



STRATEGIES TO PERFORM A MIXED METHODS STUDY

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Abstract:

Mixed methods research is an approach that combines both quantitative and qualitative methods into a single study in order to provide a broader and more complete vision of a problem. Mixed methodologies are employed when both comparative analysis and the development of aspects of the study need to be undertaken comprehensively and in depth. The use of mixed methods turns possible to overcome the limitations of quantitative and qualitative methodologies, allowing the researcher to get rich information that could not be obtained using each method alone. However, the number of published scientific studies addressing the use of mixed methods is limited, and most of them focus on describing a single implementation approach without giving a global and comparative overview of the various approaches. In this sense, this study tries to synthesize and describe each of the mixed methods approach, also providing indications about the advantages and limitations of each of these approaches. In total, ten mixed methods approaches are identified that can be grouped into four major groups: (i) sequential design; (ii) concurrent design; (iii) multiphase design; and (iv) multilevel design. It was also possible to conclude that although each mixed method design presents specific advantages and limitations, sequential approaches are easier to adopt since they facilitate the integration process of both studies but generally lead to higher implementation time. On the other hand, concurrent design typically leads to greater difficulties in the integration of both studies, but they speed up the development process, because quantitative and qualitative can be executed in parallel. Finally, multiphase and multilevel designs are emergent approaches that are used in more complex studies in which it becomes necessary to consider several dimensions of analysis.

Keywords: research methods, mixed methods, research process, quantitative analysis, qualitative analysis

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1. Introduction

For several years, the scientific community has been engaged in an intense and continuous debate about the use of qualitative and quantitative paradigms for scientific studies. These paradigms consider different assumptions and premises when it comes to the purpose and nature of research. Qualitative research has as fundamental objective the understanding of certain behaviors and the collection of opinions and expectations of the individuals in a population. This research methodology is exploratory in order to obtain insights, often unforeseeable, on a research question. The most used techniques in qualitative research are structured interviews, semi-structured interviews, focus groups, and field observation (Queirós et al., 2017). On the other hand, quantitative research intends to assess and measure the behavior of the individuals of a certain group or population. Data collection process is well structured with subsequent statistical treatment of the data.

However, a research question cannot always be answered using the qualitative or quantitative approach alone. In this sense, mixed methods have appeared that intend to offer a new approach, in which a researcher intends to use the strengths of both methodologies (qualitative and quantitative). Therefore, it is expected to follow a methodology that not only responds to complex problems, but also aligns the preferences of researchers in multidisciplinary fields (Tobi & Kampen, 2018).

Several definitions of mixed methods have been appeared in the research community. Greene (2006) defines mixed methods concept as *“mixed method inquiry is an approach to investigating the social world that ideally involves more than one methodological tradition and thus more than one way of knowing”*. Other more complete and exhaustive definition is given by Cresswell & Clark (2011) that state *“mixed methods research is a research design (or methodology) in which the researcher collects, analyzes, and mixes (integrates or connects) both quantitative and qualitative data in a single study or a multiphase program of inquiry”*. This latter definition will be adopted in the context of this study.

The adoption of mixed methods has been growing in the scientific community. However, in practice, there are several difficulties in defining and building a mixed method strategy that can be used consistently throughout a given study. In this sense, this study seeks to clarify the different approaches and alternatives that can be used in a mixed method research. Each of these approaches is explored in order to identify its fundamental steps. This study intends to increase the degree of knowledge of the scientific community, particularly among young researchers, about the process of formulation and execute a mixed method research. This manuscript is organized as follows: First, a literature review on mixed methods is performed in order to recognize the most predominant authors in the field and several mixed methods approaches available in the literature were identified. Then, the methodology of the study is presented. Consequently, the results are analyzed and discussed looking for them in three perspectives: (i) analyze the impact of each mixed methods design; (ii) characterize the steps included in each approach; and (iii) explore the main benefits and

limitations associated to each approach. Finally, the main conclusions of the study are stated.

