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Teaching Note—Innovations in Teaching Research: Learning by Doing

Wendy Zeitlin

ABSTRACT

The field of social work recognizes the need to evaluate one's practice. Social work educators are mandated to prepare students to evaluate their own practices and be knowledgeable consumers of research. The goal of being competent in both of these is often challenged by the fact that many students do not initially understand the relationship between research and effective practice upon entering research classes. This Teaching Note was written to describe innovative techniques in a practice research course. This course uses innovative teaching practices including the use of freely available statistical software to teach students to analyze their data visually, descriptively, and statistically within the context of their practice evaluation projects that are conducted in *vivo*.

ARTICLE HISTORY

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MSW students frequently do not readily connect research skills to effective social work practice. Active learning research projects can help overcome these obstacles by engaging students in all aspects of the research process. This includes designing a meaningful research study, collecting and analyzing data, and applying those findings to social work practice. This article details how single-subject research designs and freely available statistical software have been used in an innovative manner to teach MSW students pragmatic practice evaluation skills in a required research course. Students complete a semester-long research project in *vivo* from field practice. A student exemplar assignment illustrates a culminating project from the course.

Overall, those in the field of social work recognize the need to evaluate their practice. The Council on Social Work Education (2015) names engaging in practice-informed research and research-informed practice as the fourth of nine competencies essential to effective social work practice. Similarly, the National Association of Social Workers (2017) relates research to competent practice and integrity in the field.

Social work educators, then, are mandated to prepare social work students to evaluate their own practices and be knowledgeable consumers of research after graduation. The goal of being competent in both areas is often challenged by the fact that many students do not initially understand the relationship between research and effective practice when entering research classes (Iovu, Runcan, & Runcan, 2015; MacIntyre & Paul, 2012).

One way to address this challenge has been to engage students in active learning research projects. In these types of projects, students learn by actually participating in the design and implementation of research studies, which includes designing a study, collecting data, analyzing it, and presenting findings (Lundahl, 2008). Projects that have been considered successful in social work programs have often focused on agency-based research in the form of either program or practice evaluations (Fisher-Borne, Hall, & Casstevens, 2014; Gerten, 2015; Thomas & Hersen, 2011).

Although social work students can engage in agency-based active learning research projects in numerous ways, one way is to evaluate their direct work with a single-client system while

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simultaneously providing services. With this method the connection between research and practice may seem less remote as the results can yield immediate feedback that can help students improve their practice. This type of research enables social work students to assess their work dynamically with clients and adjust interventions as indicated by the evidence generated by their research projects (Auerbach & Zeitlin, 2014; Bloom, Fischer, & Orme, 2009; Orme & Combs-Orme, 2011).

Although this type of research is similar to published single-subject research studies, the purpose differs in that the former is intended to inform practice and the latter is intended to share knowledge with some broader audience (Bloom et al., 2009; Kazdin, 2011; Kratochwill et al., 2013; Orme & Combs-Orme, 2011). This design is not intended to be rigorous in the manner that published research studies are; it is intended to be fully integrated into practice and provide empirical data related to client change during the time the social worker is working with the client. Therefore, less rigorous A-B designs (i.e., a baseline phase followed by a single intervention phase), which do not control for threats to internal validity, are acceptable and are often the norm in some settings (Bloom et al., 2009; Orme & Combs-Orme, 2011). If after analysis it seems that the client is improving, the worker may have some sense that the intervention is contributing to this. On the other hand, if the worker sees no change, or the client is getting worse, the worker should consider reevaluating his or her work with the client in some way (Auerbach & Zeitlin, 2014; Bloom et al., 2009; Orme & Combs-Orme, 2011). In this way, these evaluations should directly affect social work practice.

From a pedagogical perspective, teaching students to engage in single-subject practice evaluations while in their field placements may have several advantages. First, there is a strong tradition in this type of research to rely primarily on visual analysis by examining line graphs of behaviors in various phases of the research (Auerbach & Zeitlin, 2014; Kazdin, 2011). Interpretations of graphs may seem less daunting to students than analyzing statistical output. If students can effectively be taught to analyze client data visually, they may gain a practical research skill: They will have acquired the ability to evaluate client progress in the field once they graduate and assume professional responsibilities. An additional benefit to having students conduct these types of studies is to clearly connect research to practice in a meaningful context.

