Detecting Low Incidents Effects: The Value of Mixed Methods Research Designs in Low-N Studies

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Many important educational situations such as traumatic brain injury among preschoolers, school gun violence, preadolescent eating disorders, and adolescent suicide happen relatively infrequently. In this article, the authors explain why mixed methods research designs offer more meaningful empirical results than do qualitative or quantitative designs alone when asking research questions about low incident situations. The authors present and explain three mixed methods models applicable to low incidents situations.

On one hand, quantitative methods and statistics can measure outcomes and test their relationships to interventions but can limit researchers' ability to capture the unique and idiosyncratic nature of variables. One unique challenge of quantitative research is the inability to detect effects when the incidence of the criterion variable is infrequent, yet has real life consequences. On the other hand, qualitative research designs can excel in uncovering the meaning of lived experiences when the criterion variable is infrequent (i.e., low-N) but be incapable of measuring treatment outcomes.

Detecting effects when the incidence of the criterion variable is infrequent can be problematic. Replicable studies may seem impossible. However, researchers face important research questions about phenomena that are infrequent. For example, preadolescent eating disorders (Crowther, Post, & Zaynor, 1985), internet bullying (Williams & Guerra, 2007), adolescent criminality, traumatic brain injury in preschoolers, severely physically disabled students, medically fragile students, and those with certain rare cancers are all potential low-N situations. The purpose of this article is to present a research strategy based on a mixed methods conceptualization that allows researchers to have greater confidence in the findings of studies of low-incident situations. Our purposes are two-fold: to define low incident situations in education

and social sciences and argue why they need to be studied and to present and explain a mixed methods solution that helps ameliorate problems with low-incident studies based on the constructs of a nomological network and truth value. We explain these two constructs later in the article but briefly introduce them here. First, for a particular phenomenon, the relationships among variables and how they interact is one image of a nomological network. Theories that explain phenomena are a type of nomological network. How does one explain not only the variables that make up job satisfaction, but how those variables relate to one another? Second, truth value, briefly defined, refers to the estimate of the validity of evidence, usually the total validity evidence gathered in research studies. How confident should we be that the evidence gathered in this study is valid, is legitimate, and is trustworthy?

Meaningful situations in the social and behavioral sciences, education, and medicine may occur relatively infrequently, such as incidents of students recognized for unusual contributions or achievements, students unleashing violence on their school, students contemplating or completing suicide, violence against teachers, internet bullying, preschool traumatic brain injury, adolescent criminality, preadolescent eating disorders, those with rare cancers, and counseling underrepresented groups such as gay or lesbian students. For instance, Crowther et al. (1985) found that eating disorders prior to age 13 were rare. Bullying is more or less frequent in schools relative to the schools' culture and climate (Williams & Guerra, 2007). One student referral for suicidal ideation out of 1,000 students in a middle school (a hypothetical example) is an example of low incidents. A small number of real-life incidents do not necessarily imply that such situations are less important than situations that occur more frequently.

Adolescent Suicide: One Example of a Low Incidents Research Situation

One low-incident situation the authors studied was a program focused on adolescent suicide. Three of the four authors were evaluators of the program. The Red Flags program (Newman, Smith, Newman, & Brown, 2005) was a training program to increase students' awareness of the symptoms of suicide and depression. The intent of the program was that students armed with this information and with heightened awareness would be better prepared to refer themselves or others for treatment. This federally funded suicide intervention program (Newman, Smith, Newman, & Brown, 2005) was provided to over 300,000 middle school students.[1] The sample in the evaluation study was approximately1,100 students. Schools were separated into two groups: schools in which students received the training, or the "treatment" group, and schools in which students did not, the "nontreatment" group.

Comparing the outcomes from the treatment and nontreatment groups was the purpose of the evaluation. The criterion variable was student referral for suicide risk (did the student refer self or others, a dichotomous variables coded "1" or "0"). The predictor variables were scores from the Emotional Quotient Inventory, EQ-I (Bar-On, 2000) and scores from a school climate scale.

For example, suppose there were actually three suicidal students from one school. And, further suppose that of the three students who were referred by those in the treatment group – all were

[1] The development of this manuscript postdated the evaluation and was not funded. It grew from reflections on methodology.

presently suicidal. The researcher could conclude that, in the treatment group, the students were successful in referring 100% of those students who needed referral. The 100% success rate, however, would reflect low statistical power. Results would not show a statistically significant difference between the two groups. If the treatment group had three more referrals than the nontreatment group (in the sample of 1,100), results would be not statistically significant. Based on these data alone, no significant differences may be concluded. This conclusion is statistically accurate but not an appropriate conclusion about the effectiveness of the treatment. Therefore, using these data, no conclusions could be confidently made about the treatment (training).