2. Literature Review

The classical approach to categorize mixed methods designs organizes them into two major categories (Creswell et al., 2003): sequential and concurrent. The sequential design organizes the process into two stages: in an initial stage, either the qualitative or quantitative data are collected; then, in a second stage, other data type is collected. On the other side, in concurrent design establish that all both types of data are collected during the same stage.

In the meantime, during the last years, more exhaustive studies have appeared that detail the relationship, interpretation and integration of qualitative and quantitative data in greater depth. One of the main reference works on mixed methods research was presented by Creswell & Clark (2007), which introduce the phases in the process of mixed methods research and propose four specific mixed methods designs, respectively:

- Triangulation design – it is the most common and well-known approach. It has the purpose to obtain different but complementary data on the same topic. The interpretation is based on Quantitative (QUAN) and Qualitative (QUAL) results. Different types of mixed method evaluations can be used, such as different conceptual frameworks, different methods of data collection, different interviews, different times or different locations and contexts (Bamberger, 2012);
- Embedded design – this approach assumes that a single data set is not sufficient and, therefore, it is required to use different types of data. It is established the concept of primary data, which may be qualitative or quantitative, and a secondary role assumed by other data type. Cronholm & Hjalmarsson (2011) state that configuration type (QUAL -> QUAN) is preferred when there is a low pre-knowledge of the studied phenomenon. Additionally, Hughes (2016) refers that embedded exploratory design is adequate for testing emergent theory because both types of data are interpreted during the data integration phase;
- Explanatory design – it is a two-phased approach, in which the qualitative data helps explain or build upon initial quantitative results. This design has a strong quantitative orientation because quantitative data is the key element to start the process;
- Exploratory design – it is similar to the explanatory design approach, but in which the qualitative data is the primary source of information. This design is particularly suitable for exploring a phenomenon, in which there isn't a guiding framework or theory and measures or instruments are not available.

The classical approach has been extended and combined by Johnson et al. (2007) and Bergman (2008) that suggest six design approaches based on sequential and concurrent approaches:

- Sequential explanatory design – quantitative data is collected in a first instance followed by qualitative data collection;
- Sequential exploratory design – similar to previous approach, but in which qualitative data is collected first;
- Sequential transformative design – the order of data collection is determined by the theoretical perspective of the researcher. Both methods are integrated during the interpretation phase;
- Concurrent triangulation design – this approach uses concurrently and simultaneously the qualitative and quantitative approach. Koskey & Stewart (2013) advocate that this approach is particularly useful for decreasing the implementation time, but presents low flexibility and learning potential regarding the results obtained by the individual execution of each one of them. Bryman (2006) also employs the “parallel” term to define a concurrent approach;
- Concurrent nested/embedded design – similar to previous approach but in which priority is given to one approach that guides the project;
- Concurrent transformative design – similar to the sequential transformative design, but in which both methodological choices are executed concurrently.
- Traditionally, mixed methods research considers the existence of one qualitative and another quantitative study, independently of the order. However, Onwegbuze & Collins (2007) extends this vision by proposing the use of three or more qualitative and quantitative studies, which originated the multiphase or iterative mixed methods design.

Another relevant contribution is given by Ponce & Pagán-Maldonado (2015) that present three mixed methods design frameworks, respectively:

- Convergence design – it is used to study a problem in its entirety and dimension. It uses two parallel phases: the quantitative approach is used to measure the properties and objective aspects of the problem; while the qualitative approach is applied to understand and describe the subjective aspect. Hughes (2016) advocates that this approach allows the researcher to examine phenomena on several different levels;
- Complementary design – this approach is very similar to the embedded design, in which one of the research methodologies is used to counter the deficiencies of the other. There is also the notion of primary data that may be quantitative or qualitative. Greene (2007) also refers to this model as an integrative design, in which the limitations of the first methodology are pointed out during the design process;
- Multilevel design – this approach assumes that the problem has several dimensions, manifestations or ramifications. Consequently, it requires the use of different samples and the adoption of different research approaches to understand and decrypt it. Baran & Jones (2016) employ the “multi-layered” term to refer the use of mixed methods in multi-dimensional problems. This approach uses more than two qualitative and quantitative studies like in the multiphase design.

