Integrative approach of mixed methodology in educational research

El enfoque integrador de la metodología mixta en la investigación educativa

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Abstract

Educational research examines complex and dynamic social phenomena which requires a global perspective. The integrative approach of mixed methodologies (MM) allows QUAL and QUAN perspectives to be merged during the research process. Flexibility, the nature of the phenomenon and analytical density are essential aspects of this integration. The present study aims to analyse the integration of MM as a way of improving the quality and validity of educational research. A systematic review of literature published over the last ten years was carried out following the PRISMA protocol. A total of 22 documents were analysed. Present findings reveal that the effectiveness of MM lies in the degree of integration achieved with regards to methodological equality. In order to address this, it is necessary to consider its integration within theoretical perspectives, alongside research justification, design, objectives, methods, data analysis and transfer, and organisation of the research team. Nonetheless, there are many challenges to effective integration. These include debate pertaining to the rigidity of QUAL and QUAN approaches, the efficacy of integrating MM, research quality and the evaluation criteria of separatist currents which may overshadow the nature of integration. The rise of MM has contributed to understanding the dynamism of educational phenomena. The greatest potential of MM is found in its capacity to achieve effective integration but, at the same time, it presents a challenge for research teams. Hence, consolidated bases are needed to enable the scientific community to develop practices guided by principles of quality, validity and research effectiveness.

Keywords: Mixed methodology, integration, research project, educational research, educational sciences, social sciences.

Resumen

La investigación en educación estudia fenómenos sociales complejos y dinámicos que deben ser analizados de manera global. El enfoque integrador de la metodología mixta (MM) permite fusionar las perspectivas CUAL y CUAN durante el proceso de investigación. La flexibilidad, la naturaleza del fenómeno o la densidad analítica son aspectos imprescindibles para la integración. Este estudio pretende analizar la integración en MM para incrementar la calidad y la validez de las investigaciones en educación. Se ha realizado una revisión sistemática de la literatura de los últimos diez años siguiendo el protocolo PRISMA. Se han analizado un total de 22 documentos. Los hallazgos muestran que la eficacia de la MM radica en el grado de integración contemplando la igualdad metodológica. Para ello es necesario contemplar la integración en las perspectivas teóricas, la justificación, el diseño, los objetivos, los métodos, el análisis de datos, la transferencia y la organización del equipo de investigación. Sin embargo, existen retos para integrar eficazmente. El debate perteneciente a la rigidez de lo CUAL y lo CUAN, la integración efectiva de la MM, la calidad de la investigación o los criterios de evaluación de corrientes separatistas pueden eclipsar la naturaleza de la integración. El auge de la MM ha contribuido a entender el dinamismo de fenómenos educativos. La integración efectiva es el mayor potencial de la MM, pero, al mismo tiempo, es un reto para los equipos de investigación. Por ello, se requieren bases consolidadas para que la comunidad científica desarrolle prácticas bajo principios de calidad, validez y eficacia en la investigación.

Palabras clave: Metodología mixta, integración, proyecto de investigación, investigación educativa, ciencias de la educación, ciencias sociales

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Mixed methodologies (MM) have evolved exponentially over the last twenty years (Fàbregues et al., 2021). Nevertheless, uncertainties continue to arise when it comes to explaining the way in which the qualitative (QUAL) and quantitative (QUAN) aspects of this type of research, which are frequently used in the field of education, are related (Akerblad et al., 2020; Tashakkori and Creswell, 2007; Uprichard and Dawney, 2019). Given the complexity of educational issues, the use of MM may be justified by the contextual and idiosyncratic dimension of educational practices, development of generalisable recommendations, or support for educational policy decisions (Fetters and Molina-Azorin, 2017).

Historically, the rigidity of methodologies did not allow for such scope. Thus, ontological and epistemological conceptions made it difficult to contemplate the emerging aspects of research (Morse, 2009; Sale et al., 2002). MM studies pertaining to the social sciences have increased in number over the past 30 years. Although studies characterised by the collection of QUAL and QUAN data appeared in the 1960s, it was not until the 1980s that MM experienced a boom in popularity. This, Creswell (2015) has referred to as the *third research paradigm*. Still, there is little agreement on what MM consists of (Morse and Cheek, 2014). Currently, it is conceived as a process where QUAL and QUAN aspects are projected throughout research, with integration emerging as the main element (Creswell and Plano-Clark, 2018). This considerably increases the value of research because it manages to link contrasting perspectives in all aspects of the research (Morse and Cheek, 2014).