This approach supports Knowles's theory of adult learning, which specifies, for example, that students' learning is predicated, among other things, on their need to know, their self-concept, their orientation to learning, and their motivation to learn (Knowles, Hollton, & Swanson, 2014). Students who enter the classroom reluctant because they believe that research is irrelevant to social work practice or that they will have to be good in math to succeed in research classes need a specialized approach. To this end, Knowles et al. (2014) have endorsed Kolb's (1984) practice of experiential learning.

Kolb (1985) asserts that experiential learning helps students understand new perspectives by altering old ideas, thus enabling resistant students to reframe previous experiences or notions. Experiential learning also emphasizes the students' interaction between himself or herself and the environment (Kolb, 1984). Using this paradigm, it can be assumed that active learning research projects may not only teach students research skills but may also help them reconsider previously held notions about research in general.

This article describes innovative techniques in a practice research course. In this class, students engage in an active learning research project throughout the course of the semester to evaluate their own work with a client system using aspects of single-subject research designs. This course uses innovative teaching practices including the use of freely available statistical software to teach students to analyze their data visually, descriptively, and statistically in the context of their practice evaluation projects conducted *in vivo*. The culmination of this class is an actual practice evaluation of students' work with a client system that can be used to inform their practice. The benefit is that students gain skills that are easily transportable and useful in practice settings postgraduation. That is, by engaging students in the research process using freely accessible software, they may have a more positive impression of research and will have acquired the tools and skills to become adept at using research to affect their own practices in a positive and sustainable manner.

Course description

The overall goal of this required course is to teach students to use aspects of single-subject research designs to evaluate their own practice empirically with individual client systems during their field placements. In the course of the 14-week semester, students are taught to identify client problems and then use specific measurable goals to assess client progress toward those goals over time, prior to and after the introduction of an intervention. It should be noted that all class projects focused on A-B designs because of time constraints, although additional, more rigorous designs were introduced.

Single-subject research designs are substantially different from the more common group designs often found in social work research. Often referred to as $n=1$ designs or *single-case*, these designs are used most often in intervention research and feature frequent and repeated measures of a single subject across one or more phases. Phases mark some level of intervention; for example, often a baseline phase in which there is no intervention is used as a comparison for subsequent phases. The introduction of an intervention or alterations to an intervention or the intensity of an intervention mark a phase change. Changes over phases can be interpreted visually and statistically; however, data that are serially dependent pose a need to deal with autocorrelation in the analysis and interpretation of findings. Similar challenges exist when data trend within a phase (Auerbach & Zeitlin, 2014; Kazdin, 2011; Kratochwill & Levin, 2014; Orme & Combs-Orme, 2011).

In these types of practice evaluations, it is particularly valuable to describe the magnitude of change between phases using measures of effect size (Auerbach & Zeitlin, 2014; Bloom et al., 2009; Parker, Hagan-Burke, & Vannest, 2007; Vannest, Davis, & Parker, 2013). Because the number of observations in these studies is typically small, statistical significance is difficult to achieve, creating conditions in which an effective intervention could be wrongly rejected (i.e., increasing the chances of making a Type 2 error). Therefore, it is helpful to use effect sizes to describe the degree of observed change from one phase to the next, and these are relatively easy to interpret. Effect sizes are one of the accepted solutions to the field's overreliance on statistical significance in decision making (Murphy, Myers, & Wolach, 2014; Schneider, 2013).

As an ongoing project, each student evaluates one client system over the course of the semester and collects relevant data, which are stored on a spreadsheet. To facilitate data analysis, students are taught to use *SSDforR* (single-system research design data for R, an open-source programming language) to evaluate single-system data visually and statistically (Auerbach & Zeitlin, 2013; R Foundation, n.d.). In addition to a textbook to help students learn about single-subject research methods, students use references cited in Auerbach and Zeitlin (2014). This text is specifically designed for users of the *SSDforR* package and explains how and when to use the various functions. This text also guides users in reading and interpreting output from *SSDforR*.

