

Variants of Integration in Mixed Methods Research: An Evolutionary Approach

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Introduction

For many decades, mixed-method research (MMR) has been a new/emerging focus among researchers of different disciplines. It has been considered a comprehensive approach to investigating complex research questions requiring in-depth inquiry. A more profound understanding of the phenomenon can be best developed when the outcomes of MMR have strong relations with the MM research question. In addition, the research question of MMR provides the foundation for selecting the compatible design, sampling, and data collection techniques for easy Integration of the results. The hallmark of MMR is integrating two different natures of results [1]. Data from quantitative and qualitative strands can potentially compensate for the weaknesses of each complementary approach. For instance, the validity of quantitative findings can be strengthened by exploring the same phenomenon through qualitative research. Furthermore, qualitative data can be used to develop or design quantitative instruments, interventions, or theories to be tested quantitatively later. There are many other advantages to integrating findings in MMR. However, this dimension has been under-utilized in literature. A few specific approaches to Integration have been applicable at different levels in a single MMR.

On the other hand, ample literature mentioning “Mixed Method Research” in the title can be found; however, MMR is relatively new, and many are still under debate. Although MMR is generally interpreted as a unique methodology that utilizes two different strands, there is still no agreement on how to mix or integrate them. Even if researchers mix both approaches, there are several levels at which these can be mixed. In most cases, the literature reported mixing levels as a preference by the researcher which might include mixing at the research design, methods, and data levels [2]. This paper will address the ways of achieving Integration MMR. The flow of this paper is as follows: Section 1 describes the Integration, its evolution, and variants in MMR; Section 2 discusses the utilization of integration concepts in the published literature on MMR; Section 3 represents innovative integration strategies used in MMR. In the end, section 4 describes the challenges reported in the literature in achieving Integration.

Section 1: Integration, Its Evolution, and Variants in MMR

The terms integration and mixing have been used interchangeably by the researchers. One of the greatest concerns in MMR is “what and when to integrate”. MMR findings can be integrated during data collection, interpretation, or analysis, either simultaneously or consecutively. Generally, many define Integration; one among them

states Integration as connecting qualitative and quantitative strands to develop a complete sense or more profound understanding, which cannot be achieved by one strand alone [3]. Apart from this, it is considered the most narrowly understood concept by many researchers who took it as merely merging or combining only. Moreover, to understand the concept of Integration, it is necessary to get familiar with the historical pattern of Integration. Integration historically can be divided into the infancy stage, framing stage, and utilizing/evaluating stage. In the infancy stage, there was a glut of pioneering MM researchers exploring different ways to employ MMR in various disciplines. The critical input during this stage was writings by scholars about issues in Integration, the justifications for adopting it, and initial quarrels on integration strategies [4]. Undoubtedly, initial research explored Integration by comparing the rigour of two results (quantitative & qualitative). Furthermore, in these studies, the issues of both qualitative and quantitative mixing shed light on the emergence of integration concepts in MMR through triangulation and validity, which raised hope for the possibility of Integration in MM.

Table 1: Definitional Variations of Integration in Early Studies.

S.No	Proposed Definitions by Authors
1	As a process, Integration may be constructive to the fundamental research instead of any part of it alone [5].
2	Triangulation enables the researcher to develop a unique dimension [6]
3	Two different methods can be Each method can be supported through the different key characteristics of each other [7]
4	The purpose of triangulating two different approaches is to validate the strength results by looking if the results are converging or building on each other [8]
5	Triangulation, Complementarity, Development, Initiation, and Expansion are five reasons for Integration and conducting MMR [9]
6	MMR is conducted when there is a use of survey, fieldwork, and experiments altogether in single research [10]
7	Integration in MMR can be acquired by analyzing the data through the merging of data, the transformation of data, and extreme case analysis [9]
8	The extrapolation of two different methods/paradigms can be conceivable if the researcher has developed a quality inference of each strand [11]

Defining and Framing Stage: Secondly, with the increasing usage of MMR in various disciplines, i.e. health, social, and behavioural sciences, the discussion has been built to a step ahead of the development stage. Notably, because the infancy stage paved previously, definitional variations related to Integration have now become more comprehensive, enhancing our understanding of MMR, MM questions, typology, sampling, and data analysis. In this era, the focus was on definitions of Integration. Definitional variations of Integration have been reported in early pioneering studies (Table 1) [5-11]. Regarding the definitional variations, Sieber formally proposed Integration (1973) by discussing two fundamental approaches to doing social research: fieldwork and surveys. Based

on a study of multiple types of research at the time, significant advantages in design, data collecting, and analysis may be identified. The author suggested changes in the former design typology by combining different methodologies such as field works, interviews, observations, and surveys to establish a unique study now known as MMR.