Studies that opt for this integration are still scarce (Borglin, 2015). In fact, this approach is not exempt from multiple challenges which are both procedural and methodological in nature, as well as ontological and epistemological. As a result, some authors argue that this approach produces a confusing and disorderly view of the issue (Sanscartier, 2020). Questions remain around the extent to which QUAL and QUAN research can be combined without violating existing paradigms, or, the way in which research questions can be framed by integrative MM. The philosophical foundations of MM are a subject of debate, along with the fusion of research designs and the way in which researchers present and transfer findings.

In consideration of this context, the general objective of the present study is to analyse current empirical research, which explicitly considered MM in the field of social sciences and, especially, in educational sciences. To this effect, the following specific objectives were established:

- Identify the characteristics that justify the use of MM in educational research.
- Analyse the principles of MM in each phase of research development.
- Identify aspects that can be improved to increase the quality and validity of MM research in education.

Method

In order to meet the stated objectives, the basis of the present research was formed by an original systematic literature review following the PRISMA protocol *(Preferred Reporting Items for Systematic reviews and Meta-Analyses)*. This ensured that all recommended information would be captured and that the process would be replicable (Page et al., 2021). Likewise, this approach promotes research quality by providing a checklist and flowchart to facilitates systematisation (Moher et al., 2009). The present approach promoted an exploration of the areas of social sciences whose main focus is "the identification of trends and the mainstream, as well as the detection of gaps and research opportunities" (Codina, 2018, p. 11). Specifically, the process followed three phases: (1) document search and evaluation using the *VOSViewer* tool, (2) selection and filtering of documents according to defined criteria, and (3) analysis of documents (Littell et al., 2008; Petticrew and Roberts, 2006).

The first step was to narrow down the databases and select the sources for inclusion.

Special attention was paid to databases associated with the social sciences and the educational sciences. In addition, the search was further refined to only include documents that had been subjected to evaluation processes, such as peer-reviewed journal articles or book chapters. Doctoral theses were discarded due to their lack of publication in relation to the study aims.

With a view to achieving the most updated content, the review was limited to literature published between the years of 2011 and 2021. In order to identify and analyse the documents focused on MM and provide a clear and applicable picture of its use in the field of education, an initial search was carried out in four specific databases, *Scopus*, *Web of Science*, *Eric* and *Dialnet Plus*, with the keywords *Mixed Methodology* -ERIC Thesaurus- *Integration* -ERIC Thesaurus- and *Social Sciences* - UNESCO Thesaurus, ERIC Thesaurus, European Education Thesaurus, EuroVoc Thesaurus. After the first initial search, the keyword *Social Sciences* was eliminated to obtain a greater representation of documents associated with the object of study. Through application of a sequential process including faceted searching, derivation and a combination of keywords, final search equations were elaborated and are presented in Table 1.

Table 1. Search equations

Database	Search equations	Date	Documents
Scopus	AUTHKEY (("mixed methodology" OR "mixed methods" OR "multimethods" OR "mixed stud*") AND ("integrative strategy" OR "analytical integration" OR "theoretical integration" OR "integrative data"))	26/01/2021	129
WOS	TS = (("mixed methodology" OR "mixed methods" OR "multimethods" OR "mixed stud*") AND ("integrative strategy" OR "analytical integration" OR "theoretical integration" OR "integrative data")) OR TI= (("mixed methodology" OR "mixed methods" OR "multimethods") AND ("integrative strategy" OR "analytical integration" OR "integration"))	27/01/2021	92
ERIC	(("mixed methodology" OR "mixed methods" OR "multimethods" OR "mixed stud*") AND ("integrative strategy" OR "analytical integration" OR "theoretical integration" OR "integrative data"))	27/01/2021	8
Dialnet Plus	("mixed methodology" OR "mixed method") AND ("integration" OR "integr design*" OR "integr data*")	27/01/2021	32

Note: own elaboration.

The filtering of results was carried out in consideration of the possibilities of each database. In the case of *Scopus*, results were filtered by publication year and by the section of the documents in which keywords should appear, i.e. keywords. In *WOS,* the aforementioned parameters were used but keywords were also searched for in the title and topic. In *ERIC,* results continued to be filtered by publication year, whilst, in *Dialnet Plus,* year and language of publication were also defined given that interest turned to identifying documents published at a national level.