However, if the total of referrals from all people in the treatment group was three and from the nontreatment group was zero; and, if the treatment group had more insight and awareness than the nontreatment groups, perhaps these few incidents suggest some impact of the program. The inability to statistically test hypothesis does not necessarily mean that no relationships exists. How else might we examine treatment effects in this low-incident situation, besides the statistical test? The answer is simple; this can be achieved by adding a qualitative component that allows for detailed examination of the treatment effects.

The outcomes can be strengthened, we argue, using mixed methods. In this approach we frame the search for meaningful data from combining the nomological network and the principles of truth value. In other words, what is shown next is that the researcher adopts a qualitative approach to build the nomological network, which is then tested quantitatively.

A Solution within a Mixed Methods Research Approach

Mixed methods research designs have proliferated over the past two decades. Some methodologists have developed ways to combine qualitative and quantitative research that result in designs to address specific types of research questions. For instance, Creswell and Clark (2011) offer at least six categories of mixed methods designs: convergent parallel design, explanatory sequential design, exploratory sequential design, embedded design, transformative design, and multiphase design. The design option depends on the research question being asked. Ridenour and Newman (2008) reduce the potential mixed methods designs to three categories: sequential, simultaneous, and the interactive continuum. A “low incidents approach” is not another category of mixed methods approaches – categories that have been defined elsewhere by Creswell, Clark, Guttman, and Hanson (2003), Greene and Caracelli (1997), Morgan (1998), Morse (1991), Patton (1990), Steckler, McLeroy, Goodman, Bird, and McCormick (1992), Tashakkori and Teddlie (2003), Newman, Newman, and Newman (2011), and Ridenour and Newman (2005b). Rather, it is a method that can be applicable to any one of the categories these authors suggest when the criterion variable occurs infrequently.

Some researchers might believe that low-N studies almost always lend themselves to qualitative approaches. However, just because qualitative studies most often involve only a few participants does not mean that situations with few participants are legitimately studied only through qualitative methods. The researcher must always begin by focusing on the research question, not the N-size. If the research question and purpose call for measures of group differences or program effectiveness then qualitative research approaches would not suffice and quantitative methods would be appropriate, even with small numbers. On the other hand, a low level of

statistical power (i.e., small sample size) prevents effective quantitative analysis (Cohen, 1988; McNeil, Newman, & Kelly, 1996; McNeil, Newman, & Fraas, 2012). Optimally, both together, a mixed methods approach, would be more likely to maximize the capacity of the researchers to produce meaningful results. Good mixed methods designs can be complementary – the quantitative evidence informs the qualitative evidence. Each has weakness and using both strengthens the study's potential.

We recommend for a mixed methods approach derived from dual constructs: a nomological network conceptualization (Cronbach & Meehl, 1969; MacCorquodale & Meehl, 1948) and truth value (Lincoln & Guba, 1985). We argue that the constructs of nomological network and truth value are part and parcel of the same phenomenon. Both can frame the researchers' work in ways that strengthen validity in low incidents situations. In quantitative research, validity sets the standard researchers aim to meet. As the study design eliminates explanations for the variable relationships other than the researchers' hypothesized ones then the internal validity grows in strength. Stated another way, when internal validity is strong, the study design has more capacity to show links between cause and effect, or to confirm hypothesized relationship among variables.

In qualitative research, truth value is increasingly strong as the design reduces ambiguity about patterns of emerging meaning. In other words, when truth value is strong, the design has more capacity to claim the emerging themes of meaning have solid foundations in verifiable evidence. In quantitative research truth value is enhanced when internal validity is strong. These constructs (nomological network and truth value) are discussed in more detail in the next two sections.

Theory and the Nomological Network

Our conception of theory underlying the approach advocated here is theory as a nomological network. One obligation of researchers in any study is to define how they are using the concept of theory because the meaning of "theory" varies (Anfara & Mertz, 2006).

The first meaning of theory is an explanation (made up of logically related propositions) consistent with observed phenomena that is testable (verifiable) and predictive (Kerlinger, 1964; McMillan & Schumacher, 2009). For example, Krathwohl (2009) invokes this conceptualization as one criterion for a good research problem, that is, "Is it [the research question] embedded in theory so that it is part of a network of propositions and explanations?" (p. 89).