Similarly, Jick [6] used data triangulation to seek convergence between qualitative and quantitative techniques. He deepened his grasp of triangulation by looking at the same occurrence from many angles, allowing new or deeper aspects to emerge. The use of several methodologies not only provides a commonality for triangulation but also allows for a deeper understanding. Likewise[6], recommended mixing two different approaches by evaluating the advantages of quantitative data on the qualitative strand and the influences of the quantitative part on qualitative data. Triangulation is examined from different aspects, including design and methods of analysis. Additionally, the purpose of triangulating methodologies is to increase the validity of the overall conclusions through congruence and complementarity of the results from each approach, they said first. They found that triangulation is feasible only inside paradigms. Any effort to compare or integrate data from different approaches needs the previous acceptance of one paradigm or the other; they used a survey (quantitative) and interview (qualitative) methods were used simultaneously. Consequently, the prospect of attaining Integration of qualitative and quantitative strands was demonstrated to be possible and practicable in their investigation.

Rationales for Integration: Particularly, ample literature mentions five reasons for integrating the MMR findings. Hence it is essential to seek for rationale/purpose of MMR before deciding on its design and analysis methods concerning achieving Integration. Table 2 summarizes the five different purposes of conducting MMR for achieving Integration [9].

Table 2: Purposes of MMR in Rationalizing Integration. Adapted from Greene, et al. [9].

Goals of Integration	Justifications
Triangulation	To enhance the consistency of two contradictory data regarding designs and methods utilized.
Complementarity	To maximize the validity of results on one strand through another.
Development	To enhance the constructs building by informing one results too other
Initiation	To expand the thickness and bring new insights which discover frameworks through divergence and incongruent findings
Expansion	To intensify the possibility of analysis by employing multiple methods

Utilizing and Evaluating Stage: Accordingly, based upon the previous stage in which different definitional issues have been explored and led to the construct of conceptual frameworks, comes a

new era with more critical and in-depth issues regarding rationalizing Integration and introducing its different strategies in MMR. Besides, Creswell and Plano Clark heralded the new age with their second edition MMR book, which expanded on the previous edition published in 2007. Compared to the first, they elaborated on various themes and included additional high-quality empirical evidence on MMR. Furthermore, one of the six core elements of MMR highlighted in this version was to encourage researchers to “mix (or integrate or connect) the two types of data simultaneously by combining (or merging) them, sequentially by building one on the other; or embedding one within the other.” Moreover, words such as connecting, combining, or merging have been defined for Integration. According to the latest edition of the Mixed-method Research book by (Creswell & Plano Clark), one of the duties that a mixed researcher must perform is to combine two different sets of data and their outcomes for Integration. The authors further endorsed the new definition of Integration by citing past research: Integration is the intentional dialogue between an MMR’s quantitative and qualitative aspects.

More importantly, Integration assists MM scholars in exploring many strategies for achieving Integration throughout the process. Plano Clark suggested tactics on why, what, when, and how to integrate with the article, such as using visuals that are integrated into the material to provide “when to integrate”; and using joint displays to demonstrate “how to integrate.” In addition, as more empirical research on MMR has been published, the mounting obstacles to employing MMR have been identified.

Integration Strategies in MMR: A series of articles are available on MMR to improve understanding of Integration and triangulation. Also, more research in this age has begun to resolve the challenging problem of where and how Integration occurs in MMR. For instance, O’ Cathain, et al. [12] proposed three integration techniques based on their analysis of the scarcity of integration strategies of two different components in Health and social research:

- (a) Triangulation protocol,
- (b) Thread following, and
- (c) Mixed techniques matrix.

It may be used in the triangulation process’s interpretation step, which requires researchers to explicitly integrate both sets of findings to determine the amount of convergence for each approach. The second method enabled researchers to discover Integration during the data analysis by selecting a concept from one data set and following it across the other. The entire procedure was named “following a thread.” Subsequently, in the third method, findings from both approaches were shown as listing quantitative variables and qualitative themes. This strategy can also be applied in the data analysis section. Aside from the three integration strategies presented [13], described how to convert qualitative data into numerical in MMR.

