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Mixed Methods Research in Education: Capturing the Complexity of the Profession

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Abstract: Mixed methods research is recognized as a third model of research in social and behavioral sciences. Its value for educational research just recently began to be discussed in the literature (Ponce, 2014: Scott & Sutton, 2009: Ellis, 2005). A mixed methods research study means the use of quantitative and qualitative methods as components of a research design (Caruth, 2013; Ponce, 2011; Creswell, 2009; Greene, 2007) or a research program (Phillips, 2009). Most of the literature on mixed methods research could be considered generic (Creswell, 2009). This means that the discussion centered on research designs with little or no relation to any particular disciplinary context. According to Creswell (2009), the development of literature in a particular discipline's context, using mixed methods research, will help to strength the mixed research movement. In this article, the authors explain mixed methods research and its possible uses, strengths, and challenges in educational research.

Key-Words: Educational Research, Mixed Method Research, Mixed Method Designs, Educational Sciences, Behavioral Sciences.

1. Introduction

There is no one universal definition for educational research (Hedges & Hanis-Martin, 2009: Condliffe and Shulman, 1999). A common view of educational research is to define it as research into educational matters (Johannigmeier & Richardson, 2008: McMillan, J. H. & Schumacher, S., 2005: Condliffe & Schulman, 1999: Segovia, J., 1997: Charles, C.M., 1988: Cohen & Manion, 1980). Historically, the field of educational research has faced controversies in its quest for effectiveness in capturing the complexity of educational phenomenon (Walters, 2009: Vonovkis, 2009: Johanningmeir

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& Richardson, 2007: Condliffe, 2000). We consider three controversies in educational research as relevant to illustrate the challenge of researching educational complexities. The first deals with how education is defined to do research in educational matters. This controversy originated when the field of educational research was emerging (Johannigmeier & Richardson, 2008). Is education a natural phenomenon that manifests in the same way for all students regarding any particular schools or educational systems or is education a cultural phenomenon mediated by the social norms and the values of students, teachers and administrators? (Latorre, 2008: Pring, 2000: Carr & Kemmis, 1986). If education is defined as a natural phenomenon, then teaching and learning process becomes a lineal phenomenon where educational policies, teaching practices and the administrators and teachers behavior become the "causes" and learning the "effects." From this point of view of education, the quantitative research methods become the dominant approach to assess individual components of the schools (e.g., student satisfaction) or the effects of one component into another (e.g., the effect of math teacher in producing student's learning). If education is defined as a cultural phenomenon, research into educational matters should focus on multiple and complex social relationships that occur in school settings to produce learning. The relationships among students and their parents with teachers and administrators, place educational researchers in a position that they have to deal with abstract social phenomenon such as school constituencies' interpretations of the educational policies, the school's curriculum or the teaching styles used in the school as well as the cultural values of students. The use of qualitative research methods have been the dominant approach to understand the student's learning experiences, the values students bring to the educational process, or how the educational process change student's values and cultures, as well as the political aspect of education that comes in the form of educational policies, programs and curriculum (Latorre, 2008: Carr & Kemmis, 1986). No matter how researcher defines education or decided to approach the educational phenomenon, the field of education is complex and elusive **(**Johannigmeier & Richardson, 2008: Condliffe, 2000).

A second controversy in educational research deals with how to capture the complexity of educational phenomenon since the research paradigm war between 1970 and 1980. The debate, well documented in the literature (e.g., Eisner & Peshkin, 1990), exposed two opposing views of educational research: a) the believe that one research model was superior than the other (Tashakkori & Teddlie, 1998), and (b) the relevancy of qualitative research as a research method in education (Denzin, 2009). An outcome from the paradigm war was the recognition that quantitative and qualitative research methods are important in educational research to capture the complexity of the field (Hammersley, 2007: Pring, 2000). Quantitative research methods are

important for measuring educational phenomenon with precision and to determine and evaluate the value of educational programs and public financial investments. Qualitative research is important for capturing the context of educational phenomenon and the humane and social aspect of education (Greenne, 2007).

The third controversy deals with the quality and utility of educational research to solve the problems of public education and to generate educational policies (Walters, Lareau & Ranis, 2009). Capturing the complexity of educational phenomenon is one of the criticisms raised in educational research. To solve the problems of public education, educational research must be sustained on science to produce evidence educational practices as occurs in medical research or agricultural research (Walters, Lareau & Ranis, 2009). Scientific research means quantitative research (Shavelson & Towne, 2002). This controversy emerged between 1994 and 2001 (Walters, Lareau & Ranis, 2009) and is considered a political issue rather than a science issue. Qualitative research is not considered scientific in some political and influential groups (Denzin, 2009). From this controversy, the use of quantitative and qualitative research is considered an important component of any educational research program in order to capture the complexity of this field (Phillips, 2009).

2. Mixed methods research

A mixed methods study is research intentionally combining or integrating quantitative and qualitative approaches as components of the research. The use of these approaches can occur at different points in the research process. (Caruth, 2013; Creswell, 2011; Ponce, 2011; Teddlie & Tashakkori, 2009; Greene, 2007).

a. In the planning phase where the research plan is developed, it becomes clear what is investigated and how quantitative and qualitative approaches are used.
b. Combining or integrating research questions from quantitative and qualitative approaches to guide the researcher into the complexity of the problem studied.
c. Using quantitative measurement instruments with qualitative research techniques to generate quantitative and qualitative data for the research problem.
d. Combining or integrating quantitative and qualitative data in the analysis of study data.
e. Combining or integrating quantitative and qualitative data in the presentation of the study findings.

