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Review and Comparison of Multi-Method and Mixed Method Application in Research Studies

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Purpose: To explore the feasibility of using the multi-method and mixed-method in research studies by reviewing and comparing both methods.

Design / Method / Approach: Using the literature, historical background on mixed-methods and multiple-methods design principles are collected and applied in this paper in a systematic review format.

Findings: The major finding from this research is that incorporating quantitative and qualitative data in the form of a mixed or multi-method study has the potential to dramatically increase the accuracy and quality of any research's analysis and conclusions.

Theoretical Implications: The study contributes to the theoretical understanding of how mixed and multi-method studies have distinct and distinguishable characteristics; it encourages researchers to conduct investigations appropriately to accomplish their research goals. The authors of this article introduce different designs (e.g., embedded design, explanatory design) which combine a mixed-method approach with a multi-method one.

Practical Implications: This study concludes that both mixed methods and multi methods are reliable and have unique characteristics that increase the validity (i.e., external validity, generalizability) and reliability of study findings.

Originality / Value: The authors of this paper present a taxonomy how to combine mixed methods with multi methods.

Research Limitations / Future Research: Research should be directed at defining the appropriate design for a multi-method approach to help researchers conduct multi method studies scientifically.

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Огляд та порівняння застосування мульти- та змішаних методів у наукових дослідженнях

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Мета роботи: Вивчити доцільність використання мультиметодів та змішаних методів у наукових дослідженнях шляхом огляду та порівняння обох методів.

Дизайн / Метод / Підхід дослідження: Використовуючи літературу, зібрано історичну довідку про змішані методи та принципи проектування змішаних методів, що застосовуються в даній роботі у форматі систематичного огляду.

Результати дослідження: Основним висновком даного дослідження є те, що включення кількісних та якісних даних у формі змішаного або мультиметодного дослідження здатне значно підвищити точність та якість аналізу та висновків будь-якого дослідження.

Теоретична цінність дослідження: Дане дослідження робить внесок у теоретичне розуміння того, як змішані та мультиметодні дослідження мають відмітні та помітні характеристики, що спонукає дослідників проводити дослідження відповідним чином для досягнення своїх дослідницьких цілей. Автори статті представляють різні дизайни (наприклад, вбудований дизайн, пояснювальний дизайн), які поєднують у собі змішаний та мультиметодний підхід.

Практична цінність дослідження: У цьому дослідженні робиться висновок про те, що і змішані, і мультиметоди надійні і мають унікальні характеристики. Це підвищує валідність (тобто зовнішню валідність, узагальнюваність) та надійність результатів дослідження.

Оригінальність / Цінність дослідження: Автори даної роботи представляють таксономію, як поєднувати змішані та мультиметоди.

Обмеження дослідження / Майбутні дослідження: Дослідження повинні спрямовані на визначення відповідного дизайну для мультиметоду, щоб допомогти дослідникам науково проводити дослідження з використанням мультиметодів.

Тип статті: Концептуальний

Ключові слова: мультиметод, змішані методи, якісне дослідження, кількісне дослідження.

Обзор и сравнение применения мульти- и смешанных методов в научных исследованиях

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Цель работы: Изучить целесообразность использования мультиметодов и смешанных методов в научных исследованиях путем обзора и сравнения обоих методов.

Дизайн / Метод / Подход исследования: Используя литературу, собрана историческая справка о смешанных методах и принципах проектирования смешанных методов, которые применяются в данной работе в формате систематического обзора.

Результаты исследования: Основным выводом данного исследования является то, что включение количественных и качественных данных в форме смешанного или мультиметодного исследования способно значительно повысить точность и качество анализа и выводов любого исследования.

Теоретическая ценность исследования: Данное исследование вносит вклад в теоретическое понимание того, как смешанные и мультиметодные исследования имеют отличительные и различимые характеристики, что побуждает исследователей проводить исследования соответствующим образом для достижения своих исследовательских целей. Авторы статьи представляют различные дизайны (например, встроенный дизайн, объяснительный дизайн), которые сочетают в себе смешанный и мультиметодный подход.

Практическая ценность исследования: В данном исследовании делается вывод о том, что и смешанные, и мультиметоды надежны и обладают уникальными характеристиками. Это повышает валидность (т.е. внешнюю валидность, обобщаемость) и надежность результатов исследования.

Оригинальность / Ценность исследования: Авторы данной работы представляют таксономию, как сочетать смешанные и мультиметоды.