For outcomes produced using *Scopus* and *WOS*, a bibliometric analysis was carried out using the *VOSViewer* tool in order to consolidate the significance of the relationship between search equations and the study objective. Since documents cannot be included in the *VOSViewer* tool in *ERIC* export file format and *Dialnet Plus* omits the option to download a file containing search results, outcomes from this database could not be analysed using said tool. Nonetheless, 84.67% of the preliminary results came from the first two databases. This fact implies that the *VOSViewer* is highly useful for producing outcomes.

VOSViewer allows visualisation of bibliometric networks by means of occurrence matrices, also known as a data matrix, which is made up of documents and keywords. This matrix determines whether i and j are present in the same document. In co-occurrence matrices, which are in fact matrices formed by association between symmetric squares, each element represents the association between keywords. In the case of the present study, the minimum number of occurrences between keywords was set at greater than or equal to 5 [$f (KW) \geq 5$]. This was to enable the detection of medium and large outcome clusters, also known as neighbourhood matrices or thematic nuclei. In addition, the larger the circle and item label, the greater the weight of the keyword within the cluster, whilst the distance between clusters indicates the strength of association, with short distances indicating greater correlations.

In the case of *Scopus*, four clusters were found -Cluster 1 with 11 items represented in red, cluster 2 with 10 items represented in green, cluster 3 with 6 items represented in blue and cluster 4 with 3 items. A total of 30 co-occurring keywords are represented by the colours in the bibliometric map (Figure 1). Outcomes were significant since the keywords *mixed methods* and *integration*, which correspond to search keywords, obtained maximum reach (134 and 117, respectively), with a higher number of occurrences (62 and 51, respectively) than the other keywords.

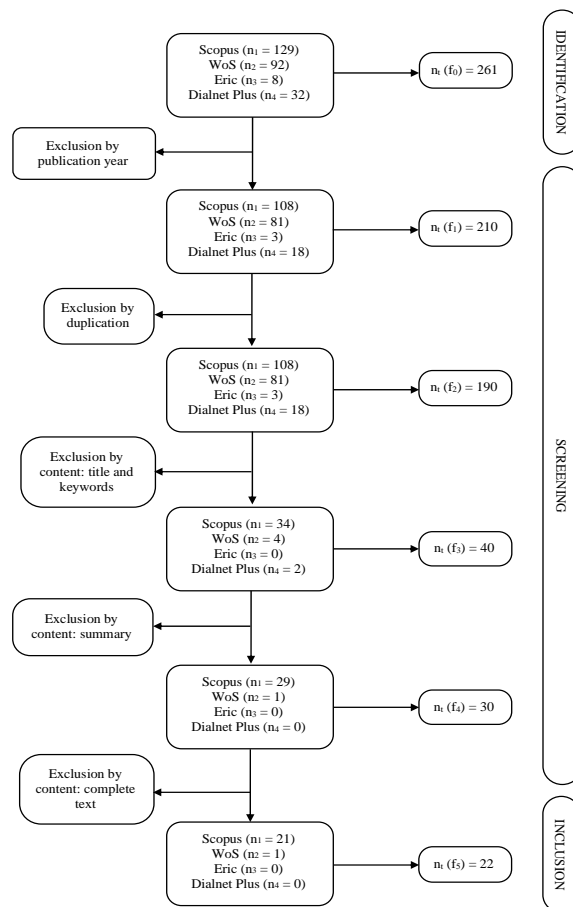Figure 1. Bibliometric map of keywords -Scopus-
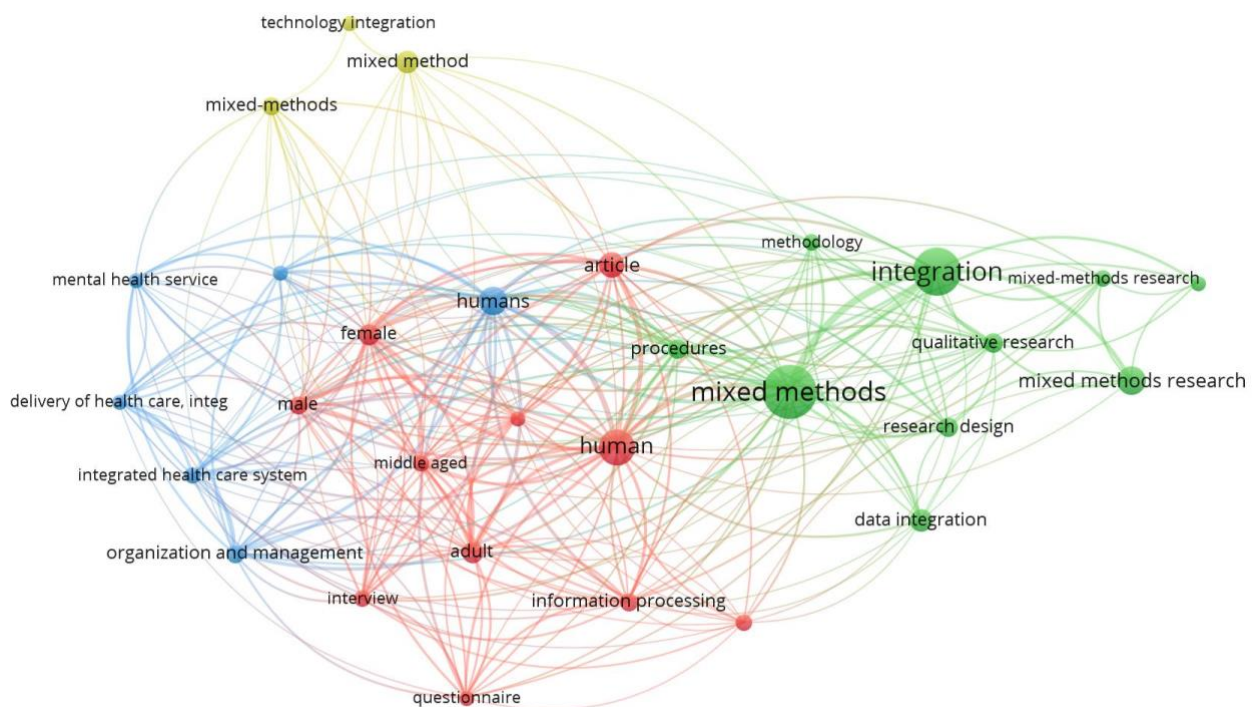
Note: retrieved from VosViewer (2021).