The reason behind quantitating was to correlate the variables to test the hypothesis. This approach is accomplished using a counting and transformation procedure. Systematically, Integration in MMR can be achieved at different levels (i.e., design, methods, interpretation, and reporting). Table 3 summarizes the Integration at different levels in MMR [14].

Table 3: Integration Levels in MMR Adopted and Modified from Fetters, et.al. [14].

Integration Level	Methods
	Basic
	MM Exploratory-sequential Design
	MM Explanatory-sequential Design
	MM Convergent Designs
Design Level	Advanced
	MM Multistage Design
	MM Intervention Design
	MM Case Study Design
	MM Participatory Design
Methods Level	Connecting as Integration
	Building as Integration
	Merging as Integration
	Embedding as Integration
Reporting Level	Reporting in Narrative Form
	Reporting in Data transformation
	Joint-display Tables
	“Side-by-side display”
	“Theoretical lens display”
	“Cross-case comparison display”
	“Statistics-by-themes”
	“Participant selection display”
	“Instrument development display”
	“Qualitative data experiment display
	“Interview question display”
	“Generalizing themes display.”

Integrating - Design Level: Integration can be performed at the design level using one of 3 primary and 4 advanced mixed-methods methodologies. There are three types of designs:

- (1) MM exploratory-sequential designs,
- (2) MM explanatory-sequential designs, and
- (3) MM convergent designs.

MM sequential designs aim to combine the first part with the second for better understanding. At the same time, convergent designs conduct both parts simultaneously and then combine

them for comparison. In an MM exploratory sequential approach, the researcher collects and analyses qualitative data first, and the findings guide future quantitative data collection. In an MM explanatory sequential design, the quantitative data is initially collected and analyzed, and then the findings guide qualitative data. A MM convergent design collects and analyses data from both strands simultaneously. During this phase, an interactive strategy may be adopted, in which iterative data collecting and analysis drive improvements in data collection processes. Advanced frameworks entail incorporating a more extensive framework that may include;

- (1) MM multistage;
- (2) MM intervention;
- (3) MM case study; or
- (4) MM participatory research.

Researchers employ many phases of data gathering in a multistage mixed-methods framework, which may include combining multiple sequential and convergent techniques.

Integrating - Methods Level: There are four different interpretations introduced for Integration:

- (1) Connecting;
- (2) Building;
- (3) Merging;
- (4) Embedding;
- (5) Threading (Table 4).

Table 4: Integration at Methods Level.

Approach	Description
Connecting	Through sampling, one database is linked to another
Building	One dataset informs the other's data collection method.
Merging	The two datasets are combined for examination.
Embedding	Linking collection and analytic techniques frequently.
Threading	Initial analysis to identify central themes and questions.

When one form of data connects with another via the sampling frame, it is called connecting. For example, a survey for quantitative and interviews for the qualitative part was done in one research. Likewise, Integration as building happens when the findings of one data collected through a method inform the data collected through another technique and builds on the first data collected afterwards. Similarly, when the research is conducted for comparison, and two different data sets from the same population are combined, now the Integration is considered merging. Additionally, Integration with embedding happens when the researcher links the data collection

with analysis at numerous locations. Finally, threading is the initial analysis of two sets of data to identify significant questions, followed by picking one question and following it through among all other processes. Method-level Integration is frequently associated with the study's design. Connecting, for example, happens in MM sequential designs naturally. Conversely, merging can happen with every design. Embedding is most seen in interventional designs. As a result, the design establishes parameters within which methodological integration decisions can be made.

Integrating - Interpretation and Reporting Level: Integrating two sets of data at the interpreting and reporting level takes 3 forms:

- (1) Narrative Integration,
- (2) Integration through data transformation and
- (3) Integration through joint displays.

Several publication techniques have been proposed that utilize these approaches when merging both data sets in a single report. In research reports, there are three techniques for narrative Integration. The weaving method entails putting both findings, subject by theme and concept by idea. The contiguous method of Integration entails presenting findings in a single report, regardless of whether two sets of data are presented separately. The staged approach to Integration is employed in multistage mixed methods research, where the findings of each phase are delivered in stages as the data is analyzed and published individually. Secondly, two methods are integrated because of data transformation. The first step is to convert one type of data into another (i.e., qualitative into quantitative or vice versa). The transformed data is then mixed with non-transformed data. For instance, in qualitative investigations, researchers may label qualitative data and then analyze the frequency of recognized codes or domains, a technique called content analysis. Comparatively, in mixed methods research, data transformation refers to converting qualitative data into numbers and variables using content analysis to combine the data with a quantitative database.