Ограничения исследования / Будущие исследования: Исследования должны быть направлены на определение соответствующего дизайна для мультиметода, чтобы помочь исследователям научно проводить исследования с использованием мультиметодов.

Тип статьи: Концептуальный

Ключевые слова: мультиметод, смешанные методы, качественное исследование, количественное исследование.

1. Introduction

A mixed method can be taken as a blend of quantitative and qualitative studies. There are many arguments and agreed points on using both methods together. Now the trend is emerging to use the concept of mixed methods in studies in the research world. It has become more popular than before. Gaps have been identified using a single methodology in studies. Therefore, it is evident that combining both methodologies increase strengths and counterbalances the limitations of the single methodologies. Mixed-method studies in educational research are built strongly to have better implications. In educational research, using multiple methods assists the application of mixed methods in research, which also creates awareness of studying these phenomena (*Pole, 2007).*

A significant number of early empirical researches in social sciences use a mix of quantitative and qualitative techniques. Considering the popularity of these widely cited studies, method integration was a rare practise in social research for the majority of the twentieth century. However, the methodological discourse was immensely threatened by methodological dualism that believed quantitative and qualitative research "paradigms" were founded on irreconcilable epistemological foundations (*Guba & Lincoln, 1988*). Even as quantitative researchers emphasise the importance of exact measurement and quantification to achieve generalizable, reliable, and value-free knowledge, qualitative researchers insist that studying social interaction and meaning-making necessitates non-standardized, interpretive methods and the observers' reflexive participation (*Krauss, 2005*).

However, each kind of study has its own set of flaws. Standardized methods depend on considerable previous information, which may be difficult when studying contemporary societies' flexible and diverse relationships and structures (*McKendrick, 2020*). Furthermore, quantitative research tends to be very reductionist in how it operationalizes social processes, resulting in construct and ecological validity problems (*Creswell, 2004*). Simultaneously, the reconfiguration of situated significance through qualitative methods places severe constraints on the set of observation cases, which can lead to generalizability problems, because both the gathering and analysis of qualitative data are heavily dependent on individual researchers' viewpoints, which can obstruct interactional understanding (*Cram & Mertens, 2015*).

In the study conducted by *Östlund, Kidd, Wengström, & Rowa-Dewar, (2011)* the study of "Combining qualitative and quantitative research within mixed method research designs: A methodological review", the researchers investigated the parallel, concurrent, or sequential approaches used in health care studies with mixed-method studies that illustrate triangulation as a representation of both quantitative and qualitative study findings. In the same study, the researchers found out that parallel data analysis of both paradigms was conducted in previous studies. The researchers further identified that multi-method triangulation can ease the incorporation of the findings of studies, and such eased incorporations will provide a good understanding of the connection between theoretical and empirical findings and will help to create new theories, and challenge the existing theoretical assumptions. (*Östlund et al., 2011*).

2. Theoretical background

According to *Rocco, Bliss, Gallagher, & Prado, (2003)*, it is necessary to weigh psychological traits accurately; Campbell and Fiske, who are known to be quantitative researchers, recommended a mixed method before 40 years ago to increase credibility of research findings. This was used to validate the variances, but it was not to ensure the methods. Researchers further mentioned that scholar *Denzin (2012)* labelled this method as triangulation. However, matching two paradigms continues to be a challenge. Researchers use both paradigms to meet the requirement of their stakeholders to apply multiple methods to the gradation of the research question and the characteristics of the study. During the 1980s, based on the social benefits, combining both methods was accepted. Moving forward in that period, researchers started to recognize that a mono method has a bias in studies, hence mixed methods became a more profound study *(Rocco et al., 2003)*.

3. Research Problem statement

Although studies integrating qualitative and quantitative data are not new in fields such as social, educational, behavioural, health, and sports sciences, they have grown in popularity over the past 20 years (*Creswell, 2015*). The mixed-method research movement developed as a distinct research paradigm, providing a contrast to exclusively qualitative or quantitative research (*Johnson, Onwuegbuzie, & Turner, 2007*). It has grown quickly over the last two decades (*Tashakkori & Teddie, 1998, 2003, 2010*) and, despite many methodological difficulties that remain unresolved (*Archibald, 2015; Archibald et al., 2015*), it continues to draw attention. *Greene (2015)* asserts that mixed-method research, at least at the beginning, provided chances to "meaningfully interact with difference" by integrating data at several levels. However, in the last 20 years, there has been an explosion in research that has, in many cases, shown that misunderstanding over the meaning of multimethod and mixed techniques is still widespread.