Four objectives are pursued in mixed methods research (Caruth, 2013; Creswell & Plano Clark, 2011; Ponce, 2011; Teddlie & Tashakkori, 2009; Berman, 2008; Greene, 2007):

a. Combining or integrating quantitative and qualitative methods toward the best possible approach to the research problem.
b. Generate quantitative and qualitative data toward a clear and deep understanding of the research problem being addressed.
c. Generate quantitative and qualitative data from the same research problem that allows the researcher greater certainty in inferences, conclusions or statements which formulate its findings.
d. Make more robust research by using the strengths from one research model to offset methodological shortcomings from the other. This produces more reliable research.

3. Characteristics of mixed methods studies

There are many forms of quantitative and qualitative research. Both the model of quantitative research and qualitative operate upon some assumptions about what research is and how it should develop. When the researcher combines or integrates quantitative and qualitative approaches in the design of mixed study, what it does is create a third research model that allows using these two in an articulated and harmonic manner. The first step to combine or integrate quantitative and qualitative approaches in the same study is to understand the assumptions, the foundations and characteristics of mixed studies, as a third research model (Caruth, 2013; Creswell & Plano Clark, 2011; Ponce, 2011; Campos, 2009; Morse Niehaus, 2009; Teddlie & Tashakkori, 2009; Greene, 2007; Mertens, 2005; Tashakkori & Teddlie, 1998). Let's review some of them:

a. *The nature of the problems of mixed research (premise).* Mixed methods research is used only when the complexity of the research problem cannot be addressed from the unique perspective of a quantitative or qualitative study. The argument is that contemporary society has evolved and has become more complex. The vast majority of the social, economic and contemporary political problems show that complexity. Let's use the example of environmental problems. Environmental pollution is the result of many factors; urban development, the development of various means of transportation, like the car, the use of water bodies as a recreational environment, and so on. Researching the problems of the environment, and venturing into its complexity, demands the use of multiple studies to address

the complexity. Mixed methods studies are based on the belief that there are existing problems whose complexity cannot be fully researched when the combination or integration of quantitative and qualitative approaches are not undertaken as components of the study. Simply put, the complexity of the problem cannot be deciphered or fully understood from a single quantitative or qualitative approach. Mixed studies address research problems in which clear objective and subjective aspects are manifested that require the use of quantitative and qualitative approaches. For example, the temperature in a cinema. Subjective elements are aspects of the problem that can be understood only by the perceptions and experiences of those who live them. For example, if the temperature of the theater is considered pleasant or unpleasant. Mixed methods research is used only when we address research problems which have objective and subjective elements in its manifestation.

b. *The research question (foundations).* Mixed studies emphasize the research questions of the study being the focus of all methodological decision. The research question guides the study and determines which components of quantitative and qualitative models are used. In other words, what determines the combination or integration of quantitative and qualitative approaches are the research questions of the study. The relationship between the research questions and the quantitative and qualitative approaches should be seen clearly when designing the study. This is important to establish the relevance and alignment of quantitative and qualitative approaches which are selected to study the research problem.

c. *The research process (methodology).* The process of a mixed methods study is to integrate or intentionally combine quantitative and qualitative approaches as components of the study. The aim is to explore the complexity of the research problem to measure their objective aspects and to understand / describe their subjective elements as directly and accurately as possible towards its manifestation or expression. The combination of approaches occurs in two ways; prior to the study or in the planning stage as in quantitative studies, or in the development of the study where the researcher recognizes the need to depart from the original design of research to achieve their research goals, as in qualitative studies.

d. *The behavior of the researcher (philosophy).* The action of the researcher is pragmatic, meaning the product is more important to study the process. Any decisions on how to combine or integrate quantitative and qualitative approaches, once the study is in place, is based on how these provide an insight to the complexity of the problem and answer the research questions of the study to achieve the research objectives. The more a combination or integration of quantitative and qualitative approaches can

zoom in and capture the essence of the problem, the greater the relevance and effectiveness of the design. When this occurs, it can be argued that the researcher's decisions were correct.

e. *The study outcomes.* The product of a mixed methods study is quantitative and qualitative data upon the problem studied. The collection of quantitative and qualitative data provides more complete information, descriptive or broader, from the research problem and this allows the researcher to make more informed decisions about how to solve the same.

4. Models of mixed methods research

There is no universally accepted definition of mixed methods research. In the literature the following two models mixed methods research are identified (Ponce, 2011; Creswell, 2009):

Model 1

1. Is the first model of mixed methods research identified in the literature prior to the 1990's.
2. Quantitative and qualitative approaches in the same research were used, but not connected, integrated or combined.
3. Combining or integrating the data is done at the end of the study to answer the research questions.

Model 2

1. Is the model of mixed methods research emerging in the 1990's, and defines its contemporary practice.
2. Combining or integrating research approaches intentionally to produce a more robust study that one of mono-methodological approach.
3. Integrating approaches occurs in the philosophical positioning of the study, methodology and data analysis.