One of the main decisions in designing a mixed method relates to the timing of the qualitative and quantitative components. According to Guest (2013) timing has two components: simultaneity and dependence. Simultaneity indicates whether both studies can be performed simultaneously or only after completion of the other; while dependence evaluates whether the process of conducting a study is dependent on the results obtained in another study. Schoonenboom & Johnson (2017) advocate that simultaneity and dependence are two separate dimensions. This implies that sequential design could include independent data analysis and concurrent design could use dependent data analysis. On the same direction, Molina-Azorin (2016) refers that a key aspect of mixed methods research is the integration issue. He advocates that a researcher must consider what synergies can be gained by the integration of both qualitative and quantitative methods. Burt (2015) emphasizes that dealing with the integration issue is a hard challenge for many researchers because few of them have received formal training in hands-on methods for integration findings.

There are several reasons and benefits for using a mixed method approach. Toomela (2008), Ponterotto et al. (2013) and McKim (2017) emphasize that mixed methods research helps the researcher to deeply and accurately understanding of the phenomena under study. Bamberger (2012) complements this vision by advocating that mixed methods research promote greater understanding of stakeholder perspectives on the nature of the intervention. Tariq & Woodman (2013) synthesize five reasons for its adoption: (i) complementarily; (ii) development; (iii) initiation; (iv) expansion; and (v) triangulation. Almalki (2016) adds two new kinds of benefits such as the flexibility and rigorous offered by the process. Additionally, Plastow (2016) refers that in mixed-methods the strengths of one research method compensate the weaknesses of another.

Despite the incontestable and significant advantages offered by the mixed methods research, some barriers to their integration in scientific studies were found. Lisle (2011) refers that robustness and credibility must be assured through all the process of conducting a mixed methods research. Most validity issues faced by mixed methods include representation, legitimation and integration (Onwuegbuzie & Johnson, 2006). The high time required and costs involved in the process of data collection, analysis and interpretation are also mentioned by several authors (Silva, 2011; Malina et al., 2011; Miller et al., 2013).

A significant number of empirical studies emerged in the last decade in which the challenges and difficulties in the development process of a mixed methods approach are addressed. Bryman (2007) conducted a case study consisting of 20 interviews with UK social researchers to conclude that the main barriers to greater widespread adoption are: (i) difficulties in integrating quantitative and qualitative data; (ii) methodological preferences; (iii) structure of research projects that are typically built to deal essentially with quantitative data; (iv) time consuming process; (v) skill specialism; and (vi) publication issues, since some journals give preference to quantitative or qualitative research studies. In this sense, it is not surprising the study conducted by Bazeley (2015) that reports that organizational and management researchers have been slow to adopt mixed approaches. In the last decade, it is verified

that the majority of the studies are of a quantitative nature and typically employ statistical analysis, and experimental or survey data. In the same sense, Choudhary & Jesiek (2016) also report the existence of a reduced number of mixed methods studies in the engineering education field. They state that significant vulnerabilities were encountered in the description of the integration process of quantitative and qualitative components in the 12 studies that use mixed methods approach published between 2010-15 in the Journal of Engineering Education (JEE).