4. Data and methods

In his studies, *Pole (2007)* states that interpretivists say that a single reality is absent and knowledge is subjective and bound with culture as well. Usually, qualitative studies are established in process theory. This theory explains how the process connects some events and how they are influenced by others. However, qualitative studies are to understand social occurrences from the participant's point of view. According to *Pole (2007)* and as cited by *Tashakkori & Teddlie (2003)*, the early mixed methodology was not named. The researchers didn't realise that they were conducting unusual research. Researchers used suitable methodologies according to the objectives until they questioned the correct application of combining methodologies. There are different perspectives on qualitative and quantitative studies. Researchers in the quantitative world trust that the social world is shaped by scientific rules and laws to shape the physical world. Qualitative researchers trust that each individual has an interconnection. Without that connection, the world would not exist. *Pole (2007)* further explored the differences between both methodologies depending on the purpose of the studies. When the studies require a heavy descriptive manner, the methodology will be decided to be qualitative. If there is a requirement to confirm or test an existing theory, the method will be quantitative *(Pole, 2007)*.

There seem to be consequences in designing a study. The selection of samples will differ based on methodologies. Qualitative studies have small-sized samples, which are purposefully selected, and will not match randomization, data collection methods have a commonly subjective way such as including focus group discussions and interviews. Quantitative studies are larger in sample sizes, the samples can meet randomization and the data collection methods include surveys and questionnaires. When both methodologies are mixed, the researcher is responsible for ensuring that quantified qualitative data is met with standards and quantified data is analysed with respondent's notes in the survey instruments. Therefore, when mixed methodologies are selected, researchers need to carefully observe the aim of the studies. The data collection method and data analysis method depend on the objective of the study *(Pole, 2007)*.

The assumptions in both qualitative and quantitative are different according to the objective of the study. Since the qualitative study is subjective, researchers tend to choose respondents with rich

information. However, in the field of education and nursing, researchers commonly conduct qualitative studies, but the social science field encourages and tends to rely on quantifiable methods. Therefore, by conducting a mixed-method study, researchers can alleviate the bias and could increase their understanding (*Arora & Stoner, 2009*). *Skirton, O'Connor, & Humphreys (2012)* conducted a study on nurses' competence in genetics: a mixed-method systematic review. The study design conducted a systematic review in a mixed method. This method confirmed that all data related to this study was taken into consideration as everything was included to get valid results and conclusions of the study.

5. Results

5.1. Multi Method and Mixed Method in Research Studies

Policy analysts utilise research material to assist them to modify their ways of thinking about a problem, assess the merits of various ideas for action, organise support for a stance or point of view, enhance current programs, and bring concerns to the attention of decision makers. Policy research must be of high technical quality, thorough, and devoid of jargon. Because it includes both common, qualitative language and quantitative, technological data, mixed-method research has the ability to meet these requirements.

Mixed-method research is one where the researcher uses both qualitative and quantitative data collecting and analysis techniques in the same study. This kind of study allows a policy researcher to comprehend complicated events intuitively as well as describe them quantitatively using statistics, charts, and basic statistical analysis. A multimethod approach to policy research has the potential to better understand the complex phenomena of our social world by viewing it through multiple lenses and employing eclectic methodologies that respond to the multiple stakeholders of policy issues than a single method or approach to research *Creswell (1999)*.

According to *Pole (2007)* qualitative and quantitative methods are included in a mixed-method design as a single study or multiple studies. However, there are discrepancies and confusion in different terms concerning the definition of mixed methods. Pole cited *Tashakkori & Teddlie (2003)* and figured out that data in a mixed method is seen from different perspectives; therefore it can give stronger implications to complement both methodologies in-depth and breadth of the data. *Rocco et al. (2003)* explained that combining the two methods will create spaces for exploratory inductive studies. Triangulation, complementarity, development, initiation, and expansion are the main objectives of mixed-method studies. People who are about to make decisions in the fields of technology, education, society, and business can apply this contemporary design to increase trustworthiness of research findings, specially in Strategic Management and Project Management field of study (*Vivek & Nanthagopan, 2020*).

The mixed-method approach to understand the main objective of brand personality study was to apply the mixed-method approach to explore the product personality and personality dimensions of two retail stores for two athletic brands. Researchers gathered quantitative data to investigate personality in marketing settings. Rich qualitative data was taken from narratives to fill in the gap in the study to assist with advertising development *(Arora & Stoner, 2009)*. The finding of this study showed a lack of communication between qualitative and quantitative methods, which resulted in a lack of convergence of personality dimensions. Further weight of the study went towards the qualitative method as the narrative nature was taken into consideration to draw brand characteristics *(Arora & Stoner, 2009)*.