5. The basic structure of the mixed methods study

Two basic structures or ways of combining or integrating quantitative and qualitative approaches as part of the design of a mixed methods study are recognized. These structures are explained below (Ponce, 2014: Caruth, 2013; Creswell & Plano Clark, 2011; Ponce, 2011; Teddlie & Tashakkori, 2009):

a. Research in sequential phases (sequential phases design). Signifies that the researcher begins his study with a research approach (phase I) and uses findings to design a second phase (Phase II), but using another research approach. For example, the study begins with a qualitative phase and uses

findings to design the quantitative phase. The fundamentals of studies with sequential phases are to use a research approach to study deeply the research problem and then use the findings of the first phase and design the second phase. The two possible combinations under the structure of sequential phases are presented in Figure 1:

Figure 1
Sequential Phases Mixed Studies Structure

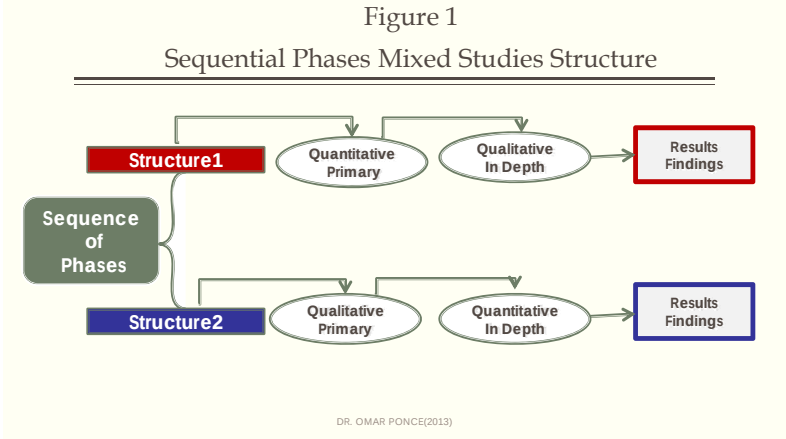

Figure 1. Sequential Phases Mixed Studies Structure

*b. Research in parallel phases (*convergent parallel design*).* Means that the researcher uses quantitative and qualitative approaches simultaneously in the development of their study. Generally, parallel phase studies consist of studying the problem in an integrated manner from the quantitative and qualitative approaches. Figure 2 illustrates the structure of parallel phases of a mixed methods study.

Figure 2
Parallel Phases Mixed Design Structure

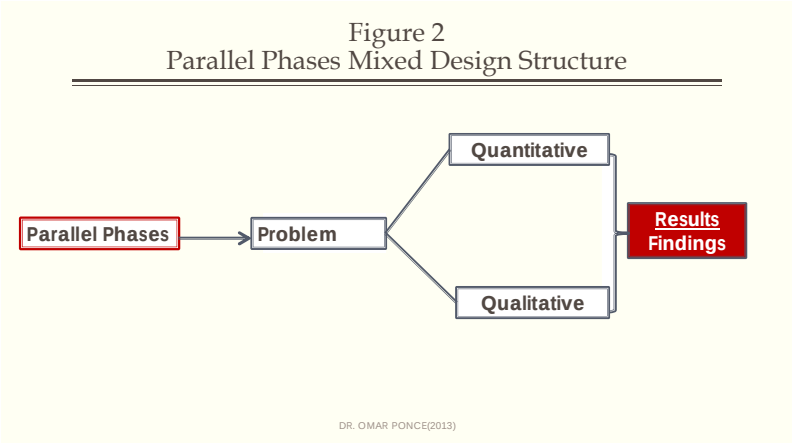

Figure 2. Parallel Phases Mixed Design Structure

6. Mixed methods research designs

The design means the research plan that will guide the researcher in conducting the study. Mixed research designs are accepted ways of how integrated quantitative and qualitative approaches can be combined in mixed methods study. Below are presented seven mixed methods research designs that illustrate the structures of sequential phases and of parallel phases (Ponce, 2014: Creswell & Plano Clark, 2011; Ponce, 2011; Teddlie & Tashakkori, 2009; Greene, 2007):

a. Exploratory design using sequential phases (quantitative - qualitative). The objective of this design is the exploration of the research problem. Exploration is used when very little is known about the research problem. The less information about the problem, the greater the relevance of this design to begin learning about it. This design first uses a qualitative research approach to explore the experience of participants with the phenomenon under study, their culture or values of the group, or the structure of the institution being studied. With the findings of phase I (qualitative), the researcher designs a quantitative study (phase II) to define or measure the findings of the qualitative phase (phase I) in a sample of the universe under study. For example, say that a car company wants to redesign your model sedan in the face of reduced sales. As they do not know the needs and interests of their customers, the study will begin with a qualitative approach using focused interviews. Identify buyers of that sedan model of the San Juan dealer, start the interview process and generate a list of the aspects both positive and negative and should consider the recommendations for a sedan car more responsive to the interests and needs of customers who bought it. With these findings, the researcher designs a questionnaire (quantitative phase II) to be administered to a sample of buyers of the same model at other dealerships of the company. Once administered the questionnaires and the data collected can specify the order of preferences, strengths and needs of customers to be incorporated into the next model line sedan cars offered for sale. In this study, the qualitative phase reveals the needs of customers and the quantitative phase facilitates the understanding of these needs in a large sample of the population (Figure 3).

b. Explanatory design using sequential phases (quantitative - qualitative). The purpose of this design is to study or describe the research problem in depth. To achieve this, it first uses a quantitative study to measure the attributes or properties of the problem (phase I) and then to a qualitative study (phase II) to deepen the findings of Phase I. For example, say that the Residents Association of an apartment complex decides to study the levels of

resident satisfaction with recreational areas. A survey with questionnaires to residents is performed (phase I). This survey asks how satisfied residents are with recreational areas, using a scale of 1 to 4. In this survey, 1 means very dissatisfied and 4 very satisfied (quantitative phase). After the structured quantitative survey the study continues with a qualitative interview, this time trying to understand the reasons for the initial response (qualitative phase). Each resident is asked to explain or qualify his answer. This allows generation of a list of strengths and weaknesses as perceived by residents of the recreational areas of the apartment complex. With this data, a plan is generated to meet the same. In this example, the quantitative phase measures the level of satisfaction of residents with the recreational areas and the qualitative phase allows us to understand the reasons (Figure 3).