Lastly, when researchers integrate utilizing joint displays, they visually put the data together to provide new insight. Moreover, similar data may be clustered in a figure, table, matrix, or graph to achieve this. Data representation is crucial in helping readers understand the integrated findings and inferences effectively. Many methods are available to describe and illustrate the findings of MMR, such as graphical maps, bubble plots, joint display tables, and images or pictograms. However, the joint display table is the most popular method among researchers. The joint display tables generally consist of raw data (qualitative and quantitative) with their inferences, mixed methods interpretations, and meta-inferences. The inferences about the mixed methods approach can be reported as convergence/confirmed, divergence/discordant, or building/expanding as an outcome of Integration. Although there is no standard joint display

table, researchers often are innovative in making the displays attractive and easily understandable. In addition, the study purpose, design, and integration techniques are foundational for selecting a

type of table [15]. In fact, within the literature, various joint display tables are reported. Table 5 summarizes the typology of joint display tables [15,16].

Table 5: Typology of Joint Display Tables Adapted and modified from [15,16].

Type of joint display table	Statistics-by-themes	Participant selection display	Instrument development display	Qualitative data-experiment display	Theoretical lens display	Cross-case comparison display	Side-by-side	Interview question display	Generalizing themes display
Integration techniques	Merging	Connecting	Connecting & Building	Embedding	Threading'	Threading	Merging	Connecting & Building	Connecting
Presentation	Involves presenting quantitative data and themes	It involves linking quantitative data with the selected sample	It entails portraying qualitative themes, codes, and categories alongside quantitative items and variables that have been developed	This entails displaying the qualitative data and its relationship to the larger experimental data.	It entails putting the data inside the specified theoretical or conceptual framework.		This entails displaying both datasets accompanying research questions, themes, and statistics.	It entails connecting quantitative data with subsequent qualitative data for explanation reasons.	It entails showing quantitative and qualitative findings and how they might be generalized.
Used in	MM Convergent Design	MM Sequential explanatory Design	MM Sequential Exploratory Design	MM Intervention design	MM Participatory Design	MM Combined Design	MM Convergent Design	MM Sequential explanatory Design	MM Convergent Design

Section 2: Utilization of Integration Concepts in Published Literature

This section was kept intentionally by the author to find out how frequently the MM researchers used the integration concepts in their writings which have been published. This will help the author of this paper to contribute to an existing body of literature to pinpoint the focus in considering Integration as an essential aspect of MMR and see what literature contains as far as published work is concerned. Furthermore, the author has tried to see the frequency of different integration strategies utilized by the researchers in the published work. Considering the scope and time constraints, this search was limited to CINAHL, PubMed, Nursing, Mixed Method, and Health-

related Journals. The key terms used were “Integration Strategies in Mixed Method Research”, “Mixed Methods Analysis”, and “Mixed Method Research”. A total of 30 full-text articles were retrieved, and different concepts were examined.

Literature on Integration Strategies in MMR: Out of 30 MM articles, 20 comprised basic integration strategies (See Appendix 1) [17-36], while the other 10 included innovative integration strategies (See Appendix 2) [15,37-44]. The preliminary findings about the frequency of utilizing integration strategies such as us: mixed-methods design, mixed-methods research questions, and mixed-methods rationale are shown in Table 6. Table 7 summarizes the frequencies of utilizing specific integration strategies such as mixed-methods sampling, data mixing, and interpretation and reporting.

Appendix 1: List of Articles Consisting of Basic Integration Strategies.

S.No	Citation	Title	Journal
1	Zumbrunn, et al. [17]	Toward a Complete Understanding of Writing Enjoyment: A Mixed Methods Study of Elementary Students	AERA Open
2	Cole, et al. [18]	Examining a Comprehensive College Transition Program: An Account of Iterative Mixed Methods Longitudinal Survey Design	Research in Higher Education
3	Dincer, et al. [19]	Self-Determination and Classroom Engagement of EFL Learners: A Mixed-Methods Study of the Self-System Model of Motivational Development	SAGE Open
4	Demir, et al. [20]	A Convergent Parallel Mixed-Methods Study of Controversial Issues in Social Studies Classes: A Clash of Ideologies	Educational Sciences: Theory and Practice
5	Makamure, et al. [21]	Teaching practice and preservice mathematics teachers’ teaching knowledge in Zimbabwe: A mixed-methods study	Issues in Educational Research
6	Seghers, et al. [22]	Social class and educational decision-making in a choice-driven education system: a mixed-methods study	British Journal Of Sociology Of Education