3. Methodology

The adopted methodology is characterized in Figure 1. It is composed of three fundamental phases. The preliminary stage is the starting point of this study and intends to look for the process of performing a systematic review approach. This phase intends to give to the reader a concise but sufficiently embracing vision of the several dimensions and features associated with mixed methods research. Then, the synthesis stage takes the various design proposals from mixed methods research and synthesizes these processes looking at their similarities and differences. Finally, the exploration stage is a central phase in this study. Within this phase, three operations are performed: (i) analysis of the impact assessment. For this purpose a systematic review study is carried out in which it is intended to measure the number of studies published in the last decade by each mixed methods research design; (ii) identification of the steps involved in each mixed methods research design; and (iii) analysis and discussion of the advantages and limitations associated to each approach.

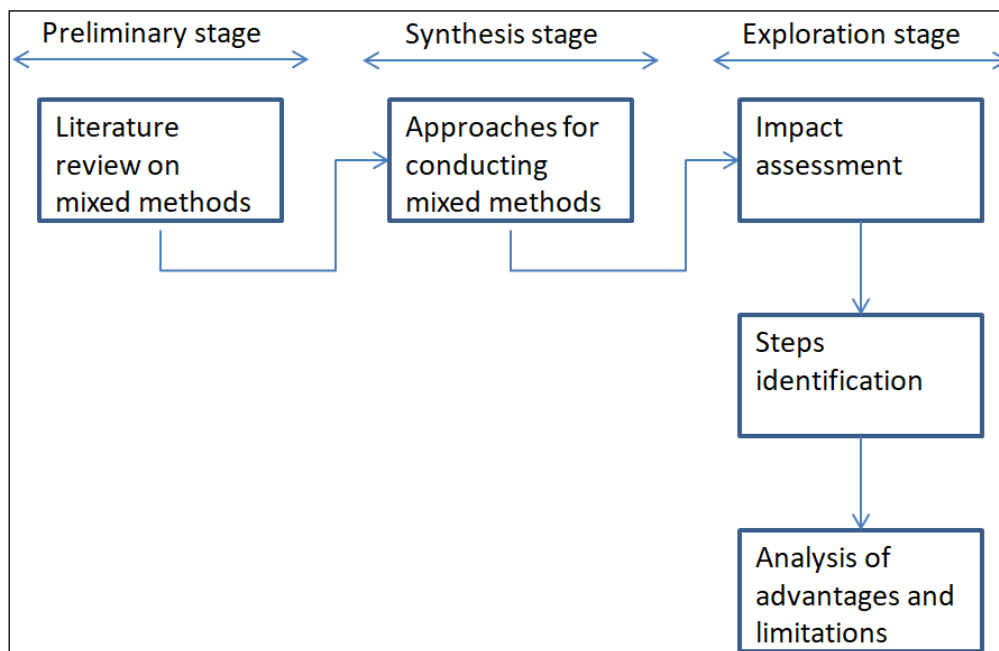


Figure 1: Phases of the adopted methodology

In the process of identifying several mixed methods, research design an increased difficulty arose. During the review of the literature, it was possible to discover that the

terminology used in the identification of each mixed methods research design is not standard, and several terminologies are used by different authors to characterize the same approach. In this sense, Table 1 provides a mapping between the terminology used in this study and other common expressions used by other authors.

Table 1: Adopted terminology to characterize mixed methods research design

Adopted terminology	Alternatives
Sequential explanatory design	Explanatory design
Sequential exploratory design	Exploratory design
Sequential transformative design	
Sequential complementary design	Sequential integrative design
Concurrent triangulation design	Parallel triangulation design
Concurrent embedded design	Concurrent nested design; Parallel embedded design; Parallel nested design
Concurrent transformative design	Parallel transformative design
Concurrent convergence design	Convergence design; Parallel convergence design
Multiphase design	Iterative design
Multilevel design	Multi-layered design

4. Results and Discussion

This study started initially to assess the scientific impact of each of the mixed methods research strategies in the last decade. For this purpose, three digital libraries were used: (i) Web of Science; (ii) Scopus; and (iii) Inspec. According to Cavacini (2015), these three digital libraries provide high quality bibliographic records in terms of control, accuracy and granularity of information. The terms used in this systematic review were presented in Table 1. Both adopted terminology and alternative terms were considered. These terms are searched in the title, abstract or keywords for each article. The results of this process are depicted in Figure 2.