Figure 3

Mixed Designs Basics

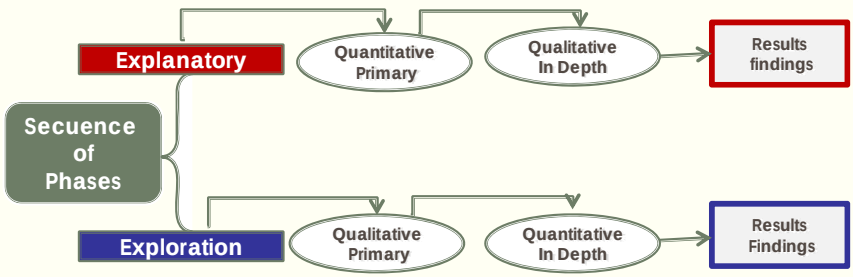

Figure 3. Mixed Designs Basics

c. Convergence design using parallel phases. The objective of this design is to study the research problem in its entirety and dimension. The quantitative approach is used to measure the properties and objective aspects of the problem. The qualitative approach is used to understand and describe the subjective aspects. It is known as convergence because each design approach is used to study different aspects of the problem. The quantitative approach measures the objective aspects of the problem and the qualitative phase enters the subjective aspects of the problem or the experiences of the participants. Convergence occurs because it is the researcher who integrates quantitative and qualitative data to explain the problem studied. For example, let's say the X Hospital hires a consultant to assess their pediatric services. As a quantitative approach, the consultant designs a checklist for pediatric

services regarding to the commitments established by the hospital toward patients; no wait time more than 30 minutes to be served, friendly doctors and nurses, make the best treatment accessible to patients, based on income and people's health plan. With this checklist, the consultant observes the performance of the pediatric ward, and how they care for patients and evaluates services according to established commitments. To understand the experience of parents and children with pediatric services, interview those who agree to be interviewed. In this conversation, the researcher tries to understand the perception of parents and children with the service they received. With the quantitative assessment component measures the degree of concordance between the services offered with the commitments in the hospital's mission. With the qualitative component, understands the experience of parents and children with the service received. The convergence of quantitative and qualitative data allows the consultant to explain how responsive and consistent pediatric services are offered by the hospital with the promises it makes to their patients, according to the experience and lives of the patients.

d. Triangulation design using parallel phases. The objective of this design is to use quantitative and qualitative approaches to study in depth the same aspects of the research problem. To achieve this, the researcher carefully plans the entire process of research to address these aspects of the problem from quantitative and qualitative perspectives. This is achieved if the measuring instruments and research strategies are aligned and complementary to collect quantitative and qualitative data of the problem. Thus, the data analysis focuses on these aspects to obtain quantitative and qualitative data to triangulate or consider the same aspects of the problem. We return to the example of the consultant evaluating pediatric services. To make the study of figure 3, a convergence study one of triangulation, the consultant must define pediatric services, build a checklist, align this to the promises (mission and vision) established by the hospital to their patients to measure the performance and effectiveness of services (quantitative phase). Also he needs to know the experience of parents and children, with each of these services received (qualitative approach). In conducting the study, he uses quantitative and qualitative approaches to examine the same aspects of the research problem. Thus, the researcher is able to penetrate and explain the problem in depth from quantitative and qualitative perspectives (Figure 4).

e. Complementary design using parallel phases (embedded designs). The objective of this design is to use one of the research approaches to counter the deficiencies of the other. In this design, a research

approach is used in a primary role because it is the dominant or principal method of study. Let's say we use an experiment as the main research method to test the effectiveness of a technique for relaxation and stress management. The strength of the experimental design in this case is that it tests, with people, the relaxation technique. Typically, the stress level of the subject before the test is measured, the technique is applied and the result is measured to determine whether the treatment effect appeared or not. The test technique with people is the greatest strength of the experiment. However, its shortcoming is that it does not provide an explanation of the process or how the technique works. This occurs because the experiment assumes that if a change occurred in the levels of relaxation of the subjects, as measured in the pre and post-test, it was due to technique. In this example, if a qualitative research approach is used where you can understand the experience of those with the technique is incorporated, then you might have a clearer idea of how it works. In this case, the experiment is the primary method of research and the qualitative approach is the complementary method because it is used to compensate for the methodological deficiencies of the experiment (Figure 4).

