, data collected to support the program review (n=91) suggests a third of responding alumni (34%) listed the research course experience as one of the most meaningful educational experiences of their time in college. Asked specifically about the utility of the course via an online survey, approximately 50% of responding alumni indicated they had actively used skills developed in the course after graduation, 42% indicated improved information literacy (including understanding literature and the research process), 34% reported skill improvements they felt directly contributed to their success, and 29% indicated that the team skills helped them in their career and graduate school pursuits. The following are relevant reflective quotes from students pertaining to the course:

Course-based undergraduate research experiences provide numerous benefits to students including research, writing, and presentation skills.

> "*As a graduate student, I am beyond grateful for the experience I had in [research methods]. I feel far ahead of my classmates in my cohort who never had an experience of carrying out their own research project*."

> "*Research methods pushed me to look for a career outside of the typical health provider role that I was originally working towards, and I am very grateful for this exposure. The research project was extremely helpful and gave me a head start on my training once I was hired in clinical research*!"

To facilitate the potential immediate appreciation and application of the course, instructors frequently remind students of the utility of research skills in their future careers and health literacy. In addition, the instructors also developed a handout to guide students in listing research skills on their resumés to facilitate job-seeking opportunities. The handout contains language translating the project into skills that can be listed on a resumé, typical keywords to search for jobs that require research skills, and suggested common graduate school and job interview questions where the research project might be a suitable example.

Conclusion

Course-based undergraduate research experiences provide numerous benefits to students including research, writing, and presentation skills. In addition, CURE can positively impact students' view of the sciences and, therefore, increase interest in pursuing graduate education, especially among underrepresented student groups. However, there are many barriers to implementing program-wide CURE experiences, especially among high-volume departments. Further, many programs may have difficulty in developing direct assessments of learning for such courses. This paper discussed how one program implemented and assessed such an experience by focusing on assessment of the demonstration of specific research-related skills, rather than the subjective evaluation of the quality of the overall research project. Programs that wish to develop an assessment of CURE must understand that developing an assessment process and tools is an iterative process, which should include the collaboration of course instructors, department chairs, and assessment and evaluation experts, if available. A successful assessment of CURE may guide further development of course content and teaching strategies.

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