Preparing Scholarly Practitioners to Use Improvement Science: A Systematic, Iterative, and Reflective Approach to Teaching Applied Quantitative Research Methods

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ABSTRACT

While doctoral leadership programs have widely adopted Improvement Science (IS) as a signature pedagogy, few studies have examined how to best equip doctoral students with the knowledge and research skills they need to utilize IS in practice. More specifically, research is needed to determine the most effective and meaningful pedagogy for preparing doctoral students to understand, analyze, and apply statistical theory and quantitative research designs in coursework and as part of the IS Dissertation in Practice. This essay focuses on the systematic, iterative, and reflective approach of one faculty member to develop and refine a Doctor of Education program's primary applied quantitative methods course to help students across three cohorts develop the theoretical and practical knowledge and skills they need to lead change.

KEYWORDS

doctor of education, improvement science, research methods, quantitative methods

INTRODUCTION

Doctoral leadership programs designed to prepare scholarly practitioners have widely adopted Improvement Science (IS) as a signature pedagogy (Hinnant-Crawford, 2020; Perry et al., 2020); however, few studies have examined how to best equip doctoral students with the knowledge and research skills they need to utilize IS in practice (Firestone et al., 2019). More specifically, research is needed to determine the most effective and meaningful pedagogy for preparing doctoral students to understand, analyze, and apply statistical theory and quantitative research designs in coursework and as part of the IS Dissertation in Practice (DiP). Faculty in one Doctor of Education (EdD) program have utilized an IS approach to develop and refine research methods coursework and provide DiP advising support with the academic, professional, and personal learning needs of scholarly practitioners in mind. This essay focuses on the systematic, iterative, and reflective approach of one faculty member to develop and refine the program's primary applied quantitative methods course to help students across three cohorts develop the theoretical and practical knowledge and skills they need to lead change.

Program Background

This EdD is an applied professional doctorate designed for leaders working full-time in educational settings. While some students work in higher education or for other education agencies, most are certified PreK-12 practitioners with an Education Specialist (EdS) degree (or equivalent) working in leadership roles in high-needs schools and districts across the state and region. The

program seeks to develop these leaders as scholarly practitioners (Perry, 2016) with a strong background in leadership, ethics, research, and IS. Coursework and field-embedded experiences are intended to prepare students to utilize IS as part of the DiP such that they can identify complex problems of practice, develop and implement innovative change, and measure the impact, most often in their work settings (Bryk et al., 2015; Hinnant-Crawford, 2020; Perry et al., 2020). The program is focused on helping leaders address problems of practice related to systemic educational inequalities, particularly those impacting historically underserved students and communities.

The EdD program is a collaborative effort supported by partnerships with three regional public institutions geographically located across the state. Through this partnership, faculty have worked collaboratively to align their EdS degree programs such that graduates can be prepared with the requisite knowledge and skills they would need for advanced doctoral studies. In this way, the EdD offers graduate students in historically underserved areas of the state a pathway to earning the doctorate. Since becoming an institutional member of the Carnegie Project on the Education Doctorate (CPED), educational leadership faculty across the partnership have utilized the CPED (2022) Framework© to engage in continuous program improvement efforts.

Faculty have been particularly focused on the Design-Concept of Inquiry as Practice (CPED, 2022) in program improvement efforts. Defined as "the process of posing significant questions that focus on complex problems of practice," Inquiry as Practice requires students to develop certain skills, namely "the ability to use data to understand the effects of innovation…[including] the ability to gather, organize,

judge, aggregate, and analyze situations, literature, and data with a critical lens" (CPED, 2022, para. 8). While faculty have been working to embed IS across the courses in the program, there are currently two research methods courses in which students primarily develop the quantitative and qualitative analytic skills they will need to use data to understand the impact of their DiP interventions. Thus, focused attention has been given to research methods courses as part of collaborative efforts to align curriculum across degree programs among partner institutions.

Research methods courses in the college of education at this institution are generally taught to students across the college by faculty in another department (i.e., outside the department of educational leadership in a department that includes educational psychology, counseling, and special education, among other programs). Through coordinated efforts between both departments, educational leadership faculty had been able to teach the quantitative and qualitative research methods courses to the first two cohorts of EdD students. These courses were initially offered using existing courses in the graduate catalog, which listed a prefix, number, and description for each course. Thus, courses using the same prefix/number were offered in Doctor of Philosophy (PhD) programs as well as the EdD program, albeit EdD students completed their courses as a cohort in a particular sequence. However, the existing research methods courses as described in the graduate catalog (i.e., based on the course descriptions and objectives, student learning outcomes, etc.) focused more on helping students understand statistical theory and develop technical skills for statistical analysis than how to conduct applied research in educational settings.