Figure 4
Mixed Design Basics

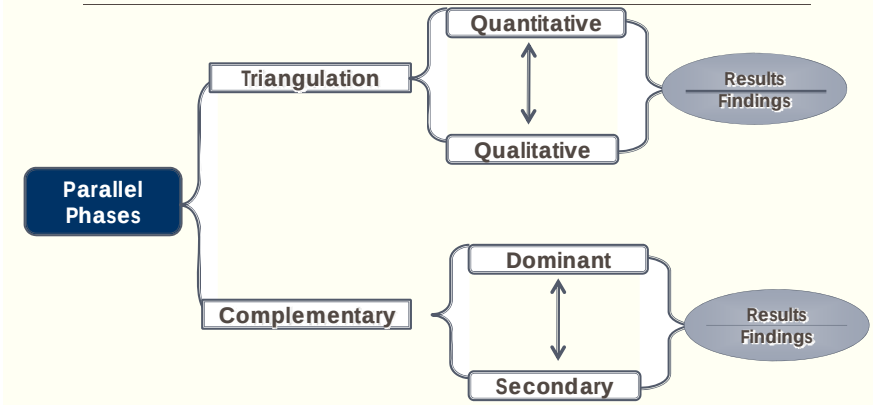

Figure 4. Mixed Designs Basics

f. Multilevel design (multiphase design). Multilevel designs are studies where the researcher needs to venture to different levels of analysis, study and research because the problem has several dimensions, manifestations or ramifications. Therefore requires different research approaches and different groups or samples to enter this complexity and to decrypt it. Let's say that the management of a private school decides to adopt a new curriculum where all classes will be conducted in English and Spanish

alternately. One day the class will be in Spanish and the next in English. The school administration argues that this new approach will help create bilingual graduates better prepared for many changes that are occurring in the workplace. To assess the extent of this decision prior to implementation, the measure should be understood from different perspectives of what it will entail for faculty, students and parents. For example, how would this influence the daily preparation of teachers to teach a course bilingually. The same would apply to students. What monetary cost would this decision have for parents, perhaps, to purchase materials and equipment for their children in English and Spanish? In this example, the list of questions (complexity of the problem) can be much larger, if approached from the various population groups that would be impacted by the decision (parents, teachers, students). To study a problem of this nature, it is necessary to use a multilevel design or a study that uses various quantitative and qualitative approaches using different population groups or samples, as part of the research design (Figure 5).

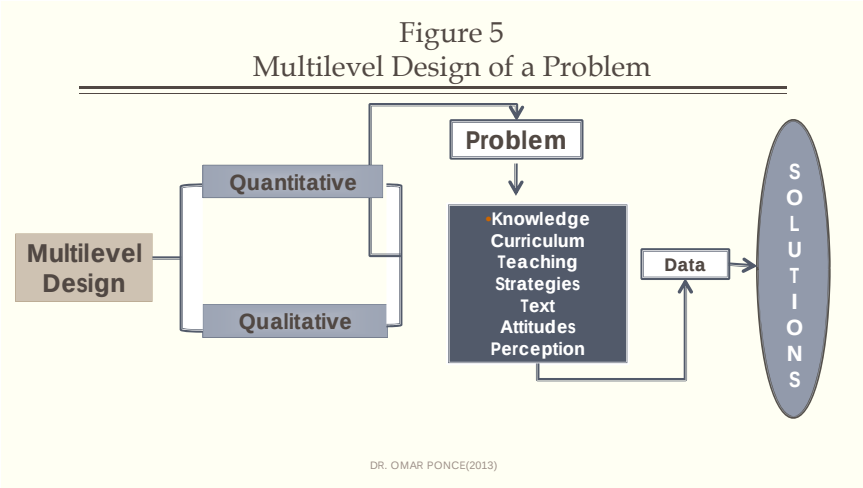

Figure 5. Mixed Designs of a Problem

g. Emergent designs (transformative design). It is common in mixed studies to deviate from the research design for the following reasons that occur when combined quantitative and qualitative approaches in the same study; the researcher encounters quantitative and qualitative data that contradict, the researcher identifies new perspectives on the problem that had not been included in the initial study design, however they merit investigation, or discovers methodological errors in the study. When these situations occur, the researcher has two options; concludes his study and accept this as limitations of research or modify the design to respond to them.

When these modifications are made to the joint studies to answer those findings that emerge from the research process and that merit response it is known as an emergent design. Therefore, the researcher must explain this in the final research report. In other words, the study began with a design that evolved to another in the process of conducting research.

7. Data collection in mixed studies

Data collection constitutes the phase of developing mixed methods research. The fundamental principle is to collect data *respecting the rules of each research model in the design and developing of a mixed methods study***.** What is quantitative is quantitative and what is qualitative is qualitative. Keeping each research approach aligned within their paradigm or model strengthens the rigor of each approach and the validity of the mixed study.

a. Define the research problem. The research problem consists of situations, phenomena, processes or persons who are the focus of study. In mixed studies, research problems have the tendency to be complex because they include objective and subjective elements to be addressed with a combination of approaches. There are two styles when presenting the research problem:

- *Write the problem by way of composite question where the objective and subjective aspects are highlighted.* For example; which candidate for governor people prefer and why?
- *Write the problem by way of simple question and leave the objective and subjective aspects to the research questions.* For example; what radio station do those aged 20 to 30 prefer?

b. Write the research questions. Research questions decompose the problem into manageable units to be studied. In mixed methods studies quantitative and qualitative questions are used. A common practice in mixed methods studies is always designing questions beginning with what, how, when and where. This is accepted because it is easier to answer questions when contrasting with the survey data. For example; what is the social issue that most worries Puerto Ricans? Two styles dominate in drafting research questions in mixed studies:

- *Write research questions for each research approach*. In other words, write four to five questions for the qualitative component and the same amount for the quantitative component. In this format, each research approach answers its research questions. Those who favor this format argue that it provides much more specificity to the research because each component has its own questions.

- *Write research questions to guide the entire study*. In this format, the full study aims to answer these research questions. In other words, the quantitative and qualitative components of the study are designed to generate quantitative and qualitative data to answer the research questions.

c. Select the research design. The principle key in selecting the design is to understand the quantitative and qualitative research to use them appropriately in a mixed methods study. It is very difficult to conduct a mixed methods study without understanding the models of quantitative and qualitative research.