A nomological network could be considered as a subset of a "theory" – a network which explains how a number of components within a theory are interrelated. A nomological network was defined by Cronbach and Meehl (1969) as "the interlocking system of laws which constitute a theory" (p. 10). We interpret their use of the word "laws," however, not to mean concrete unambiguous "givens" but rather as propositions. They suggested that some of these "laws" may be "observables" (quantitative measurements) but not all need to be. We argue that the nomological network provides a venue for the researcher to use both data and logic to confirm patterns of evidence in low incidents situations.

A nomological network suggests sources of data as well as methods of data collection and analysis. A nomological network suggests the relationships among the sources of the data. Consistent with Cronbach and Meehl (1969), some sources may be quantitative ("deterministic") and some sources may be qualitative ("implicit" and "derived"). As a type of confirmatory analysis, the mixed methods approach we are advocating here for situations of low incidents is more powerful than using one method alone; this is similar to the fact that a directional hypothesis is more powerful than a nondirectional hypothesis if the researcher predicts in the right direction. This type of analysis and logic, if confirmed, produces greater "truth value" than one-dimensional methodology (quantitative or qualitative alone) could provide.

In quantitative (usually theory-testing) research, the researcher aspires to take a disinterested and neutral position from which to approach the study. The researcher's objective stance acknowledges what some postpositivists refer to as the theory-ladenness of the research situation (Campbell & Stanley as cited in Plano Clark & Creswell, 2008; Phillips & Burbules, 2000; Plano Clark & Creswell, 2008). In other words, what the researcher observes is influenced by the theory (or framework) that the researcher uses. For example, according to Phillips and Burbules (2000):

> What an observer sees, and also what he or she does not see, and the form that the observation takes, is influenced by the background knowledge of the observer – the theories, hypotheses, assumptions, or conceptual schemes that the observer harbors. (p. 15)

In essence, this quote from Phillips and Burbules is a conceptual link to the second meaning of theory, that is, a worldview or perspective.

This second meaning of theory comes from those who use theory as a lens through which they experience and interpret the world. For them, theory can constitute one's methodology (Crotty, 1998; Denzin & Lincoln, 2003). Some researchers using qualitative methods adopt this meaning of theory – theory relates to the methodologies and the epistemologies that support them (Anfara & Mertz, 2006). Critical theorists and feminist theorists are examples of researchers whose epistemologies define their theories, according to Creswell (1998). Denzin and Lincoln (2003) proposed a more expansive view and "equated paradigms with theory" (as cited in Anfara & Mertz, p. xxi). Creswell (1998), too, suggests that some qualitative researchers adopt cultural and ideational theories (lenses) as they write about groups of people living through changing conditions. In other words, the researcher assumes a particular lens on what is being studied and writes the interpretation of data analysis from this theoretical perspective.

In this article we use the construct of theory in the first way we discussed, that is, theory as a nomological network, not in the second way, that is, theory as a perspective, methodology, or lens. There are researchers who accept the role of some quantitative studies to test theories and the role of some qualitative studies to build theories (Krathwohl, 2009; Ridenour & Newman, 2008; Strauss & Corbin, 1994.) This dichotomy is not universally accepted[2], but is not disputed

[2] Anfara and Mertz (2006) argue for three uses of theory in qualitative research: (1) as invisible – a potential outcome of qualitative data analysis; (2) as a methodological and epistemological lens (3) as informing all aspects of the structure of the study. We are arguing the first use in our model of qualitative – quantitative mixed methods continuum.

in positioning theory as one of the linchpins that connecting qualitative and quantitative designs into mixed methods studies (see Morse & Niehaus, 2009; Ridenour & Newman, 2008).