7	Banerjee, et al. [23]	Overcoming Obesity: A Mixed Methods Study of the Impact of Primary Care Physician Counseling on Low-Income African American Women Who Successfully Lost Weight	American Journal of Health Promotion
8	Bennett, et al. [24]	Mixed methods, mixed outcomes? Combining an RCT and case studies to research the impact of a training program for primary school science teachers	International Journal of Science Education
9	Adewuyi, et al. [25]	Dementia Care Content in Prelicensure Nursing Curricula: A Pilot Mixed-Methods Study	Journal of Nursing Education
10	West, et al. [26]	Occupational stress and well-being among Early Head Start home visitors: A mixed-methods study	Early Childhood Research Quarterly
11	Lamont, et al. [27]	Student health professionals' attitudes and experience after watching "Ida's Diary", a first-person account of living with borderline personality disorder: Mixed methods study	Nurse Education Today
12	Thomson, et al. [28]	Developmental Science Efficacy Trajectories: A Longitudinal Mixed-Methods Investigation	Teaching & Teacher Education
13	Johnston, et al. [29]	A Mixed Methods Evaluation of the "Aged-Up" STAC Bullying Bystander Intervention for High School Students	Professional Counselor
14	Bressington, et al. [30]	Concept mapping to promote meaningful learning, help relate theory to practice, and improve learning self-efficacy in Asian mental health nursing students: A mixed-methods pilot study	Nurse Education Today
15	Bendixen, et al. [31]	Participatory Concept Mapping as an Integration Tool in Mixed Methods Research: Exploring Preservice Teachers' Epistemic Cognition and Teaching Orientation	International Journal of Educational Methodology
16	McCrudden, et al. [32]	Implementing Integration in an Explanatory Sequential Mixed Methods Study of Belief Bias about Climate Change with High School Students	Journal of Mixed Methods Research
17	Veziroglu-Celik, et al. [33]	Teaching Approaches and Practices of Student Teachers in Early Childhood Education: A Convergent Mixed Methods Study	Journal of Educational and Training
18	Otundo, [34]	Effect of Situational Interest and Social Support on College Students' Physical Activity Motivation: A Mixed-Methods Analysis	The Physical Educator
19	Bradbury, et al. [35]	Multiple stakeholder views of pre-school child weight management practices: A mixed-methods Study	Health Education Journal
20	Barndardt, et al. [36]	A Transformative Mixed Methods Assessment of Educational Access and Opportunity for Undocumented College Students in the Southeastern United States	Journal of Mixed Methods Research

Appendix 2: List of Articles Consisting of Innovative Integration Strategies.

S.No	Citation	Title	Journal
1	Wagner, et al. [37]	A mixed-methods study of the social support networks of female sex workers and their primary noncommercial male partners in Tijuana, Mexico	Journal of Mixed Methods Research
2	Fetters, et al. [38]	Innovations in mixed methods-Causality, case study research with a circular joint display, social media, grounded theory, and phenomenology	Journal of Mixed Methods Research
3	Younas, et al. [15]	Perceived challenges of nurse educators while teaching undergraduate nursing students in Pakistan: An exploratory mixed-methods study	Nurse Education Today
4	Blayone, et al. [39]	Ready for digital learning? A mixed-methods exploration of surveyed technology competencies and authentic performance activity	Education and Information Technologies
5	Usher, et al. [40]	Sources of math and science self-efficacy in rural Appalachia: A convergent mixed-methods study	Contemporary Educational Psychology
6	Boström, et al. [41]	Protection and restriction: A mixed-methods study of self-reported well-being among youth with intellectual disabilities	Journal of Applied Research in Intellectual Disabilities
7	Ding, et al. [19]	Applying gamifications to asynchronous online discussions: A mixed-methods study	Computers in Human Behavior
8	Gaugler, et al. [42]	Six-Month Effectiveness of Remote Activity Monitoring for Persons Living with Dementia and Their Family Caregivers: An Experimental Mixed Methods Study	Gerontologist
9	Smith, et al. [43]	Social media dialogues in a crisis: A mixed-methods approach to identifying publics on social media	Public Relations Review
10	Young, et al. [44]	From Policies to Principles: The Effects of Campus Climate on Academic Integrity, a Mixed Methods Study	Journal of Academic Ethics

Table 6: Frequency of utilizing integration strategies at the design level (n=30).