To positively enhance the quality of the decision or results of a marketing research study, marketers can gather quantifiable data to take main decisions to mitigate problems. However, qualitative studies will provide rich and meaningful data if the data is analysed carefully. In the marketing field, mixed methods will help in the area of creating advertising strategies. Both methods will complement each other for brand expansion rather than conducting studies on only one method *(Arora & Stoner, 2009)*. In multimethod studies, triangulation evolves by incorporating many observers, theories, methods, and data sources. Therefore, it will be easy for researchers to mitigate a bias from single-method studies. One professional's view may be positivism; hence their reality may be measured to some degree. Some others may have constructivism or interpretivism. They tend to trust reality as it is built on many points of view on the subject. The qualitative method is usually applied to understand the occurrence in its social context. Mixing can happen at any stage of the research study. This can occur sequentially or simultaneously. Methodologies of study can also be used equally or dominantly. Data analysis will occur cross-sectional where the quantitative data is also analysed qualitatively and vice versa *(Rocco et al., 2003)*. *Subedi (2016)* stated that in a confusing situation, the study conducted on Explanatory Sequential Mixed Method Design as the Third Research Community of Knowledge Claim will provide assistance to identify the views to recognise and explore another perspective. Subedi's objective was to explain the holistic ideas of a mixed-method design, focusing particularly on philosophical premises, generating research questions, data collection and analysis process, potential ethical issues, quality of inference and teaching mixed methodology. This study revealed that the mixed method is not a famous one as it has emerged in the recent past. In this method, the researcher chose the desired methodologies to answer the research problems. According to many resources, social and behavioural scientists' application of mixed methods has increased in contemporary studies *(Subedi, 2016)*.

According to *Subedi (2016)* researchers are interested in and prefer mixed methods due to their practicality and applicability as they provide a model which allows using mixed model designs and it avoids theoretical debates. However, implementation of the design, weight of the methodologies provided for data analysis, sequential data collection with analysis and the stages of the integration of results are connected. For beginners in research, it may be challenging to choose appropriate methodologies for their studies. The mixed method paves the way for them to create a design that can discourse their research problems. According to *Abowitz & Toole, (2010)* surveys, questionnaires, experiments, ethnographic observation, and unobtrusive techniques are certainly important research tools, but each technique has a different perspective on addressing the research problem. Individual methods have issues with generalization, validity, and reliability. Therefore, when combining some techniques, researchers may be responsive to selecting the tools. Non-probability sampling techniques usually provide good and informative insights. But generalization to large population will be restricted to such techniques. Therefore, sampling errors may occur and result in sample bias in the data. Probability sampling usually decreases the sampling error as it includes larger samples *(Abowitz & Toole, 2010)*. Multiple methods support the study of the problems that occur continuously and the relationship between the problems and variables. Triangulating the methods will enhance research studies to measure the hypothesis. Triangulating or mixing the methods would complement the strengths and weaknesses of the studies *(Abowitz & Toole, 2010)*. But according to *Pole (2007)*, the mixed method is different from the multi method. The multi-method is applied to many methods, but it is limited to one objective.

Caracelli & Greene (1993) reviewed their study conducted in 1989 and other 57 mixed-method studies to create a mixed-method evaluation conceptual framework. The study revealed that mixed-method studies include at least one quantitative method and one qualitative method (*Caracelli & Greene, 1993*). Mixed-Method Designs in Implementation Research conducted by *Palinkas, Aarons, Horwitz, Chamberlain, Hurlburt, & Landsverk (2011)*

describes the application of mixed-method designs in implementation research in 22 mental health service research studies published in peer-reviewed journals over the last 5 years. The analysis revealed 7 different structural arrangements of qualitative and quantitative methods, 5 different functions of mixed methods, and 3 different ways of linking quantitative and qualitative data together (*Palinkas, et al., 2011*). Mixed methods are used to evaluate the intervention and understand the process together; conduct exploratory and confirmatory studies together; examine the context and content to understand the interventions and their outcomes; it includes the perspectives of evidence and participants/audience; and complement both methods by compensating each (*Palinkas, et al., 2011*).