Truth Value

The concept of truth value is derived from Lincoln's and Guba's (1985) strategies (expanded in Ridenour & Newman, 2008) for enhancing trustworthiness in qualitative research. Truth value is the sum of the strategies researchers employ to strengthen the validity estimate of their findings in qualitative studies. These strategies are design techniques (also called legitimation techniques) that build logic and trust in the results; in fact, they are often referred to as trustworthiness strategies. From a longer list of strategies, there are four examples we can cite. The first strategy is when the researcher spends time observing a cultural group such as a classroom until he/she begins to see the same behaviors repeatedly, and sees no new behaviors. Lincoln and Guba would likely claim that researcher had employed the strategies of prolonged engagement until saturation. Second, when the researcher returns to informants he/she has interviewed to check their agreement with the transcripts of their words, the researcher is employing member checking, another strategy to build trustworthiness. Third, triangulation is the strategy of employing more than one source of data in a qualitative study (i.e., teachers and parents), or using more than one data collection technique (e.g., interviews as well as observations). Fourth, negative case analysis is another strategy that might be used when encountering a unit of data during the analysis that fails to fit into an emerging theme. The researcher revises the emerging theme and the evolving theory until it logically can include that data unit.

Trustworthiness strategies or truth value (the sum of all the strategies) is parallel to the notion of validity for some researchers (Lincoln & Guba, 1985; Ridenour & Newman, 2008). When results from several trustworthiness strategies (e.g., member checking, prolonged engagement, triangulation, and negative case analysis) accumulate and together strengthen emerging meaning, the credibility of findings is enhanced. Truth value evidence is, in essence, an estimate of the validity of the qualitative study.

Combining the Nomological Network and Truth Value

We combine truth value and the nomological network. Combining them creates a mixed methods approach. In this section we present three mixed methods models to study a low incidents situation within adolescent suicide awareness and prevention.

The first mixed methods model. The description of the first model can be explained by using the basic methodological model on which we base our views of mixed methods research, that is, the Qualitative Quantitative Interactive Continuum (Ridenour & Newman, 2008). Figure 1 depicts the continuum. As we relate the specifics of the low incidents research example, we include discussion of the basic assumptions of this model.

The Qualitative Quantitative Interactive Continuum is an approach to mixed methods that assumes the two research paradigms exist in a holistic methodological continuum. They are not a dichotomy of distinctly separate qualitative and quantitative methods. For example, in Figure 1 the circles represent a common sequence of researcher decisions when the study is primarily

qualitative and the squares represent a common sequence of researcher decisions when the study is primarily quantitative. The place of theory (the nomological network) is a connecting link between the two paradigms. The model also assumes that researcher decisions are sequential, and it assumes that there are various points at which the researcher can enter the model. Further, it assumes that qualitative research is often theory-building research and quantitative research is theory-testing research. Qualitative researchers typically begin immersed in the data (circle A) while quantitative researchers often begin with theory (square 1). The following steps show the sequential process. The first mixed methods model can be explained using Figure 1.

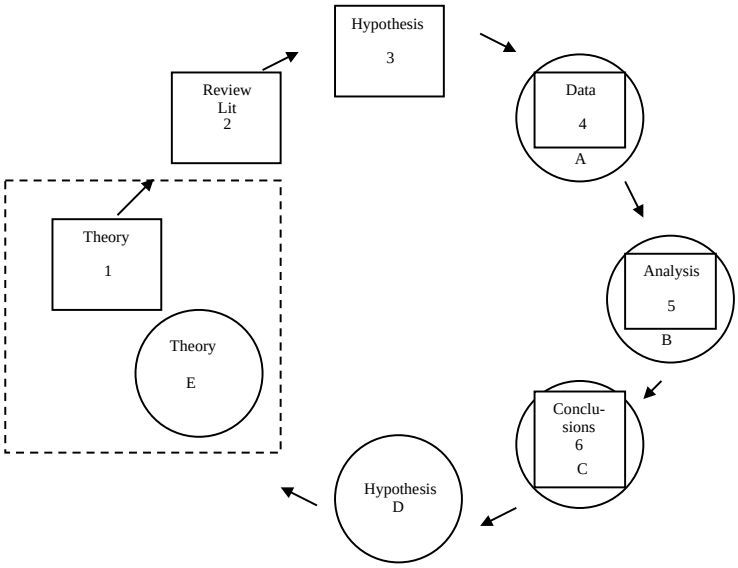

Figure 1. Mixed Methods Model 1. Qualitative-Quantitative Interactive Continuum (Ridenour & Newman, 2008). A common sequential mixed methods approach assumes that qualitative research is theory-building and quantitative research is theory testing. Circles represent the sequence of qualitative research. The researcher begins at immersing herself in the data (A), then analyzing those data (B), drawing conclusions from the analysis (themes) (C), deriving hypotheses from those themes and their relationships to one another (D), and constructing a theory of understanding the qualitative object of study. Squares represent the sequence of quantitative research. The researcher begins with theory (1) which comes from the literature review and leads to the literature review (2), which gives foundation for the researcher to derive hypotheses (3), and then collects data on relevant variables in those hypotheses (4), analyzes the hypothesis with statistical tests (5), drawing conclusions from those tests (6) which may or may not support the theory (1). This diagram is much simpler than the actual research processes – which are often iterative (back and forth) between the steps.