It became increasingly evident to educational leadership faculty that the research methods courses need a more explicit focus on IS as students struggled to draft the research methods chapter (i.e., the second chapter of a four-chapter DiP model) in the first two cohorts. As an example, EdD students struggled when trying to write about their plans for quantitative data analysis. Rather than organize the second chapter by discussing their plans for data analysis according to phases of the Plan-Do-Study-Act (PDSA) cycle, most students tried to write one large section on analysis toward the end, seemingly disconnected from the rest of the chapter. As a result, students often needed to make significant revisions, particularly in terms of the structure and organization of the chapter, before they could successfully complete a proposal defense, which ultimately delayed their progress to degree completion. As educational leadership faculty sought to integrate IS into the pre-existing courses, it became increasingly evident that research methods courses specific to the EdD program were needed. After discussions among faculty in both departments, new applied quantitative and qualitative methods courses with a focus on IS were developed and have since been approved through the university curriculum review process. Students in the third, fourth, and now the fifth cohorts have since taken the new research methods courses.

There are currently approximately 65 students enrolled in the EdD program across multiple cohorts. A new cohort of students is admitted annually in the summer. The first two EdD cohorts, which had approximately 15 students each, were admitted in Summers 2018 and 2019, respectively. Their courses were delivered in an executive format with students meeting in person one weekend (Friday evening and Saturday) each month of the 15-week semester. Faculty traveled to one of the university satellite locations around the state to teach these two cohorts of EdD students, who completed

their courses as part of a sequence. The quantitative and qualitative methods course were offered in the second and third semesters of the program, respectively.

To expand access to students who could not easily travel to the satellite locations to attend class, faculty began preparations in Fall 2019 (i.e., before the COVID-19 pandemic) to transition the EdD program to a fully online delivery model to begin with the incoming third cohort in Summer 2020. The new model offered 8-week courses that blended synchronous and asynchronous learning activities in virtual spaces. As part of this transition, both quantitative and qualitative research methods courses were restructured as 8-week courses, albeit still offered in the second and third semesters of the program. As part of this transition, the pacing guide and content for each course were adapted to align with an 8-week online format, which included a blend of synchronous and asynchronous activities via Zoom and Canvas. The third cohort, considerably larger than the previous two cohorts with approximately 30 students, was the first to complete their courses fully online using the new delivery model. The fourth and fifth cohorts with 15 students in each cohort have been admitted with the online delivery model fully in place.

Perspectives

As educators, EdD students need strong data literacy skills such that they can identify, analyze, and interpret data commonly available in educational settings (Gummer & Mandinach, 2015). With an enhanced understanding of data availability, access, analyses, interpretation, and appropriate use, they are better equipped to make inferences and leadership decisions (Firestone et al., 2019; Leech & Haug, 2015; Pogrow, 2018). My philosophy for teaching research methods is based on these premises. How to best equip students with the knowledge and skills that they need to apply quantitative and qualitative research methods as part of the IS DiP has been a primary focus of faculty in this EdD program over the past few years. Reflective of this commitment to continuous improvement, faculty who most often teach the research methods in the EdD program have utilized IS to develop and refine those courses in meaningful ways.

This IS approach is also reflected in the efforts of individual faculty members in the courses they teach, including my own as the faculty member who has taught the applied quantitative methods course to the most recent three cohorts of EdD students (n=60 across the second, third, and fourth cohorts). Using a systematic, iterative, and reflective approach, I developed, taught, and refined the course over three iterations. First, I developed the course to teach the second cohort, shifting from a traditional focus on statistical theory to practical application throughout (e.g., using analytic techniques and tools to explore local data related to the problem of practice). As part of initial course development, I selected the course texts, created materials (e.g., presentations, handouts, and other resources for students), and developed assignments (e.g., discussions, weekly application assignments) as well as a culminating project more closely aligned to the objectives and student learning outcomes for the course. In each subsequent iteration (i.e., to teach the third and fourth cohorts), I utilized multiple data sources (e.g., student outcomes, student and peer feedback) for refinement, particularly in terms of strengthening the integration of IS throughout the course.

My approach to developing and subsequently revising the course was systematic, iterative, and reflective. In each of the three

semesters I taught the course, I systemically collected data from multiple sources, including evidence of student learning outcomes from assignments, common anonymous mid-semester surveys and end-of-semester course evaluations completed by students, and three formal reviews conducted by faculty peers using a common rubric. At the end of each semester, I iteratively analyzed the quantitative data (e.g., calculating descriptive statistics for individual items on the mid-semester surveys and end-of-course evaluations) and qualitative data (e.g., coding open-ended survey and evaluation responses and peer feedback on the rubric for themes). As part of this process, I reflected on what I had learned and planned for next steps by identifying aspects of the course that could be improved and developing a written action plan to make changes for the next iteration of the course.