According to *Morse (2010)* the high application of mixed-method designs within the last 15 years shows that studies have included both quantitative and qualitative methodologies. Even though researchers refer to the above, there are some other researchers who use different methods for each method. Therefore, *Morse (2010)* raised the question that if the researcher uses a mixed method, what type of methods the researcher refers to. When considering a multi method within the paradigm of a qualitative study, it includes consideration of design, project planning, producing results and theory development. By increasing the complexity of the study, qualitative methods allow researchers to manage their challenges and to advance in their research design (*Morse, 2010*).

The article of Simultaneous and Sequential Qualitative Mixed Method Designs conducted by *Morse (2010)* deals with the fact that it will be appropriate to use different methods with complementary components within one methodology to have a complete study. The researchers investigated two qualitative studies and depicted two qualitative methods that could mitigate the confusion of combining textual and numerical data. However, simultaneous and sequential methods *(Tab. 1)* issues in qualitative studies exist (*Morse, 2010*). In social sciences, regardless of the model, studies mainly involve human behaviour by understanding intentions, experiences, attitudes, culture, and the place where they live (*Johnson & Onwuegbuzie, 2004*). Some methodologies are likely to be related to certain research. *Johnson & Onwuegbuzie (2004)* further said that researchers should question themselves when the approaches must be used in a helpful way and how they can be taken together. Rather than rejecting or limiting the research, conducting multi-method studies is also a way to legalize mixed methods to respond to research problems. Study can explore research in-depth without limiting it to surface research. This allows a researcher to be inclusive, pluralistic and be complemented. Nevertheless, research questions occupy a major role in selecting a research approach to identify the best chances of getting answers (*Johnson & Onwuegbuzie, 2004*).

Table 1: *Characteristics of Multimethod Designs*

Design type	
Simultaneous	QUAL+qual indicates a qualitatively-driven, qualitative simultaneous design.
	QUAN+quan indicates a quantitatively-driven, quantitative simultaneous design.
Sequential	QUAL⟶ qual indicates a qualitative-driven project followed by a second qualitative project.
	QUAN ⟶quan indicates a quantitative-driven project followed by a second quantitative project.

Source: *Morse, 2003*

5.2. Mixed And Multiple Methods Design Principles

There are two key rules that researchers should follow while using different methods. The first design principle is to identify and honour the main theoretical impetus or narrative of the undertaking, as well as to adhere to its methodological assumptions. The analytical centre of the project is formed by the main theoretical motivation, which may be quantitative (deductive) or qualitative (inductive). It is defined by the research question(s) or hypothesis(es) and should guide the approach to data and sample. For example, if the main theoretical motivation is qualitative [QUAL], the sample size is usually modest and purposefully chosen. If the secondary element is quantitative [quan], external normative values should be provided for quantitative data interpretation due to sampling breaches (*Morse, 2003*).

If the major theoretical motivation is quantitative [QUAN] and the secondary element is qualitative [qual], the sample must be deliberately drawn from the main research (*Morse, 2003*). Upper case letters, QUAN or QUAL, are often used to denote the main theoretical motive. The second premise is to identify the secondary or supplementary function of the component. The secondary component's purpose is to elicit a viewpoint or dimension that the first method cannot reach, to improve description, or to allow additional investigation or preliminary testing of a developing hypothesis (*Morse, 2003*). The secondary data and analysis are informed by the data produced by the supplementary data. The secondary function is usually denoted by lower case letters, such as quan or qual.

There are four qualitative theoretical drive combinations and four quantitative theoretical drive combinations: [QUAL+qual], [QUALqual], [QUAL+quan], [QUALquan] and [QUAN+quan], [QUANquan], [QUAN+qual], [QUANqual] (*Tab. 2*). The plus sign (+) implies that the secondary or supplementary technique was applied concurrently or simultaneously during the same data collection period, while the arrow (⟶) implies that the secondary method was implemented sequentially or after the main data was collected (*Creswell, 1999*).

5.3. Purposes for Using Mixed and Multiple Methods

Mixed-method studies can be superior to mono methods in terms of pluralism. Due to that, mixed methods are more successful than mono methods as they include many investigators as a practice. The mixed method is also considered to be the third paradigm than qualitative and quantitative ones, as it is a way of bridging both paradigms. (*Johnson & Onwuegbuzie, 2004*). According to *Creswell (2011)* the four major types of mixed-method designs are the Triangulation Design, the Embedded Design, the Explanatory Design, and the Exploratory Design.