Topics covered each week are described in Table 1. It should be noted that during the early weeks of the course, each class period is divided into two distinct sections. During the first portion of each class period, a main lesson relates to single-subject research methods, and fundamental skills in the use of *SSDforR* are introduced including navigating RStudio, the free graphical user interface used in the class, using Help functions, and learning how to enter commands in R (Free Software Foundation, 2012). By the middle of the course, the topic of each lesson converges with the *SSDforR* topic, and students are able to articulate the practical usefulness of statistical software in analyzing and presenting research data.

On the first day of the class, students are taught how to install the open-source software on their computers. After the software is properly installed on either a Mac or PC, students practice new skills in class and are assigned homework activities after most classes to reinforce skills taught during class. Homework assignments become increasingly complex over the course of the semester requiring students to make practice decisions based on analytical findings.

In terms of grading homework, students are given full credit regardless of whether their answers are correct or not, provided they complete the assignment. The rationale for this is that practicing

Table 1. Weekly class content.

Week	Topic of Lesson	SSDforR Topic
1	Overview of practice and evaluation research	Installing <i>R</i> , <i>RStudio</i> , and <i>SSDforR</i>
2	The relationship between evidence-based practice and practice research	Creating and interpreting basic line graphs
3	Defining client problems and goal setting	Plotting multiple phases and annotating line graphs
4	Measuring client problem indicators	Illustrating client goals graphically and adding central tendency annotations to line graphs
5	Identifying interventions	Obtaining basic statistics for data
6	Evaluating baseline data	Plotting multiple behaviors on one graph
7	What is autocorrelation and trending?	Analyzing baseline data for autocorrelation and trending
8	Types of single-subject research designs and design rigor	Transforming autocorrelated data
9	Traditional effect sizes	Effect size functions
10	Nonoverlapping effect sizes	Nonoverlapping effect size functions
11	Type I error	<i>T</i> -tests and the binomial function
12	Additional measures of Type I error	Chi-square and conservative dual criteria
13	Workshop to finish individual papers or presentations	
14	Final submission of individual papers or presentations	

skills related to their own research will build proficiency over time, and students may be less resistant to trying new skills if the focus is on learning as opposed to achieving a desired grade. If students consistently get a particular skill wrong in homework, it is retaught in class with additional opportunities to practice that skill.

Additionally, course lectures and demonstrations of lessons in *SSDforR* are recorded using screen capture software such as Snagit (TechSmith, 2018) and posted on the course website. This enables students to review key concepts taught in class and review the use of *SSDforR* for homework.

There are two major graded assignments for the class. The midterm assignment is to define the client problem, develop a measurement method, and then collect and analyze baseline data for stability, autocorrelation, and trending. The final assignment is to compare baseline and intervention data visually and statistically and then indicate what practice decisions students would make based on their findings.

Students engage in a wide range of semester-long practice evaluations based on their field placements. Examples of these in the past have included

- examining whether a behaviorally based intervention was related to change in a binge-eating client,
- evaluating the impact of motivational interviewing on a client with alcohol dependence, and
- assessing whether a modified form of cognitive behavioral therapy was effective in reducing compulsive sexual behavior in a religiously conservative client.

Student exemplar assignment

To demonstrate the scope of what is taught in this course, the following is an example of a final student assignment. The material presented here is only a synopsis because space constraints.

To put this assignment into context, this student intern was part of a multidisciplinary child study team in a high school for students receiving special education services. For her project in this class, the student focused on the case of Adrian, a 15-year-old Hispanic male in the ninth grade. He was referred for social work services because of poor behavior in school, including lack of participation in class, failing to complete assignments, speaking disrespectfully to teachers, and leaving class without permission.