Dimensions	Research Design		
Integration strategies	MM Research Question	MM Design Typology	MM Rationale
	MM Question Reported (n=6)	No mention of any MM Design (n = 19)	Complementary (n=17)
	MM Question Not Reported (n=24)	MMR Convergent (n = 4)	Triangulation (n=13)
		MMR Explanatory Sequential (n =3)	
		MMR Exploratory Sequential (n =3)	
	MMR Advanced (n = 1)		

Table 7: Frequency of utilizing Method level Integration strategies (n=30).

Integration	MM Sampling	Data Mixing	Data Interpretation
Strategies	Identical (n = 5)	No MM data mixing strategies used (n = 16)	Use of no Reporting strategy (n = 4)
	Nested (n = 15)	Extreme case analysis (n = 3)	Reported by Narrative (n = 20)
	Parallel (n = 7)	Joint display(n = 11)	Faced challenges in Reporting(n = 6)
	Multilevel (n = 3)		

Mixed-methods Research Question: There is no uncertainty that Integration is the most significant issue for empirical research using MMR [44,45]. The current MMR literature emphasizes the link between MM research question and design. MM research questions direct the researcher to the appropriate MM design, allowing him/her to prepare the procedures for the Integration. Regarding the critical role of the MM research question, A good MM research question must be used by MM researchers to guide the right choice of an appropriate MM design. On the contrary, only six (20%) of the 30 papers reported MM research questions (Table 8). The remaining 24 papers (80%) did not mention any MM research question [44-49].

Table 8: Innovations in Data Collection, Analysis, and Interpretation to Achieve Integration.

S.No	Integration level	Used by Authors
Data Collection		
1	Survey to collect both quantitative and qualitative data	Young, et al. [44]
		Usher, et al. [40]
2	Visual support:	Kono, et al. [46]
	Photo technique	Burel et al. [47]
	Concept mapping	
3	High-tech method for data collection	Gaugler, et al. [42]
Data analysis and interpretation		
4	Data visualization	Wagner, et al. [37]
		Younas, et al. [15]
5	Quantitizing categorized qualitative data	Bendixen, et al. [48]
		Robertson, et al. [49]

Mixed-methods Research Design: For the use of MM design, 4 (13%) utilized convergent design, 3 (10%) used explanatory designs, 3 (10%) used an experimental design, 1 (3%) used advanced designs, while the remaining 19 (63%) articles did not identify any MM design. However, all articles reviewed have reported the rationale for undertaking MM research.

MM Sampling Strategy for Achieving Integration: Undoubtedly, researchers must select an appropriate sampling method to provide a homogeneous MM sample to enhance Integration based on the relevant MM design. In terms of the data collection integration approach, 5 of the MMR studies (16.6%) out of 30 employed the identical MM sampling 15 articles (50%) employed the nested MM sample approach, and 7 (23%) used the parallel MM sampling strategy. Only 3 (10%) articles employed multilevel MM sampling approaches (Table 7).

Mixing Strategy to Achieve Integration: A good data mixing approach can help integrate two contradicting databases to accomplish a good MMR. On the other hand, as shown in Table 7, 14 of the 30 articles (46.6%) used MM data mixing procedures throughout the data analysis phase, whereas the remaining 16 (43.4%) did not. Extreme case analysis and joint displays were employed in 3 (10%) and 11 (36.6%) articles, respectively. After the data analysis phase, 20 of the 30 studies (66.6%) employed a side-by-side narrative technique to interpret mixed results. Six (20%) papers indicated difficulty understanding the results, while 4 (13%) articles mentioned no MM reporting approach.

Section 3: Innovative Integration Strategies Used in Mixed-Methods Research

Innovative MM integration is an approach that MM researchers use in specific settings in conjunction with common MM integration

strategies to achieve high integration quality. The literature presents five unique integration strategies: surveys, visual support, a high-tech approach, data visualization, and quantitating qualitative themes. The initial three innovative techniques (visual assistance, high-tech approaches, and data visualization) are used to promote Integration during the data-collecting phase. At the same time, the remaining two unique strategies are utilized to ease data analysis and interpretation (Table 8).