5.3.1. Triangulation Design

To avoid overlapping from the weaknesses of the quantitative method and to collect a variety of data in the same area, the triangulation method is used with the qualitative method. There are four variants of this design. These are a convergence model, a data transformation model, a validating quantitative data model, and a multilevel model (*Abro, Khurshid, & Aamir, 2015*). The objective of this design is to provide a valid result for a single phenomenon. New researchers can adopt the mixed method easily; in both types, this method appears to be efficient and effective as the qualitative and quantitative data is collected in the same study; data analysis can be done independently, and this method allows many researchers to participate and utilise their expertise in each area. However, high expertise is required; the cost of research will be high. Researchers may be confused when both research methods provide a different answer to one problem, and it may lead to collecting additional data, which will incur additional time and budget as well (*Mackey & Bryfonski, 2018*).

Table 2: Qualitative and Quantitative Theoretical Drive Combinations

Design Type	Timing	Mix	Weighting/ Notation
Triangulation	Concurrent: quantitative and qualitative at the same time	Merge the data during interpretation or analysis	QUAN+QUAL
Embedded	Concurrent and sequential	Embed one type of data within a larger design using the other type of data	QUAM(qual) or QUAL(Quan)
Explanatory	Sequential: Quantitative followed by Qualitative	Connect the data between two phases	QUAN ⟶ qual
Exploratory	Sequential: Qualitative followed by Quantitative	Connect the data between two phases	QUAL⟶ quan

Source: adapted from *Creswell & Plano Clark, 2007*

5.3.2. Embedded Design

In mixed methodology, "The Embedded Design" is an approach in which one data set serves as a supporting, secondary function in a research centred on the other data type (*Creswell, Plano Clark, Gutmann, & Hanson, 2003*). The principles of this approach are that a single data collection is insufficient, that various questions must be addressed, and that various kinds of data are required for each type of inquiry. When analysts need to incorporate qualitative or quantitative data to address a research question inside a primarily quantitative or qualitative investigation, they employ this approach (*Zhang, 2011*). This approach is especially helpful when a researcher wants to include a qualitative component into a quantitative design, such as an experimental or correlational design. The researcher incorporates qualitative data in the experimental example for a variety of reasons, including as developing a therapy, examining the process of an intervention or the processes that connect variables, or following up on the outcomes of an experiment (*Creswell, 2011*). In this design, a single set of data is not enough, therefore different questions need to be answered and each different type of data requires a different type of data. The larger portion of the answer will include qualitative or quantitative data. When the researcher decides to embed qualitative data into quantitative one, this design can be employed. Experimental and correlational models are the most used variants in this model. Researchers will be flexible to collect data as one method will be prioritised; can logistically manage the resource for research, and the agencies that are willing to fund mostly prefer these designs as this is traditionally inherent to quantitative. The researcher must notify the challenges to collect a large number of quantitative data. Here also there are possibilities that researchers may find it difficult to incorporate the answers when two methods are used to answer different questions. But when comparing to the triangulation design, the researcher can get two sets of results separately for different questions where triangulation collects two different methods for the same question (*Brewer & Hunter, 2006*).

When considering procedures for "Embedded Design", at the design level, the embedded design combines various data sets, with one kind of data embedded inside a technique defined by other data types (*Caracelli & Greene, 1997*). A researcher, for example, might incorporate qualitative data inside a quantitative technique, as in an experimental design, or quantitative data within a qualitative methodology, as in a phenomenological design. The Embedded Design collects both quantitative and qualitative data, but one of the data kinds serves a supporting function in the overall design. The embedded data in an Embedded Design may be collected in either a one-phase or two-phase method, and the quantitative and qualitative data is utilised to answer various research questions within the study (*Hanson, Creswell, Clark, Petska, & Creswell, 2005*). It may be difficult to distinguish between Embedded Design research and one of the other mixed-method designs. The important issue is whether the secondary data type serves as a complement to the primary data type in a design based on the primary data type (*Pigram & McGee, 2011*).

5.3.3. Explanatory Design

The main objective of this design is that qualitative data explains the data built in quantitative results. There are two variants of the Explanatory Design: the follow-up explanation model and the participant selection model. This design is the most straightforward as the two phases of research will be included in one type of data collection (*Okpotor, 2021*). Therefore, it is viable for one researcher to conduct the study. The results of the study are also straight forward and depict a clear picture to the audience (*Kettles, Creswell, & Zhang, 2011*). Multiple investigations are possible in one study, and this design is mostly for quantitative researchers as it has a strong quantitative orientation. But time limits will be high to have both phases; the researcher has to be vigilant in choosing participants to have both phases; and obtaining the approval will be challenging as the researcher may not be able to justify the participant selection in the second phase until the initial findings have been revealed (*Ivankova, Creswell, & Stick, 2006*).