During the evaluation period, the student intern learned that Adrian had been diagnosed with depression and anxiety and was briefly hospitalized the previous year because of suicidal ideation. In working with her supervisor, the student intern hypothesized that cognitive behavioral techniques

combined with teacher involvement in social work services would diminish his disruptive behavior and reduce his anxiety. The intervention included asking Adrian to keep a journal of when he behaved inappropriately in school. He wrote about his feelings preceding the event and alternative approaches that could have resulted in better outcomes. He reviewed the journal with the social work intern during each session. Additionally, he was specifically encouraged by his teachers to participate in tutoring after school.

Data were collected to assess Adrian's behavior daily from two classes in which the problem behavior was most apparent. Teachers were asked to record how many times each day Adrian left the class without permission or exhibited poor behavior that resulted in teachers expelling him from the class. To assess his anxiety, the student intern worked with Adrian to create a self-anchoring measure on a 5-point scale (ranging from 1=lowest level of anxiety to 5=highest level of anxiety; Nugent, 2001).

To assess whether Adrian's disruptive behavior changed with the introduction of the intervention, the student first plotted and annotated a graph over both phases, as illustrated in Figure 1, below. This graph not only illustrates that the data are less variable in the intervention phases compared to the baseline but also that the mean dropped from 1.8 disruptive events per day to 0.5.

The student also noted a significant trend in the baseline and intervention phases, $p=0.043$ and $p=0.0424$, respectively; however, there was no issue with independence of data in either phase with low and nonsignificant values for r_{f2} (baseline $r_{f2}=0.42$, $p=0.37$; intervention $r_{f2}=0.17$, $p=0.72$).

With this in mind, the student statistically compared the phases by using chi-square to create a desired zone below the baseline regression line, since it is desirable for Adrian's disruptive behavior to decrease. Results indicated that Adrian's behavior was in the desirable zone 30% of the time in the baseline and 100% of the time after the introduction of the intervention; this observation was statistically significant, $p=0.003$, Fisher's exact.

The student used the g -index (Bloom et al., 2009; Cohen, 1988) to examine the effect size between phases because of the trending in both phases. Not surprisingly, she noted a large effect, $g=0.70$. The graphical output for this is shown in Figure 2.

To assess whether Adrian's level of anxiety changed with the introduction of the intervention, the student first plotted and annotated a graph over both phases, as illustrated in Figure 3, below.

Here she noted that Adrian's anxiety decreased from the baseline phase during the course of the intervention but not as dramatically as the disruptive behavior. She also noted a significant trend in the baseline and intervention phases, $p=0.03$ and $p=0.05$, respectively; however, there was no issue with independence of data in either phase with low and nonsignificant values for r_{f2} (baseline $r_{f2}=0.44$, $p=0.34$; intervention $r_{f2}=0.50$, $p=0.28$).

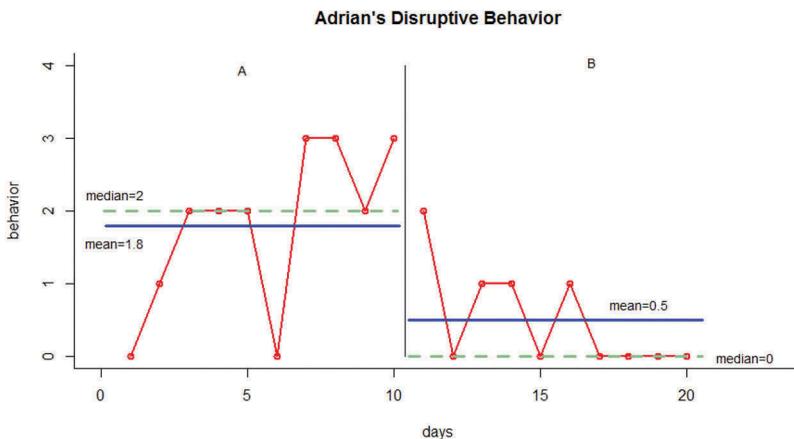


Figure 1. Basic annotated line graph of client's disruptive classroom behavior.