- *The problem and research questions have to connect with the mixed research design*. For example, studies of exploration or explanation. Studies of this nature can be carried out with sequential phase studies. If the research questions put greater emphasis on one component of research, it can probably be done as a complementary design using parallel phases. If the research questions put equal weight on quantitative and qualitative models, then it could be answered either with a convergence or triangulation design using parallel phases. The research questions are fundamental in determining what and how the approaches of quantitative and qualitative research were used.
- *Specify what to combine, integrate or complement and why*. The argument for using mixed methods is to enter into complex problems. To accomplish this, you can combine quantitative and qualitative models to examine the objective and subjective aspects of the problem. It is possible to combine the research questions with instruments and data collection techniques to generate quantitative and qualitative data that allow a deeper description of the research topic from a mono-methodological or a single quantitative or qualitative perspective study. There must always be a logic that allows explaining what and why the research questions were combined. This logic must be based on the relationship between the research aims and how this allows the achievement and success of the study. Nothing can be a whim of the researcher at the time of combining or integrating quantitative and qualitative approaches.

d. Write the study title. Titles should reflect three components; the research topic, the study population and research design. An example of a title could be: Factors that influence people to visit a mall: Exploratory mixed study in sequential phases (Creswell & Plano Clark, 2011).

e. Select the sample. In mixed research methods two types of sampling dominate (Ponce, 2011):

- *Primary sampling (adhere to the established).* Consists of selecting the sample according to the parameters of the respective models of quantitative and qualitative research. The researcher selects samples and does not deviate from these.
- *Alternate sampling (deviating from the established).* In mixed studies, three phenomena occur which force the researcher to deviate from the research plan; encounter quantitative and qualitative data that contradict, discover methodological gaps in the study due to the nature of combining approaches, as would be discovered in the interview process (in the qualitative phase) that the questionnaire used (in the quantitative phase) does not address the whole issue or new issues emerge that it is necessary to study. When these situations occur, the researcher has two options, accept these as limitations of the study or deviates from the original research plan to compensate for them. To address and resolve these situations the researcher must employ the strategy known as alternate sampling; by selecting additional samples. Alternate sampling in mixed studies are criterion samples, as in qualitative studies, or the selection of samples that allow answering the research questions of the study.

f. Develop tools and research techniques. As the sampling, the development of tools and techniques for data collection must adhere to the criteria established by the quantitative and qualitative models. An important element in this task is to ensure that the tools and techniques of data collection are aligned to the research objectives; generate the quantitative and qualitative data to answer the research questions, generate quantitative and qualitative data to understand clearly and deeply the research problem, produce quantitative and qualitative data of the same phenomenon under research.

g. Address individual authorities to conduct the study. In conducting the study, follow channels or procedures and comply with the provisions of the agency or institution where the study is to be conducted.

8. Analysis of mixed data

Analyzing data is to extract meaning, implicit or explicit, of the information collected in the study. Analyzing data is a three step process; encode and describe the information to understand the messages that may be there, analyze and interpret information to make it clean data and

communicate findings and identify the most effective way to convey the findings. In mixed studies three types of data analysis are used; analysis of quantitative data, qualitative data analysis and analysis of mixed data. The analysis of mixed data consists of organizing and combining quantitative and qualitative data to achieve one or more of the following objectives related to the research topic:

a. Triangulation of data. Is demonstrating how quantitative and qualitative data collected in the study are validated between each other. Triangulation means that the quantitative and qualitative data match, point in the same direction or converge on aspects of the research problem. For example, in a study the quantitative and qualitative data show that the participants enjoyed the educational conference given to them. The average evaluation was 3.5 on a 4.0 scale. Comments on this conference were to be repeated again and invite the family members. Triangulation of data is possible if the measuring instruments and techniques of qualitative data collection were designed to collect quantitative and qualitative data from the same aspect of the research problem. When the researcher has data to triangulate, they increase the validity of the study and facilitate inferences and conclusions that can be stated about the findings.

b. Complementing data. It means using quantitative and qualitative data to complement when presenting the findings. Complementary signifies that data supports each other. For example, 90% of individuals classified the film as excellent (quantitative data). The reason for this was that they found it fun, educational and suitable for the whole family (qualitative data). In this case, the quantitative data sets the scope of the measure and the qualitative data deepens it or one data set complements the other.

c. Deepening in data. Signifies using quantitative and qualitative data to bring the argument to a point of no refutation. In this analysis, the amount of quantitative and qualitative data provides an overview of the research problem. While in "triangulation", quantitative and qualitative data point in the same direction, in "complementing" a set of data supports the other; in "deepening" the quantitative and qualitative data provide a comprehensive and clear view of the research problem. For example, in a study we found that 90% of parents and 95% of students did not endorse the new math curriculum (quantitative data) because they consider it too complex and impractical for developments in teaching this subject (qualitative data). Comparing this curriculum with the American standards for the teaching of mathematics, practices and teaching strategies are clearly identified that

contradict the established professional standards for a modernized teaching of mathematics (qualitative data). As shown in this example, the quantitative and qualitative data are used to bring the argument to a point where there is no doubt regarding the findings of the study or to a point of no rebuttal because a comprehensive picture of the topic is provided.