Utilizing Survey to Collect Quantitative and Qualitative Data:

Effective data collection strategies in MMR improve the intent of Integration. Employing surveys to acquire both data sets proved to be the most prevalent novel approach. Aside from working with general MM integration approaches, researchers employed surveys in two novel ways to acquire high-quality data:

1. Designing an integrated survey and
2. Putting open-ended questions into an existing scale.

This unique way enables MM researchers to collect both strands of data simultaneously through one open and closed-ended questionnaire.

Visual Support to Collect Both Components: The researchers believe that gathering high-quality qualitative data enables effective Integration with quantitative data, allowing them to reach interpretative rigour in both strands. Besides the usefulness of employing a survey to gather both types of data for Integration, another novel and proper strategy used visual aids to collect data. Many papers used one of two techniques:

1. Using a picture approach to ease data gathering and
2. Utilizing concept mapping for data collection.

High-Tech Approaches for Data Collection: In the existing literature, there is a scarcity of utilizing this approach to collect data in MMR. Although several papers employed high-tech means to acquire data, one of the few used this new strategy. Researchers used a high-tech approach called Remote Activity Modeling (RAM) to obtain quantitative data, with its research goal to see the effects of RAM on patients with dementia [50]. Because assessing people's everyday activities is challenging and practical, researchers installed high-tech motion sensors in patients' houses for their activities of daily living. To ensure the RAM technology's performance, the investigators visited the residences that RAM watched, oversaw the maintenance, and handled RAM system issues throughout the data collection period. Interviews were performed for the qualitative component to obtain participants' perceived acceptability of RAM technology [50].

Data Visualization: The following example best illustrates this component: Brandtzaeg, et al. [51] used an online survey to collect quantitative component data to evaluate people's views of privacy in mobile app use. A content analysis was utilized for the qualitative component to assess themes or patterns related to privacy regulations.

In various data visualization graphs, the researchers exhibited a range of dataflow on various app usage. The goal was to improve user privacy control by facilitating understanding and transparency of app data flow. When these data visualizations were compared, a mismatch was discovered in the quantitative data between users' degree of trust and data flow. By visualizing one strand of data, MM researchers may find a significant link in this strand and use it to conduct subsequent data collection or analysis. The terms used in the subsequent qualitative component analysis that were important to privacy were evaluated using content analysis. Integration was reported by linking these two data sets: According to a user poll, mobile app users lack trust to download and use an app due to privacy concerns. This lack of trust was validated by the finding based on examining personal data flows in applications as multiple third-party domains [51].

Special Joint Display: Bustamante built a new MM joint display to report the MM data outcomes in this aspect. In the MMR literature, the usage of a joint display is extensively established. Bustamante [52] utilized MMR to understand how successfully Spanish instructors utilized Technological Pedagogical Content Knowledge (TPACK) using a MM convergent design and to choose 27 participants for both strands. The investigator created a spherical joint display rather than a table or matrix to communicate both the results and the underlying theoretical lens. Furthermore, in this spherical joint display, the researcher constructed a big round in the middle of which the quantitative data were summed with significant results. The following circle displayed the themes from the qualitative data. Quotes that were relevant to the qualitative topics were shown in the outside circle. The amount of Integration was represented by the outside circle, which used Confirmation, Discordance, and Expansion to signify the degree of convergence of the qualitative and quantitative data sets [52].

Quantizing the Qualitative Data: Researchers established innovative approaches to quantitating the qualitative to accelerate data analysis and achieve Integration. Data transformation can be best utilized for this purpose. The best strategy mentioned in the literature is to use data transformation excellently. For example, Robertson and Simmons employed mixed-methods research "to investigate sensory aspects and their association with autistic symptoms". They employed a questionnaire that consisted of closed and open-ended questions to obtain qualitative and quantitative data simultaneously. They divided the open-ended responses from the survey into three groups based on the quantitative survey scores: low (less than 19), medium (between 19 and 31), and high (i.e., scores larger than 31). The themes constitute the open-ended responses based on the three groups, which are later coded based on groupings [49]. Therefore, this novel aspect differed from the simple inductive coding approach utilized in the qualitative component. It is beneficial for researchers to successfully identify the quantitative outcomes to plan the prospective categories for the qualitative component. The difficulty in using this

novel strategy is determined by how well the researcher knows the necessary literature or evaluates the quantitative data enough.