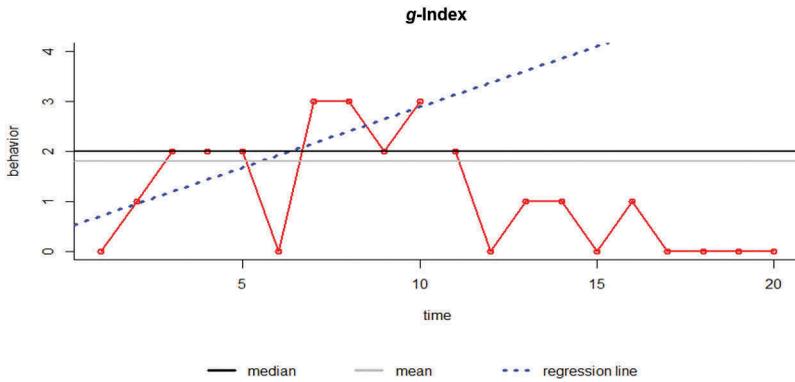


Figure 2. G-index graphical output for Adrian's disruptive behavior.

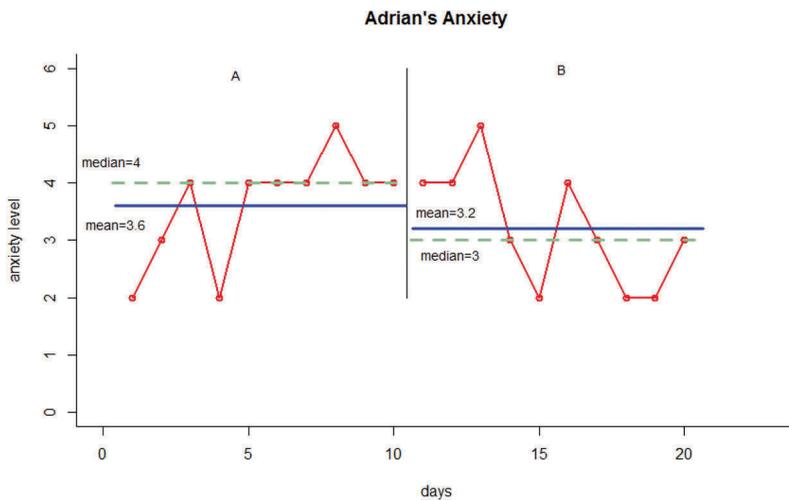


Figure 3. Basic annotated line graph of client's anxiety across baseline and intervention phases.

The student statistically compared the phases by using chi-square to create a desired zone below the baseline regression line as lower values on the self-anchoring scale indicated lower levels of anxiety. During the baseline, 40% of the observations were in the desired zone, and during the intervention all the observations were in the desired zone, Fisher's exact=0.01.

Effect size was assessed by using the *g*-index (Bloom et al., 2009; Cohen, 1988), and a large effect size was observed, *g*=0.6.

The student concluded that with intervention the client's disruptive behavior and anxiety improved and the intervention should continue.

Discussion

As previously stated, social work students taking research classes in general tend to be reluctant and anxious; however, anecdotally, students tend to enjoy this class because as reported to the professor they are able to relate this type of research design to actual social work practice. That is,

the methods taught in this class seem less remote and more pragmatic to students who are primarily interested in social work practice. Although anecdotal, these comments substantiate the change in attitude discussed by Kolb (1984) in experiential learning. Teaching research that is grounded in meaningful student projects may be an effective way to teach MSW students relevant research skills that can be carried into professional settings postgraduation because of enhanced abilities and confidence.

Although there are many avenues for engaging in such active learning research projects, the use of aspects of single-subject research designs in vivo with freely available analytical tools, as described here, may be one way to do so effectively.

The student example presented was not simply the work of an outstanding student but demonstrated the work of a typical student in this class. One of the major benefits in using *SSDforR* as a tool in students' active learning projects is that in addition to being freely available it can be used on a PC or a Mac (Auerbach & Zeitlin, 2014). Because of this, students can take skills they use in this class to the agencies where they do their field placements and to their places of employment postgraduation. It is hopeful that with the research skills gained in this class students may build evaluation capacity at social service agencies in the future by providing a means to assess work with single-client systems at no cost.

Notes on contributors

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