In relation to the analysis of the *WOS* keywords, two clusters were identified (Figure 2) (cluster 1 with 10 items represented in green and cluster 2 with 7 items represented in red) covering 17 keywords in total. With regards to representation of the subject under investigation, the second cluster was related with more keywords. However, maximum reach pertaining to *mixed methods* and *integration* was lower than in *Scopus* (93 and 63, respectively), as was the number of occurrences (31 and 16, respectively).

These outcomes made it possible to assess whether the initial search had been meaningful. Following this, a phase evaluating the characteristics of the documents was undertaken. Inclusion criteria for this phase were that included studies: 1) had been submitted to *blind peer review*, 2) reported outcomes focused on MM, and 3) published in English or Spanish between 2011 and 2021. Studies were excluded if they presented a duplication of documents or study content, or MM was identified as a technique for obtaining certain results and not as an object of study in itself (Figure 3). Finally, 22 documents were included (Table 2).

Figure 3. Selection process flow chart

Note: elaborated for the present study based on the PRISMA protocol.

Figure 2. Bibliometric map of keywords -WoS-
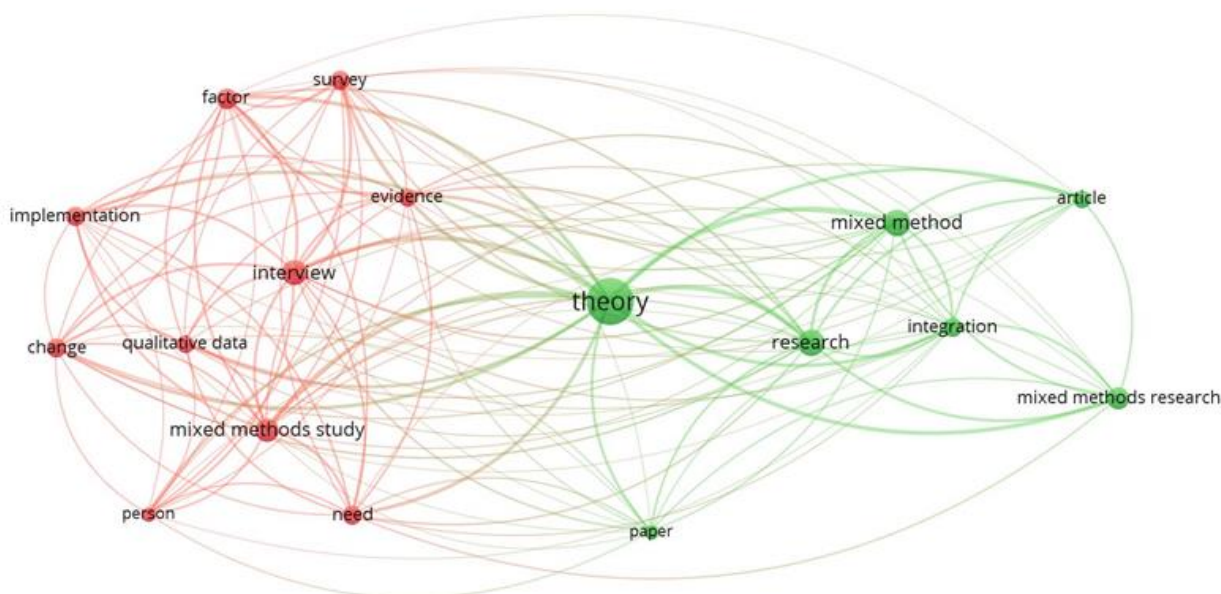
Note: retrieved from VosViewer (2021).

Table 2. Selected documents

| Authors	Year	Title	Type*
Akerblad et al.	2020	Integrative Strategies in Mixed Methods Research	Art
Anguera et al.	2020	Best Practice Approaches for Mixed Methods Research in Psychological Science	Ed
Anguera et al.	2018	Revisiting the difference between mixed methods and multi-methods: Is it all in the name?	Art
Archibald et al.	2015	Current mixed methods practices in qualitative research: A content analysis of leading journals	Art
Bazeley	2016	Mixed or merged? Integration as the real challenge for mixed methods	Art
Bazeley and Kemp	2012	Mosaics, Triangles, and DNA: Metaphors for Integrated Analysis in Mixed Methods Research	Art
Doyle et al.	2016	An overview of mixed methods research revisited	Art