In this model, the researcher carries out a sequence of qualitative research decisions followed by quantitative research decisions. This model uses grounded theory (Bryant & Charmaz, 2007). Grounded theorists generate meaning from immersion in the data. In this model the researcher generates and tests one theory about the treatment schools and generates a second theory about the nontreatment schools. Each gives potential explanatory power to the evaluation.

The mixed methods model might take place as follows: The researcher first gains access to one of the "treatment" middle school sites of the adolescent suicide program. She immerses herself in the suicide awareness program activities along with the students, jotting field notes while observing the interactions among students with each other and students with their instructors (A). Her initial goal is to narrow the selection of possible informants to students most likely to talk comfortably about themselves and their school. After the researcher builds rapport with the students, and using common procedures on informed consent, she informally interviews selected participants several times each over the 12-week duration of the program, focusing on students' ideas about depression and suicide ideation (A).

Throughout all phases of research she employs trustworthiness strategies. Mining the data, the researcher tags codes, and then arranges them into categories. Using axial coding (Corbin & Strauss, 2008), which means relating the original codes and categories of codes to one another, the researcher can create themes (B). These themes (and relationships among them) can become the variables within a nomological network (C and D). The nomological network provides a theory (E and 1) from which hypotheses can be derived and tested (3). The hypotheses are subjected to the appropriate statistical tests (5), from which conclusions are drawn (6). The conclusions are the statements of support or non-support for the relationships in the nomological network. The benefit of testing for statistical significance is obtaining an estimate of whether or not the data represent a population. The argument for model 1 is this: the more information researchers have the more accurate and the more trustworthy are their decisions based on the dataset. Researchers who might be usually restricted to qualitative judgment alone acquire more information by using model 1. The nomological net addresses the low-N problem because the N is not the number of participants but the N is the number of hypothesized relationships tested.

If all relationships are supported statistically and all hypotheses are in the right direction, the researcher can conclude that the data support the nomological network, that is, the theory. This study could be repeated in the nontreatment school to gain results that build and test an explanatory theory in those settings. When both concepts are employed in low incidents studies, this constitutes a mixed methods approach.

A variation on this mixed methods model could be carried out if the researcher collected qualitative evidence from different sources. For instance, the researcher might not only interview students, but also interview teachers and parents. To the extent the researcher gets confirmation of the nomological network from different sources, we have evidence of triangulation, and, therefore, greater "truth value" and have reduced the uncertainty concerning whether or not there is a relationship between training and the outcomes. The mixed methods approach allows the researcher to make claims that have logical as well as empirical support, Cronbach's and Meehl's (1969) definition of a nomological network.

The second mixed methods model. A second model based on the same assumptions about qualitative trustworthiness could be carried out as well. In this model, the strategy is to determine whether or not the qualitative research approach and the quantitative research approach enhance and support one another. We consider this a mixed methods model because the application crosses both paradigms. This mixed methods model is depicted in Figure 2.