There are approximately 350 published studies involving mixed methods approaches in the last decade (2008-2017). The number of these studies has gradually grown over the years with the emergence of new mixed methods approaches that essentially look to increase the robustness and significance of research methodologies. The number of studies published using sequential or concurrent approaches is similar. On the contrary, the number of studies that adopt multiphase design and multilevel design is still reduced. Two reasons emerge as the main cause: (i) little diffusion among the scientific community; (ii) most scientific studies do not justify a high complexity of the methodology and, consequently, its organization in multiple phases or levels.

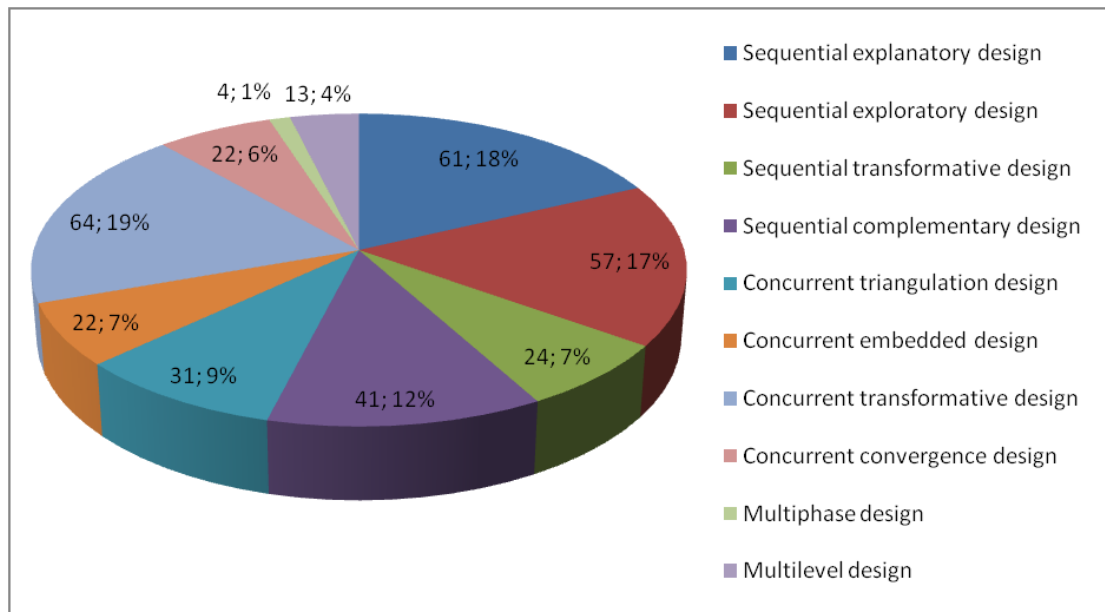


Figure 2: Number of published studies using mixed methods approach between 2008 and 2017

This study also seeks to characterize each mixed methods approach. Therefore, and for each approach, this study characterizes and details its main steps.

The sequential explanatory design is one of the most popular mixed methods techniques and its process may be easily characterized into two steps. Step (2) can only be performed after the execution of step (1).

1. Data collection and analysis of QUAN data;
2. Data collection and analysis of QUAL data.

The sequential exploratory design is similar to the previous approach, but in which the process starts by collecting and analyzing qualitative data. Like in the previous approach, step (2) can only be executed after the execution of step (1).

1. Data collection and analysis of QUAL data;
2. Data collection and analysis of QUAN data.

The sequential transformative design assumes that both previous sequential design approaches are conceptually correct and what determines the execution order of qualitative and quantitative data is the nature of the study and the vision, advocacy and ideology of the researcher. Consequently, step (1) or step (2) can be executed in a first place.