In this essay, I describe seven aspects of the course that I refined through this systemic, iterative, and reflective process over three iterations. These include (a) shifting the focus of the course objectives from theory to application, (b) making course content more relevant to practice, (c) helping students develop and apply analytic skills, (d) using technology to increase accessibility, (e) providing supportive structures for adult learners, (f) assessing student learning for mastery, and (g) embedding IS. For each of the above, I share examples of revisions made and discuss the implications for students.

REFLECTIONS

Shifting the Focus of Course Objectives from Theory to Application

This quantitative methods course reflects a shift in doctoral leadership preparation from a traditional focus on statistical theory to practical application. The primary course objectives are to prepare EdD students first to be critical consumers of research and second to be able to utilize quantitative methods to conduct research in practice. Thus, the course objectives have three main foci: (a) an introduction to applied quantitative research methods, (b) technical and analytical skills, and (c) the application of quantitative methods to problems of practice. In terms of student learning outcomes, the course is intended to prepare students with the knowledge and understanding of research design and technical skills they will need to collect and analyze quantitative data when conducting a DiP in educational settings. With each iteration, I refined the course content and assignments based on their relevance for scholarly practitioners who will apply quantitative methods within field-embedded investigations to solve problems of practice using IS.

Making Course Content Relevant to Practice

In order to teach students how to use data in their leadership roles to address problems of practice, I realized I needed to make the course content relevant to practice. When initially developing the course for the second cohort, I wanted to include texts and create resources specific to educational practice, which resulted in a curated list with some social sciences statistical texts as well as other sources students could use for reference. I also focused on creating course materials that presented theories of descriptive and inferential statistics in an applied way with in-class activities that utilized sample data sets aligned to the concepts, scenarios, and specific skills for each course topic. While the in-class activities

utilized sample data sets from educational settings, some students provided constructive feedback in their responses to the mid-term survey suggesting that more opportunities to work with their data would be helpful. One student suggested, "It would be interesting if people could bring timely data sets to analyze." Another student responded, "I think the usage of real and practical data will make the processes mean more and make more sense at a deeper level." For the remainder of the semester and in subsequent iterations, I looked for more opportunities within the discussion boards and during class for students to obtain and use their data for some of the statistical analysis. I also met with students individually and in small groups to answer questions about and work through analysis with de-identified data from their schools or districts.

Providing more opportunities for students to work with sample data as well as their data made the course more relevant to practice, according to student feedback on end-of-course evaluations. One student noted:

> This is a great introduction to statistics in a format that is easy to access and is not overwhelming. The opportunities for practice, review, and feedback are very supportive. Additionally, the class is focused on the practical application of statistics to the field, which makes it much more relatable than simply working through a stats textbook.

Other students cited "the inclusion of school like data sets," "hands-on examples and activities," and "real-world scenarios" as "making the course content more meaningful." Another student explained that "making the information relevant specifically to their research and current jobs [with] lessons that build on each other in a meaningful way" was particularly valuable.

Developing and Applying Analytic Skills

As a whole class and in small groups, I modeled and engaged students in the process of skill development and application, including how to manually create or access existing data files and develop research questions related to the data. In small groups and individually, students worked to identify and conduct appropriate statistical analyses using software (e.g., Microsoft Excel and IBM® Statistical Package for the Social Sciences [SPSS]) as well as interpret output and display the results (visually and in narrative format using American Psychological Association [APA] Style). I found that students often needed additional support, particularly in terms of selecting the most appropriate statistical test and reporting the findings, per APA Style.

Based on student feedback in the first year, I developed a collection of resource sheets for various statistical analyses and corresponding examples of results written in APA Style, which students in the second iteration noted they "would [also] refer to in the future." However, one student suggested these resources could be better organized: "There were many resources and guides with regards to APA write-ups, but having one unified document, with APA formatting and statistical write-ups, would be incredibly helpful to have as a reference." In response to this feedback, in the third iteration of the course, I created a comprehensive, unified document with guidance of how to choose an appropriate statistical test by variable type (e.g., nominal, ordinal, ratio, interval) and research question (e.g., describing data using measures of central tendency and variability, determining the relationship between variables, comparing means) with additional examples of how to write results in APA format for all the statistical tests students learn in the course. I

also spent more time providing feedback to students on the APA reporting aspect of their work. One student explained that the "outlines, examples, and other various resources helped the class understand statistics and enhanced the instruction in the class."