5.3.4. Exploratory Design

The principle of this exploration design is necessary for many reasons, when the variables, measures, theories, or instruments are unknown and when there is no proper framework to guide them. This design is based on the initial qualitative study to explore a phenomenon. This design is the best when a researcher wants to test a measure or instrument when it is already not available. When the results are generalized for population, this method is highly applicable to explore the phenomenon in depth (*Clauss & Tangpong, 2019*). This design has two common variants: an instrument development model and a taxonomy development model. Many advantages of the explanatory design are applicable to this design too, as there are two phases in this study. In addition to a single study, this design can be used for a multi study. Even though the design describes data, quantitative data inclusion provides the opportunity for the quantitative biased audience to accept this design. It needs a larger time frame to conduct this study. It is difficult to show a quantitative phase and the researcher must be aware of whether the same individuals are taken for both phases and different participants will be taken for each phase (*McKendrik, 1999*). There are several reasons for researchers to adopt a multi method. The fundamental reason is that researchers have experienced weaknesses in previous studies. Therefore, they might have looked into other preferred methods in the same study. The next importance of a multi-method study shows the relationship between scholarship of traditional academics; the audience's confidence is received tactfully; the multi method will expand the research to be more specific by deploying different methods (*Clauss & Tangpong, 2019*). Here, one method is applied as a reference to other methods. Case studies in multi methods are

known to follow detailed examinations. However, the findings of the case studies will be in broader terms. On the other hand, a multi method is used to confirm the conclusions more firmly. Multi methods can be used to address the same question from different perspectives (*Hirsch, 1979*).

Through a multi-method study, many objectives can be applied to one objective. This seems not a way of creating a problem as it takes the possibilities of the methodologies of the study (*McKendrik, 1999*). Combining more than one research in social studies has different names, such as blended research, integrative, multi-method, multiple methods, triangulated studies, ethnographic residual analysis, and mixed research. However, in marketing, mixed, and multiple methods are commonly used in research studies. The multi method deploys many types of qualitative inquiry or many types of quantitative inquiry where the mixed method will include two types of data (*Harrison & Reilly, 2011*).

5.4. Validation of data in both methods

Triangulation is known as the simplest form of the mixed method within one study. This permits a researcher to look at situational occurrences of the stated problem. Close-ended and open-ended questions are applied to find out the key concepts. When results are obtained from various measures for the same key concepts, the validity and reliability of the results will be increased. When the methods are mixed and the study is designed to be a mixed method, the strength and weaknesses will be counterbalanced through simultaneous or sequential studies. (*Abowitz & Toole, 2010*).

Conducting mixed-method studies allows the researcher to find answers to confirmatory and exploratory questions in parallel. The researcher can provide data statistically and narratively to confirm and explore the aspects of a particular study. Researchers can apply the same study through its qualitative avenue to create new theories and quantitative methods to test the theory (*Pole, 2007*). Social science research is not recommended to be done with a single method as solo methods have their strengths and weaknesses. Therefore, the multi-method approach increases the reliability and validity of the studies. Therefore, increasing the possibility of combining methods would increase the quality of the studies. However, mixed methods are more expensive than single-method approaches. When a sound methodological principle is incorporated into every stage of the study, the mixed-method approach can be utilized properly (*Abowitz & Toole, 2010*).

6. Discussion

6.1. Mixed Method

So far, the discussion has shown that the scholars engaged in mixed approaches have a broad spectrum of applications at their disposal. Simultaneously, they will almost certainly have to deal with significant problems unique to mixed methods. Two of the most difficult problems in a mixed approach is commensurability and specialisation (*Onwuegbuzie, 2007*). The issue of commensurability arises from the interaction between methodological techniques and epistemological views that underlie them. Some studies believe that integrating quantitative and qualitative views is problematic because various techniques reflect alternative epistemologies, that, by nature, give multiple assumptions about the nature of truth (*Guba & Lincoln, 1988; Lincoln & Guba, 2000*).

A similar issue comes from the fact that social sciences will almost certainly continue to specialise, including methodological specialisation. This tendency has a number of practical implications. Firstly, it will make it more difficult for a mixed-method researcher to stay methodologically current. Secondly, due to growing specialisation and the fundamental structure of the review process, mixed-method researchers will increasingly confront reviewers who are greater specialists on an analytical methodology used in the study than the authors. Thirdly, increasing specialisation will make translation more difficult (*Small, 2009*). The capacity to write and think across not just methodological approaches but also epistemological viewpoints is likely to be the most essential talent for a mixed-method researcher today (*Small, 2011*).