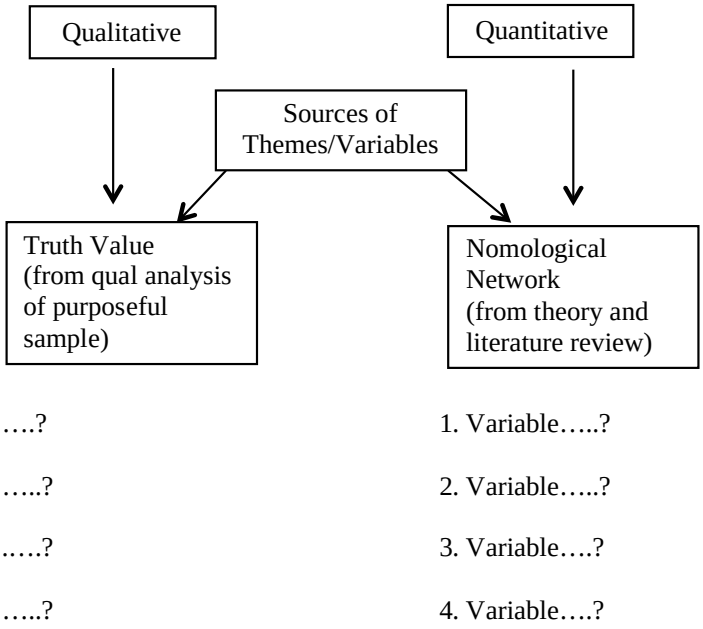

Figure 2. Mixed Methods Model 2. Matching patterns of themes and variables to verify content validity from a mixed methods approach in low incidents situations. In this model, the researcher makes the following judgments: For Confirmatory Purposes: How similar (or different) are the constructs (content) from the two approaches? For Exploratory Purposes: What are the themes from the qualitative analysis and from the theoretical framework? Are there any discernible patterns in either?

In this model, the benefit of complementarity that comes from mixed methods research (Tashakkori & Teddlie, 1998) is maximized. The variables tested from the nomological network (theory in the quantitative study) can be compared to the themes (constructed from the qualitative exploration). The researcher reviews the literature about the stressors associated with adolescent suicide and suppose she has found that the major sources of both student stress and student satisfaction are (in this order of frequency) testing, athletics, social media, grading policies, and planning for post-graduation years. In addition, she investigates the theory underlying the Adolescent Suicide Awareness Program itself and compares the theoretical constructs in that theory to what she learned from the literature review. She finalizes the list of important variables (see the right column in Figure 2).

The researcher makes contacts with the principals in a sample of the treatment schools and the nontreatment schools. She conducts interviews with a purposeful sample of students, parents, and teachers in both settings. Her interview schedule includes a series of questions about attitudes toward school, particularly the feelings of members of the three groups about various school sources of stress and satisfaction. She is looking for the themes that are to be constructed from analyzing these interviews (left column in Figure 2).

She studies the two sets of findings (the themes from the analysis of interview transcripts and the variables for the literature review and the underlying program theory) and makes a judgment as to the similarities between the two sets of findings.

In the situation where matching the emerging themes and theoretical variables reveals similar patterns, the findings are confirmatory, increasing content validity of the mutual findings. In other words, when strong truth value in revealed qualitative results matches relationships in the nomological network there is strong meaning in the conclusions. Because the researcher constructs meaning from the qualitative data, in some ways, truth value is both evidence and logic.

The third mixed methods model. A third model is depicted in Figure 3. Beginning with the theory (nomological network) that forms the foundation of the adolescent suicide program, the researcher could generate lines of inquiry. Lines of inquiry might also come from the literature on adolescent mental health. In addition, questions might be drawn from the goals of the program. Suppose that all lines of inquiry comprise the questions listed in the left column in Figure 3.

Next, the researcher could identify knowledgeable participants and stakeholders within and contingent to the adolescents involved in the program. With the purposes from these questions in mind, the researcher could interview these informants along with inspecting any written descriptions relevant to the program. The researcher would be creating a collection of transcripts and narratives.

Using standard qualitative data analysis techniques, the researcher would analyze the collected data. The explanations that emerge from the qualitative analysis have the potential to provide evidence to conclude a "yes" or "no" answer to each line of inquiry (column 2 on Figure 3). For instance, one line of inquiry (#10) seeks to discover whether or not the pattern of suicide among the acquaintances of the study participants is consistent with epidemiological databases on suicide in this age group. Are the treatment group statistics on incidence different from the nontreatment group statistics? Are the differences in the predicted direction? The researcher examines the data and makes a "yes/no" judgment. Similarly the researcher draws conclusions about each line of inquiry. Using the binomial goodness of fit index (Fraas & Newman, 1994; Newman, Fraas, & Norfolk, 1995), the hypothesis that there is a significant difference between the treatment and nontreatment schools on these dimensions could be evaluated. The researcher's question becomes: How many of these hypotheses are in the appropriate direction (to show program effectiveness)? The binomial index would be used to draw legitimate conclusions from these tests.[3]

[3] The commonly used goodness of fit measures are those such as the likelihood ratio chi square, the adjusted goodness of fit index, and the Bentler Bonett normed fit index (Schumacker & Lomax, 2004). All are based on the reproduction of the correlation matrix based on path coefficients. The binomial index of model fit, on the other hand, estimates the proportion of all subsets (hypothesized relationships) that support the theoretical model. Therefore it is a direct measure of that structural equation model. As proposed by Fraas and Newman (1994), the calculation of this index requires 2 steps. First, the researcher selects the criterion to be used to determine if the parameter (path coefficient) supports the hypothesis. Examples of the several criterions that could be used include *a priori* effect size, statistical significance, and directionality (positive or negative) of the parameters, or a combination of these.