9. Validity in mixed studies

In research, terms like internal and external validity are commonly used to describe the investigative rigor of a study. The term *internal validity* is used to describe how much correspondence exists between the data collected and the research problem. *External validity* refers to whether the study data can be used beyond the context of the study or applied to other samples that were not studied. In mixed studies the validity criteria from qualitative and quantitative models are used to meet the investigative thoroughness of the respective models. However, as mentioned above, the aim of combining or integrating quantitative and qualitative approaches is to venture into complex problems where there are clear objective and subjective aspects to generate quantitative and qualitative data to more or better approach to the research problem. In mixed studies the term of *inference validity* is used to describe the effectiveness of the researcher to approach and capture the complexity of the research problem using quantitative and qualitative approaches. Inference validity signifies that the quantitative and qualitative data describe, explain or accurately capture the research problem and its complexity. When this occurs, the researcher can argue that it was effective in combining or integrating qualitative and quantitative approaches and is therefore in a better position to make valid inferences or interpretations of the research problem for the richness of its quantitative and qualitative data collected. Below are several recommendations to establish the validity of inference from a mixed methods study:

a. Compliance with the validity criteria established in each research model. Always seek that the quantitative and qualitative approaches from your mixed methods study meet the criteria for internal or external validity of their respective models. Ensure that the internal and external validity of each research approach contributes to the validity of inference of the mixed study.

b. Establish the conceptual validity of the research problem. This signifies that the research problem is really a problem for mixed methods research with objective and subjective elements. Is difficult to measure or describe if an attribute does not exist in the research problem. At the time of

writing the research report, the research problem becomes clear, its complexity and its objective and subjective aspects.

c. Establish the methodological validity of the mixed study. This means to clearly establish the alignment of the selected mixed design with the research questions and the objective of the study. It should clearly explain the relationship between the objective of the study, the research questions and the mixed design. If the mixed study deviates from planned, is necessary to clearly establish the researcher's logic or rational use with the emergent design. The aim is that the reader of the study may assess the researcher's procedures and determine the validity of the research process or emergent design.

d. Establish the validity of the research product. The validity of the product is evaluated on the relevance of the data analysis and the correspondence between the data collected and interpretations made by the researcher of this information. The relevance of the analysis of the data signifies that the techniques used to analyze the study data correspond to the information gathered by helping to interpret accurately. For example, in quantitative research, analysis of standard deviation is a truer measure of dispersion than range analysis. In qualitative research, validation with the participants of the significance of the categories that emerge from their interviews results in a measure of greater certainty than what may be provided by an external evaluator/consultant. The respondent is in a better position to clarify what he meant about the theme instead of the opinions of an external evaluator about the category used by the researcher to describe the intent of the interviewee. The correspondence between the survey data and interpretations made by the researcher signifies the researcher's ability to cement each interpretation with the study findings. Although this is an exercise in logic, the researcher clearly establishes the link between the data and their interpretation. In mixed studies, this link is expected to be a compelling one because the researcher collected quantitative and qualitative data for the research problem. Therefore, their margin for error in interpreting should be less because it has two sets of data to formulate their interpretations and recommendations.

10. Writing the mixed methods research report

There is no universally accepted way of how to write the mixed methods research report. Below are presented several recommendations on mixed methods research reports, especially in theses and dissertations:

a. The content of mixed methods research reports follow the same linear deployment of quantitative and qualitative thesis or dissertations; Statement of the problem (Chap. I), literature review (Chap. II), method (Chap. III), findings (Chap. IV) and discussion (Chap. V). The challenge in presenting the contents of a mixed methods report is to let the reader see clearly, and in an orderly manner, the type of study that was conducted; sequential phases or parallel phases. The reader must understand quickly how the qualitative and quantitative approaches were combined or integrated in the mixed design research. The objective is to convey the feeling that two studies are presented in a single report. This challenge is evident in the writing of Chapters I, III, IV and V.

b. In presenting the research problem in Chapter I, it must clearly establish the complexity of the problem and justification for a mixed methods study. The problem may be complex, however for a mixed methods study the objective and subjective criteria must be categorically established. The other challenge in presenting the research problem lies in the way the research questions are presented to coordinate the study. The challenge here is whether research questions are presented to guide the entire study, or make mixed research questions to guide the quantitative and qualitative phases of the study. The selected style to present the questions facilitates in articulating how these are connected with the mixed research design and guide the study. The clarity and precision of Chapter I facilitates the development of the remaining chapters of the report. Another consideration when presenting the research problem is whether the study deviated from the initial research design. The explanation of the emerging design is done in a section entitled "methodological considerations." This section may explain details such as the selection of emerging samples, changing measuring instruments or other methodological decisions that led to deviate from the initial research plan. This section should not be confused with the sections of boundaries and limitations of quantitative studies.

c. In Chapter III the challenge is to present, in a consistent manner, the combination or integration of qualitative and quantitative approaches as a mixed research design. Our recommendation is to present the chapter corresponding to the type of study presented; sequential phases or parallel phases so that the reader can understand the development of the line of study. For example, if the study is sequential phases, then fully explain phase I and later phase II revealing to the reader how each phase is connected with the

other and thus constitutes a combined study. Avoid presenting each approach as if it were a separate chapter of another.

d. Organize and present the findings of the study in a way that allows answering the research questions. The clarity of the presentation of the findings is greatly facilitated by the selected strategy to communicate information. For example, if tables or graphs to summarize data or integration are used. Tables are an excellent strategy in mixed studies to summarize and integrate quantitative and qualitative data visually or on different aspects of the same problem. The goal in presenting data should be to communicate these clearly and accurately where quantitative and qualitative data facilitate answering the research questions.

e. The wording of the report should contain language that handles each research model. In other words, the presentation of the quantitative phase must conform to the technical language of the quantitative model and the qualitative phase model has to conform to the technical language of qualitative model. This is critical so the mixed method researcher demonstrates understanding, dominance and respect of the respective models rules and practices.