The complementary design can be seen as a subset of the sequential transformative design. The process is executed sequentially, in an identical approach to sequential transformative design, but in which there is a prior stage that consists of identifying the shortcomings of the main employed methodology. Step (2) and step (3) can change the execution order.

1. Explore the limitations of the main employed methodology;
2. Data collection and analysis of QUAN data;
3. Data collection and analysis of QUAL data.

The concurrent triangulation design establishes a parallel execution of the quantitative and qualitative methodologies. Therefore, steps (1) and steps (2) can be

executed simultaneously. At the end, the data results may be compared by the researcher.

1. Data collection and analysis of QUAN data;
2. Data collection and analysis of QUAL data;
3. Data results are compared.

The concurrent embedded design establishes that there is a main methodology approach (i.e., qualitative or quantitative) that guides the study. This decision must be taken by the researcher in the initial phase of the methodological choice. Step (2) can be exchanged with the step (3).

1. Choose the main methodology approach;
2. Main data: Data collection and analysis of QUAN data;
3. Secondary data: Data collection and analysis of QUAL data;
4. Analysis of findings.

The concurrent transformative design is similar to the sequential transformative design but in which the process is executed concurrently. What determines the layout of this design is the nature and specificities of the study. Two layouts can be used: (i) concurrent triangulation design, in which both QUAN and QUAL data have the same importance; and (ii) concurrent embedded design, in which QUAN or QUAL data can assume the role of main data.

The concurrent convergence design establishes two specific roles for the quantitative and qualitative approach. The process of collecting and analyzing data is divided into two distinct steps: data collection of QUAN data is performed in step (1), and data collection of QUAL data is performed in step (2).

1. Collection the properties and objectives aspects of the problem;
2. Identify the subjective aspects of the problem;
3. Data analysis of QUAN data;
4. Data analysis of QUAL data;
5. Integration of both findings.

The multiphase design is a more complex design that comprises three or more phases. Complexity is not only dependent on the number of components, but also how they are dependent on each other. These phases may be quantitative, qualitative or employing an exploratory, explanatory, embedded or convergent mixed methods approach, which must be defined in step (2).

1. Define and examine the overall objective of the problem;
2. Implement a chain of QUAN, QUAL and mixed methods studies;
3. Build each new study on what was learned previously.

The multilevel design assumes the existence of multi levels/layers in a complex problem. Therefore, a fundamental point in this approach is to identify the several dimensions of a problem. The number of these dimensions will be equal to the number of levels defined in the multilevel design. The granularity of the data is increased in each level. Both QUAN and QUAL data can be used in each level.

1. Identify the several dimensions of the problem;
2. Define the adopted methodology for each level (QUAN or QUAL);

3. Data collection, analysis and results for each level;
4. Overall interpretation of the results.

Finally, the main advantages and limitations of each mixed methods approach are explored. This information is organized in Table 2. All approaches offer advantages and limitations, but generally, it is possible to consider that the integration and analysis of data in a sequential approach are easier than in a concurrent design. However, the total implementation time of the mixed methodology is longer. On the other hand, concurrent approaches have shorter implementation time since both quantitative and qualitative methodologies can be executed in parallel. However, the integration of both findings may become more complex, especially if conflicting results appear. Finally, the multiphase and multilevel designs are recommended for complex problems. These two approaches are very time consuming, require a team of researchers with strong skills, and experience in mixed methods.