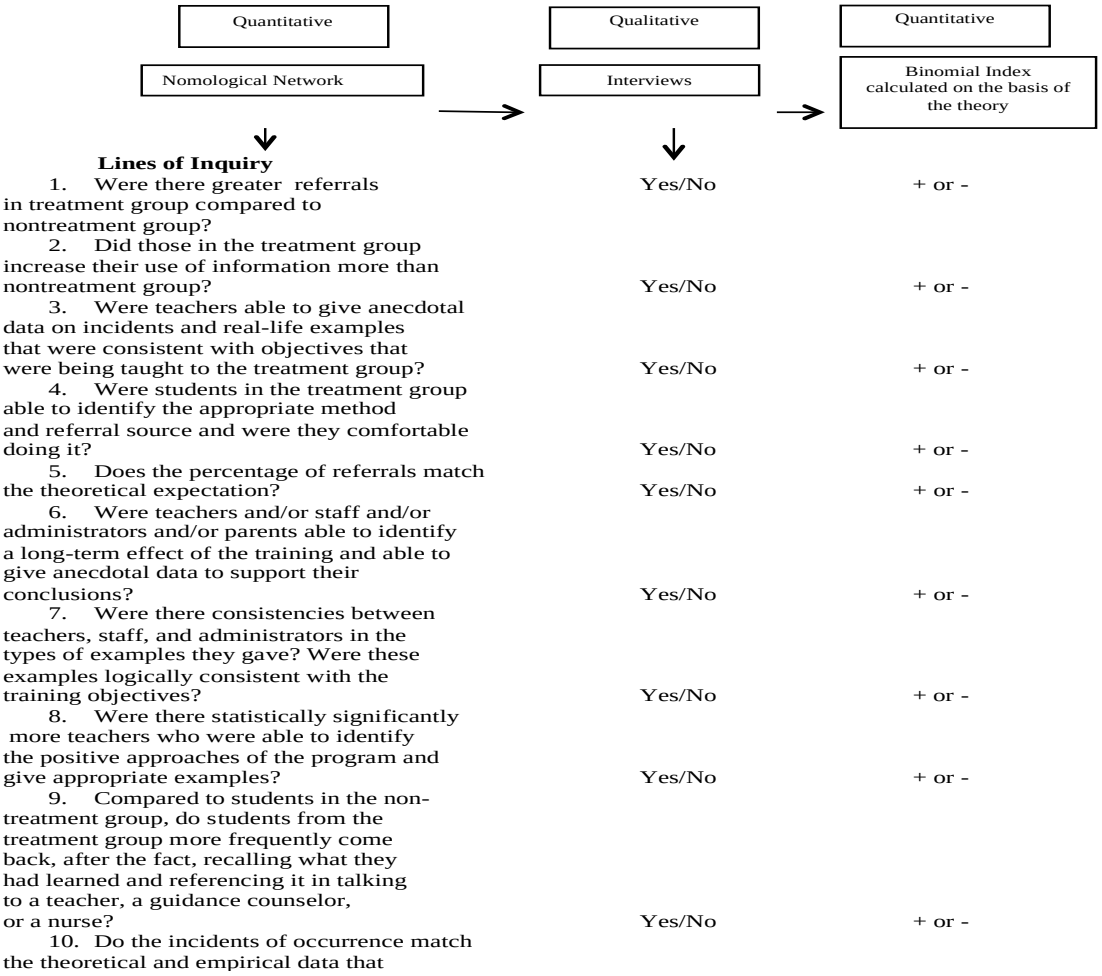

Figure 3. Mixed Methods Model 3. Using mixed methods in low incidents situations: Applying a Binomial Goodness of Fit Index to test the confirmability of Yes/No responses to lines of inquiry from a nomological network (Theory). In this model, the researcher collects evidence for each question. She makes a judgment (yes/no) to each question. She then compares the frequency of Yes/No answers that are in the correct direction, according to the theory of an effective program. For example, suppose there were 7 out of 10 items for which the frequency of answers was in the direction suggested by the theory. The Binomial Goodness of Fit Index will suggest a probability level for that N of 7. The researcher can then determine: Were there a significant number of positive results (i.e., results in the predicted direction) according to the theory?