11. Using mixed method research in education

Several doctoral dissertations are available in literature that allow us to examine the strength and challenge of using mixed methods research in education and its potential for capturing the complexity of the educational field phenomenon:

a. Researching teaching and learning. Medina (2012), Perez (2012) and Medina (2014) conducted mixed methods research on teaching and learning. Medina (2012) used a complementary mixed method design to study the effect of a virtual laboratory on students' academic achievement in ninth grade in a biology course. In the quantitative phase a pre-post test was used in two groups (experimental and control). The qualitative phase consisted of focus groups with the study participants and observations made by the teachers during the experiment. The results demonstrated that both strategies (virtual and present) were effective in students' academic achievement.

Perez (2012) developed a study to measure the effect of self-monitoring strategy in the academic achievement of students' performance in fourth grade regarding to sum skill in regrouping up to a million and explore their experience with the strategy. To perform the same, the author used a complementary mixed method. The quantitative phase used an experimental

design (pre-post test) and the qualitative phase served as a complementary function to know the perception of students towards self-monitoring strategy (interviews). The findings showed a statistically significant difference between the experimental and comparison group. The experimental group ran significantly better than the comparison group.

Medina (2014) used a triangulation mixed methods research design in parallel phases to study the effect of graphic organizers in learning math with college students. The quantitative phase consisted of an experiment using two groups with a pre-post test. The objective of the experiment was to measure the effect of using graphic organizers to learn math. The qualitative phase consisted of using a one minute paper to asses learning during the development of the experiment. The objective was to understand the students' math learning process while using graphic organizers. At the end of the experiment a focus group was asked open-ended questions to understand the students' experience using graphic organizer to learn math. A triangulation of data consisted of comparing quantitative data from pre-post tests with the qualitative learning assessment exercises data and the interview data.

In these studies, the mixed methods design allows the researchers to capture and explain the complexity of the teaching–learning process as a phenomenon. The quantitative component measured the effects of the teaching strategies (experiment treatments). The qualitative component permitted understanding how students perceived the teaching strategies, what happened in their minds and what factors allow learning.

b. Researching stress in high school teachers. Lopez (2014) used an exploratory design with sequential phases (qualitative-quantitative) to study stress in high school teachers. The study objectives were: a) identify the factors that contribute to occupational stress in high school teachers from the Department of Education of Puerto Rico and its impact on the performance of their duty; b) develop, validate and administer a measurement instrument on the factors that contribute to job stress and c) determine the relationship between these factors and their impact on teacher performance in high school teachers in the public education system in Puerto Rico. The research design used a sequential mixed methodology (Phase I- Qualitative and Phase II- Quantitative). The study was conducted across the island, and included all educational regions of the Department of Education of Puerto Rico. The sample of Phase I- Qualitative consisted of five teachers belonging to a high school who participated in an interview. Phase II- Quantitative sample consisted of 379 teachers, in which was developed, administered and validated a measurement instrument based on the findings of Phase I- Qualitative. The findings and results of both phases of the study helped identify and describe the factors that contribute to job stress of high school teachers. In terms of the relationship between occupational stress factors and

teachers performance, there weren't statistically significant inverse relationships between those factors and performance (higher stress, lower performance). However, in her study it was evident that there is a moderate direct relationship, between some factors of job stress and teacher performance (higher stress, higher performance). Based on the findings and results, including both phases of the study, the use of mixed methods research was recommended to increase awareness about this problem and know the strategies used by high school teachers in the island to deal with stress. Similarly, it was suggested to develop studies that reveal how those factors influence the health of teachers. Finally, the author encouraged raising awareness among staff of the Department of Education on the issue of job stress on teachers. In this study, the qualitative phase allows the researcher to capture teacher's daily stress conditions in the Department of Education of Puerto Rico (public schools). The quantitative research phase allows validation of these conditions in a representative sample of teachers from different districts of the same educational system.

In the studies that we reviewed, the research complexities came from two sources. The first source of complexity came from the teaching-learning process or the educational phenomenon being studied (Medina, 2012: Perez, 2012: Medina, 2014). The second source of complexity came from the cultural–context of the educational system where the teachers stress study was conducted (Lopez, 2014). In these studies, capturing and explaining the educational complexities was possible because of the quantitative and qualitative research designs used as components of the studies designs. These studies allow seeing the strength of mixed methods research designs in capturing educational complexities.

12. Conclusions

In this article the fundamentals of mixed studies and it applications to the field of educational research were presented. The examples of mixed methods studies in educational research presented allow us to appreciate the strength of mixed methods research in approaching complex educational phenomenon such as the teaching-learning process and work stress on teaching in a public educational system. One example of that complexity emerges from the nature of the teaching- learning educational phenomenon being studied. The second example emerges from the cultural-context of the educational systems where the studies were conducted. It becomes clear from the discussions generated, that implementing mixed research studies successfully requires understanding of quantitative, qualitative and mixed methods research designs. The complexities of combining research designs could make mixed methods research a time consuming activity either for

individual researchers or a team of researchers. Mixed methods research is essentially a complex task in any discipline, including education.

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