6.2. Multi-method

When analysing the limitations of a multi-method research, the first flaw with a multi-method research is failing to recognise that it is more demanding in terms of time, money, and researcher's abilities than single method approaches. Not all researchers are equally at ease or competent at using a variety of techniques. This makes a multi-method research, in general, a less feasible proposal for small-scale research, such as that needed for undergraduate dissertations (*McKendrick, 2020*). Second, the quest for triangulation for a congruence makes dealing with some discrepancy across datasets challenging. There is a special need to resist the temptation to determine which group of data is the most genuine. Thirdly, advocates of a multi-method study need to avoid presenting "breadth" of the study as an intrinsic value (*McKendrick, 2020*). While seeking more complete knowledge is a noble aim that a multi-method research may help to accomplish, the multi-method research is only useful if the design allows the subsequent/concurrent method to contribute significantly to what is learned from the previous components of the study. Similarly, it should not be expected that a multi-method research would always decrease a measurement error (*Halverson, 2017*). Fourth, there is a risk that, in attempting to capitalise at complementary strengths of various methods, the pursuit of a multi-method research encourages a more limited application of specific methods than would otherwise be the case, as each is used based on an a priori understanding of its specific strengths (*Creswell, 2004*).

6.3. MMMR (Mixed-Methods and Multi-Method Research) Application

The MMMR movement has developed into a recognised area of scientific research. A minor divergence from the Anglophone rhetoric is apparent in a fairly significant impact of qualitative research views, which is linked with the continued importance of a triangulation idea. Nevertheless, notwithstanding its qualitative affiliations, MMMR is often greeted with criticism by qualitative researchers who doubt its compliance with interpretative techniques 'proper.' Simultaneously, quantitative researchers tend to embrace the concept of method integrating more easily but frequently believe that it is something they have been doing anyway (e.g., in cognitive protest interviews), which also corresponds to an inadequate understanding of the implications of MMMR (*Knappertsbusch, Langfeldt, & Kelle,2021*).

Even if MMMR has acquired a more solid foothold, however, a broader academic environment is still influenced by qualitative and quantitative research traditions. MMMR theorists and researchers constitute a rather unfamiliar minority in many institutional settings, while qualitative and quantitative traditions generally continue on with their established routines. Hence, greater institutionalisation of MMMR views is a key goal for future growth, including improved participation in professional organisations, editorial boards, and review committees. MMMR is currently a broad and interdisciplinary research environment and will likely spread out much more. There is still a significant dearth of comprehensive studies that evaluate the incidence and quality of MMMR nowadays (*Knappertsbusch et al.,2021*).

7. Conclusion

The incorporation of quantitative and qualitative information in the form of a mixed or multi-method research has the ability to significantly improve the accuracy and enhance the analysis and results of any research. Evaluators may enable deeper, more meaningful learning about the performance and execution by carefully choosing a mixed or multi-method design that best fits the evaluation's objectives and fulfils its resource limitations.

The expansion of mixed methods and multi-method experiments was characterised by the publication of various researches discussing conceptual, methodological, and practical problems in both basic and applied research, with little emphasis on the careful, rigorous use of procedural terms. This, coupled with the vastly disparate backgrounds of researchers from many research techniques and fields, contributed to the sometimes-imprecise use of the words such as method, technique, and even paradigm, thus blurring the distinction among mixed methods and multi-method research.

By reviewing and comparing the existing works of literature on Multi-method and Mixed-method application in research, this study concludes that both mixed methods and multi-methods are reliable and have unique characteristics. Both multi and mixed methods tend to be time-consuming and expensive. The validity and reliability of the findings ensure the studies. Qualitative and quantitative methods are included in a mixed-method design as a single study or multiple studies. The fundamental reason for multi-method study is that researchers have experienced weaknesses in previous studies. Therefore, they might have looked into other preferred methods in the same study, and it will expand the research to be more specific by deploying different methods and in broader terms.

The study contributes to the theoretical insights of mixed and multi methods and discusses how multi-method studies can be carried out, as the literature is sparse and there is no solidly developed clear spectrum of applications. Future research should be directed at defining an appropriate design for a multi method to help researchers conduct multi method studies scientifically.

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9. Competing interests

The authors declare that they have no competing interests.

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