Once the criterion is established, the second step is to calculate the proportion of all subsets (hypothesized relationships) that agree with the model from the sample. This can be done by a relatively simple probability formula (see Fraas & Newman, 1994) or even more simply by referring to a sign test table in any nonparametric textbook.

Replicability: A Criterion for Good Science

Replicability, central to building a scientific knowledge base, continues to be underplayed in conversations about research and statistical analysis. Confirming the nomological network can only be done through replicated studies. Low incidents research, with small N sizes, is unlikely to result in statistical significance. But, this may be less a barrier than is replication. A relationship exists between statistical significance and replicability but not a linear one. The implications from estimates of replicability, according to Newman and Fraas (1992) include the fact that the traditional ".05" alpha level may be too high. For example, an N of approximately 12 can result in findings that are statistically significant at the .05 level which means that one is 95% confident that the relationship is not due to chance in the population. The replicability of this study may be as low as 50%, not 95%. Statistical significance at .05 means that 50% of the time the study is not likely to replicate when alpha is at the .05 level. However, results that are statistically significant when $p = .01$ will replicate statistical significance approximately 72% of the time (for an alpha set at .05). With statistical significance at $p = .001$, results will replicate approximately 90% of the time when the alpha level is set at .05. Newman, McNeil, and Fraas (2004) have elaborated on the importance of replicability estimates. They suggest that consideration be given to replacing the report of statistical significance with those estimates because such a report would be a more meaningful standard of accepting research outcomes.

Replicability means that a body of knowledge accumulates through repeated testing. The truth value of a body of knowledge that is a "scientific" body of knowledge is strengthened by replicability (Ridenour & Newman, 2005a). Reinforcing the importance of replicability as one of the foundations of a truly "scientific" knowledge base is a reminder of four other qualities of research that we can deem as "scientific": (a) that researcher processes are systematic and sequential; (b) that research process and findings are verifiable; (c) that findings are self-correcting when related to former findings, and (d) that process are frequently aimed at explanation, "explanation" being often the aim of science, and sometimes explanation of causal relationships (Ridenour & Newman, 2005a; 2008). Science is a way of knowing about the world and that process of knowing needs to incorporate these five qualities. Studies of low frequency occurrences, when approached through appropriate mixed methods, may be more consistent with these criteria of science than they would be if studied through a quantitative or qualitative approach alone.

Conclusions

We have attempted to show how traditional quantitative methods can be improved as research tools by qualitative methods, especially in low incidents (low N size) situations. Many important educational situations occur infrequently. Applying a mixed methods approach utilizes the strengths of both qualitative and quantitative research strategies to increase the trustworthiness of the researcher's conclusions. Our framework is built on the power of the nomological network and the strategies employed to enhance truth value – both epistemologies central to a strong mixed methods approach.

Although this is not the only way of approaching a low incidents situation, this serves as a model, not *the* model. Numerous advantages to this approach stem from the very limited

possibilities for designing studies with very low numbers. First, mixed methods may be more powerful than purely quantitative methods in detecting differences when differences exist in situations of low incidents. Two fundamental values of using a mixed methods approach in a low incidents situation are the value of replication that builds the nomological network and the importance of trustworthiness. Researchers can examine infrequent phenomena in ways that provide depth, explanatory power, and generalizing power using a mixed method approach.

The disadvantages are the unavoidable expanded obligations on the researcher; for instance, abandoning the assumption that infrequent events can only be investigated through case studies. Rather, the researcher needs to focus on her question and purpose – and then make decisions about methods. Using this approach requires the researcher have competencies in more than one set of methods. Furthermore, this approach requires understanding phenomena thoroughly rather than only mechanically. A researcher needs to be able to adopt a holistic viewpoint. A researcher might need to be more flexible in his/her thinking. A researcher might face challenges in writing about and explaining the data when using this approach.

Finally, the costs of using a mixed methods approach in low incidents situations need to be weighed. For instance, conducting interviews in both treatment and nontreatment groups, especially interviews of students as well as teachers and parents, adds costs to the far less labor-intensive and time-intensive costs of using quantitative data records on incidents. Such costs might seem prohibitive at first review. Within this disadvantage, however might come a hidden advantage: careful budget planning at the outset of designing the evaluation. The plan prepares the major stakeholders to acknowledge the methodological implications of serious social conditions such as adolescent suicide in which low incidents are not only likely but are desirable outcome indicators.

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