Table 2: Analysis of the advantages and limitations of mixed methods approaches

Approach	Advantages	Limitations
Sequential explanatory design	<ul style="list-style-type: none"> - Suitable when data sets of the population behavior is available - Guided by a theoretical perspective - Easy to implement 	<ul style="list-style-type: none"> - Time and resources needed for separate data collection phases - Difficult to explore new sources of knowledge
Sequential exploratory design	<ul style="list-style-type: none"> - Suitable to explore a phenomenon and identify themes - Relevant variables are identified after the qualitative study 	<ul style="list-style-type: none"> - Time and resources needed for separate data collection phases - Identified variables can be not relevant if the group is very small
Sequential transformative design	<ul style="list-style-type: none"> - Ensures that the views and perspectives or a diverse range of participants are represented - Deeper understanding of a process 	<ul style="list-style-type: none"> - Time consuming, typically higher than sequential explanatory/exploratory approaches - Resources needed are typically higher
Sequential complementary design	<ul style="list-style-type: none"> - Address complementary questions that was not possible to investigate using the main methodology - Combines the strengths of QUAN and QUAL data 	<ul style="list-style-type: none"> - Can be hard to connect the two findings - The secondary study could influence the first study
Concurrent triangulation design	<ul style="list-style-type: none"> - QUAN and QUAL data are analyzed separately - Suitable for cross-validating and confirming findings from a single study 	<ul style="list-style-type: none"> - Discrepancies between the quantitative and qualitative findings may be difficult to reconcile
Concurrent embedded design	<ul style="list-style-type: none"> - Suitable when there is predominance of a data type - There are several strategies to mix QUAN and QUAL data - Shorter data collection period 	<ul style="list-style-type: none"> - Mixing both data can be a hard challenge - Difficulties in reconciling conflicting and antagonistic results
Concurrent transformative design	<ul style="list-style-type: none"> - Ensures that the views and perspectives or a diverse range of participants are represented - Deeper understanding of a process - Both qualitative and quantitative studies can be executed concurrently 	<ul style="list-style-type: none"> - Difficulties to mix both data - Difficulties in reconciling conflicting and antagonistic results

	- Shorter data collection period	
Concurrent convergence design	- Strong theoretical background - Objectives and subjective aspects of a problem can be both identified	- Very time consuming - Relevant expertise is needed
Multiphase design	- Suitable for complex problems - Flexibility to address interconnected questions - Emergent questions can arise at different stages - Can combine sequential and concurrent phases	- Requires experience in large-scale research - Needs significant resources - Very time consuming - High cost
Multilevel design	- Suitable for complex problems - Can be used to investigate cross-level direct effects - Allow to understand the relative effect of each level - Provide more accurate and robust results	- Difficult to map the different levels - Requires experience in large-scale research - Needs significant resources - Very time consuming - High cost

5. Conclusion and Recommendations

Mixed methods are currently considered the third largest research paradigm with increasing acceptance from the research community. In a mixed methods research, theoretical and practical knowledge, both quantitative and qualitative, are combined to meet the research objective while considering multiple perspectives and perspectives. The studies resulting from mixed research processes seek the convergence of findings and they are complementary, because the results of one methodology are responsible to inform others.

This study has identified and synthesized the mixed methodologies in ten design approaches that globally fall into four major groups: (i) sequential approaches; (ii) concurrent approaches; (iii) multiphase design; and (iv) multilevel design. It has been found that studies using mixed methods approaches have gained greater prominence in recent years, with most studies adopting both sequential and concurrent approaches. Sequential approaches are characterized by greater ease of adoption, but they increase the development time of the study. On the other hand, concurrent approaches reduce the total time of implementation of the methodology through the parallel execution of the quantitative and qualitative methodology, but increase the difficulties of integration in the analysis of the results.

This study has significant practical impacts for researchers in several knowledge fields, since research methodologies are used transversally regardless of application areas. Firstly, the synthesis of various mixed methods approaches allows an investigator to easily and intuitively perceives and compares each of them. Secondly, the analysis of its vantages and limitations allows the researcher to be guided in choosing the methodology that best fits the purpose of his/her research.

As future work, it would be relevant to deepen the analysis of the development process associated with each mixed methods approach. For this purpose, it is intended

to explore practical scenarios on how each of the mixed methods research can be applied. In this process, it would be important to highlight strategies to mitigate the challenges of each approach considering the specificities of each scenario.

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