Since in-class activities were often collaborative and based on real-world scenarios, students routinely reflected on the implications of their results for decision-making. Students had opportunities to work in small groups to apply their learning. As part of this process, students often discovered limitations specific to the data (e.g., due to the structure of the data file, available variables, depth of analysis appropriate) that impacted their abilities to answer the research question(s) and make evidence-based decisions. A student appreciated "work[ing] in groups to solve relevant problems of practice by applying course content." Another student noted, "collaborative assignments allowed me to learn from my peers when I was confused."

Using Technology to Increase Accessibility

The effective use of technology (e.g., SPSS, Zoom, Canvas) in each of the three iterations of the course was critical to increasing accessibility for students. While teaching the first iteration, I quickly realized that students who struggled to independently access and comfortably use SPSS had difficulty engaging in activities in class. The first year I taught the course in person at a satellite location where some students had difficulty accessing SPSS software through the university's web-based application. In their end-of-course evaluation, a student noted, "The technology issues early on in the class with SPSS made some of the class meetings more frustrating than it needed to be." Some of the issues were addressed in the second iteration of the course because students were able to download a student version of SPSS directly to their device using the university license. Even then, students who used Mac devices still reportedly struggled. In their end-of-course evaluation, one such student described feeling "left behind to figure it [SPSS] out on their own." In response, I developed detailed, step-by-step guides with instructions on how to access SPSS (i.e., by downloading SPSS to a device, using the web-based application) on different devices. I also provided video tutorials demonstrating how to access SPSS as well as perform other tasks (e.g., saving, locating, and opening files). I reviewed these resources at the beginning of the course and referred to specific guides and videos, when appropriate, during in-class activities. I also met individually and in small groups with students to troubleshoot issues. A student in the third iteration explained in their end-of-course evaluation that "taking the time to show us SPSS, run different analyses, and interpret the outputs was incredibly helpful."

As part of the transition from the first iteration (i.e., a 15-week course taught in an executive weekend format) to the second iteration (i.e., an 8-week course taught in an online format), I adapted the course pacing guide and content to include a blend of synchronous and asynchronous activities via Zoom and Canvas. In their end-of-course evaluation, a student explained how "adapting [the] class to fit a digital environment…allow[ed] students to feel comfortable with learning new content while also showing understanding and application of previous key concepts." Another student described the screen sharing feature in Zoom as "an extremely helpful tool," explaining that "shar[ing] our screen so [the] class] could watch us walk through a task" helped them determine where they needed assistance. A third student commented on their experience learning to use statistical software in a virtual space: "The hands-on approach to learning how to use SPSS was beneficial for new users to the program."

Providing Supportive Structures for Adult Learners

To assuage any stress or anxiety students may have had about taking a quantitative methods course online, I tried to build additional supports into the course. For example, in the second and third iterations, I offered optional, synchronous virtual two-hour study sessions via Zoom every Saturday morning as well as virtual office hours on weekday evenings. The high attendance rate on Saturdays and positive feedback suggested students found these synchronous sessions helpful. In their end-of-course evaluation, one student noted, "[the] Saturday class and video recordings were extremely helpful. This was my very first experience with this type of class." Another student explained, "I really enjoyed the Saturday sessions to look at the work that was done during the week. I also like the availability of office hours during the week, though I didn't take advantage of it often." Students, including those who did not attend, had the opportunity to view the Saturday session recording (i.e., the Zoom recording linked through Canvas). One student explained, "the Zoom meetings were especially helpful. Being able to go back and rewatch the recordings to review material and fix mistakes was invaluable." According to another student in their end-of-course evaluation, the structure of the course also fit the needs of working full-time professionals: "The weekly structure, with optional office hours, was predictable and flexible with regards to our work schedules."

During one iteration of the course, a student in the PhD program also attended the Saturday study sessions as part of their graduate assistantship. One student noted that the "addition of [the PhD student]…provided balance and relatability as a practitioner and someone working on their dissertation." I debriefed with the graduate assistant at the end of each Saturday study session to gain their perspective on revisions for course activities (e.g., in-class activities where additional scaffolding would help students understand and apply new concepts) and assignments (e.g., how to increase clarity in assignment instructions, where additional sample data sets would be helpful for practice). These debrief sessions have been helpful to me in preparing for future iterations of the course.