Section 4: Different Challenges Reported in the Literature in Achieving Integration

MMR researchers have encountered several difficulties in developing the design and process integration when selecting this for their research study. Because combining the design and quantitative and qualitative data is valuable and challenging. Indeed, it is a fundamental problem in MMR to integrate both methodologies' ontological and epistemic viewpoints to provide more trustworthy conclusions with the data acquired from participants. Alongside, the experiences demonstrated the difficulty for a single researcher (who has expertise in one strand, i.e., QUANT or QUAL) carrying out both quantitative and qualitative research concurrently are being suggested to use a team method while conducting MMR. However, even with team integration challenges can be experienced on several levels but with less intensity.

Challenges - Paradigm Level: The paradigms of realists and constructivists reveal significant disparities in the MM community about the nature of knowledge and the acceptable methods for creating such information [53]. Pragmatic researchers use dual-lens (i.e., both quantitative and qualitative) and may zoom in to minute detail or out to limitless scope. Researchers agreed to combine both techniques in single research called the bi-focal lens. However, there is more intricacy and confusion from the beginning to the completion of the research.

Apparently, these two quantitative and qualitative arms possess positivist and interpretivism philosophical paradigms, respectively. They are indeed, resulting in two research subcultures, one praising the benefits of thick subjective data and the other admiring the virtues of objective and generalizable data. On the contrary, purists claim that merging quantitative and qualitative is difficult due to paradigmatic inconsistencies, as these two approaches represent distinct epistemologies. This is known as the "paradigm controversy." Moreover, MMR is considered unsustainable, i.e., incongruent, or conflicting, since some paradigms and approaches cannot properly 'fit' together. Their main point is that "it is not feasible to mix, blend, or reconcile a view of reality as unitary and objective (positivist) with views of reality as numerous and individually or culturally produced (constructivist), or as historically dependent (critical theory). However, purists in both camps have sustained that integrating both methodologies in single research is impossible due to the logic of incompatibility of paradigmatic notions [54].

Challenges - Method Level: Although, method variations are used to widen the scope of a study and incorporate method-related characteristics. Researchers nowadays strive to be more diverse, critical, and creative; as a result, they must balance one technique with another and have a solid understanding of numerous

approaches. In the same way, MMR combines non-empirical and idiographic approaches to attain both generalization and in-depth comprehension. Indeed, when several methodologies are joined without a comprehensive review of the unique principles, norms, and assumptions underlying their behaviour, corruption can occur, causing the conclusions obtained to be questionable. Similarly, one of the biggest obstacles in the MMR is producing more reliable findings by combining both methodologies. Unfortunately, the probability of technique corruption would be higher, the problem would be beyond the discipline, and the investigators could be held responsible. As a result, methodological mixing entails surviving the researcher/s' numerous inconsistencies and confusions to maintain the steady functioning of inference and persuasion processes.

Challenges - Sample Size and Approach: MMR employs a technique that combines highly organized data-collecting tools with significantly less structured ones. However, determining the sample size for MMR is one of the most difficult components of the study process. Which sample size is best for gathering both qualitative and quantitative data? Is it feasible to confirm the sample size for data collection using both approaches? The qualitative technique entails purposive sampling to improve comprehension of the information-rich instance and to develop knowledge from specific examples. In the meantime, the objective of reaching saturation is a common qualitative approach in sample selection which is not acceptable for delivering reliable study findings using the quantitative technique. In addition to the external validity issues, the researchers were concerned about two issues: sample non-representativeness and generalization. Several researchers described their sampling frame or technique for the non-representative sample, such as convenience sample, single case study, or compliance sample. Random sampling from the potential population is necessary to generalize the results to the prospective population. However, no study employed a random sample rather than a universal sample or a sample confined to a specific cultural or religious environment.

Challenges - Construct Validity: Construct validity needs concise measurement to measure what is intended to be measured. However, there have been some challenges, such as the researchers failing to verify the instrument constructed from qualitative data. In the qualitative strand, few researchers were concerned with the coding procedure. Several codes were discovered for construct validity: many authors specified the data precision they employed in their experiments. Few stressed the use of instruments that had not yet been validated. A few researchers have mentioned the poor link between qualitative and quantitative data and the little coding qualitative data method.

Conclusion

In short, the methodological aim of this paper was to have an evolutionary insight into integration concepts that emerged initially

through pioneering research. Furthermore, it was also observed how frequently the concept of Integration has been mentioned in the available literature, which helps in defining the rationale of this paper. Moreover, it also included which innovative integration strategies are being used by many scholars in their articles. Additionally, a few challenges of achieving Integration were also discussed. Consequently, this paper can contribute to existing body knowledge for novice MM researchers.

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