Assessing Student Learning for Mastery

To help provide scaffolding and teach for mastery, students were required to complete a weekly application activity independently and submit the activity to Canvas each Friday evening as a formative exercise. I reviewed students' submissions and made final modifications to the agenda for the next day's study session, based on their mastery of the learning objectives for that week. During the Saturday sessions, I worked with students as a whole class and in small groups on the activities, encouraging them to teach and learn from each other. All students, including those not in attendance, then had an opportunity to revise and resubmit their application activities to demonstrate mastery (i.e., posing research questions, conducting appropriate analysis, displaying output, interpreting results, discussing implications, etc.). A student explained the value of mastery learning while maintaining high expectations:

> The opportunity to resubmit assignments was a great component of this course. We knew that we were expected to read the material, attempt the assignment on our own, reach

out for assistance during office hours if needed, review the assignments, and then submit any corrections. I think this relieved some anxiety and improved everyone's confidence.

Another student noted: "One thing that was helpful was completing the assignments on your own, listening to the lectures to review the homework, and being able to redo the assignment for mastery."

Embedding Improvement Science

For the culminating project in the first iteration of the course, students used sample data that I provided to demonstrate their learning. Some students provided feedback suggesting a need to clearly connect the culminating project to their DiPs, specifically to better prepare them to independently analyze quantitative data related to their DiPs. One student highlighted this need in their mid-semester survey, writing "…[please] help me realize how I will make this a part of my dissertation." In response, I revised the culminating project such that students in the second and third iterations identified specific problems of practice in their schools or districts, ideally as a possible topic for their DiPs. They were encouraged to explore problems of practice related to issues of equity, a primary focus of the curriculum in this EdD program. As a next step, students described their local contexts and provided abbreviated literature reviews related to their problems of practice. As part of what would be the plan phase of a PDSA cycle in their DiPs, students obtained de-identified school or district data related to the problems and specific to their settings, based upon which they developed one or more research question(s) to better understand the problems. Using the skills they developed in the course, students identified and conducted appropriate statistical analyses aligned to their research question(s) using Excel or SPSS. Their analysis was intended to help them substantiate the extent to which this problem existed in their setting. They were also expected to interpret and display the results in ways that would be appropriate for their intended audience and discuss the limitations of their analysis and/or results and implications for decision making in context.

In the first iteration of the course, some students also suggested that the final project was somewhat overwhelming. For example, one student noted, "it would have been nice to have the final project be scaffolded with checkpoints or scaled down to just an area of conducting a small study and reporting the findings." Another student explained that "including checkpoints for the final project or adapting the project to a smaller scale or narrow focus would be beneficial." In response to student feedback, I divided the culminating project into smaller parts to further scaffold students' learning throughout the course. I provided students with detailed feedback on each part, which they could revise for the final submission. In this regard, the culminating project served as a small-scale exploration of their problems of practice in preparation for their DiPs.

DISCUSSION AND RECOMMENDATIONS

As part of ongoing reflection, I have considered lessons learned and recommendations for other EdD programs seeking to develop research methods courses for IS. In terms of lessons learned, quantitative methods courses that blend statistical theory with practical application make the content relevant and accessible to students (Ferguson et al., 2017). To help EdD students build confidence in their abilities to conduct research (Kerrigan & Hayes, 2016), faculty can provide additional support in quantitative methods courses in the form of modeling and guided practice (Wilson & Onwuegbuzie, 2001) using sample data commonly available in schools and districts. Virtual spaces, if utilized effectively, can enhance students' abilities to collaborate and apply their learning (e.g., analyzing data in small groups using statistical software). To help reduce any potential stress and anxiety around using statistics (Pan & Tang, 2004), faculty can provide students opportunities to demonstrate mastery to assess their learning of course content. Engaging PhD students in graduate assistantships in these courses as class assistants, peer tutors, etc. can enhance the overall experience of EdD students, who value the opportunity to connect with a peer who is already in the dissertation phase of their degree.

Educational leadership faculty seeking to develop and refine research methods courses might consider ways to collaboratively engage in this process. Reviewing existing research methods course offerings, including objectives, learning outcomes, content, and assignments, can help faculty determine whether those align with the needs of EdD students preparing to conduct DiPs. When there is misalignment, faculty might consider how to revise courses to reflect the content and skills EdD students need or explore options for developing new research methods courses. Collaboration in revision and development within and across programs and departments offers faculty the opportunity to align coursework to program-specific learning outcomes while avoiding redundancy. Refining courses based on student feedback and faculty reflections can further strengthen the courses in terms of their relevance, accessibility, and support of student learning. Engaging in a systematic, iterative, and reflective refinement process within and across courses in collaboration with other faculty can further enhance doctoral programs in ways that benefit students.

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