Dupin and Borglin	2020	Usability and application of a data integration technique (following the thread) for multi- and mixed methods research: A systematic review	Rev
Fetters	2018	Six Equations to Help Conceptualize the Field of Mixed Methods	Ed
Fetters and Molina-Azorin	2017	The Journal of Mixed Methods Research Starts a New Decade: The Mixed Methods Research Integration Trilogy and Its Dimensions	Ed
Fetters et al.	2013	Achieving Integration in Mixed Methods Designs-Principles and Practices	Art
Fielding	2012	Triangulation and Mixed Methods Designs: Data Integration with New Research Technologies	Art
Gobo	2016	Why "merged" methods realize a higher integration than "mixed" methods: a reply	Art
Guetterman et al.	2020	Virtual Special Issue on "Integration in Mixed Methods Research"	Ed
Lynam et al.	2019	Reframing Integration for Mixed Methods Research	Art
Plano-Clark	2019	Meaningful integration within mixed methods studies: Identifying why, what, when, and how	Art
Schoonenboom and Johnson	2017	How to Construct a Mixed Methods Research Design	Art
Tashakkori et al.	2015	Mixed Methods	Chap
Tonon	2019	Integrated methods in research	Chap
Tunarosa and Glynn	2017	Strategies of Integration in Mixed Methods Research: Insights Using Relational Algorithms	Art
Uprichard and Dawney	2016	Data Diffraction: Challenging Data Integration in Mixed Methods Research	Art
Zhou and Wu	2020	Reported Methodological Challenges in Empirical Mixed Methods Articles: A Review on JMMR and IJMRA	Art

* Type: Art = article, Ed = editorial, Chap = book chapter.
Note: elaborated for the present study.

In the final phase, documents were analysed and conceptual categories were identified for the presentation of results in line with the stated objectives. 100% of the articles were written in English. With regards to the year of publication (Figure 4), 2020 was the year in which most included articles were published, pertaining to 22.8% of the sample. It should be noted that 95.5% of articles contained the words "*mixed methods*" in the title and 63.6% contained the root word *integrat** (referring to integration as *integrated, integration* or *integrative)*. With regards to document type, 63.6% were articles, 18.2% were editorial publications and 9.1% were book chapters.

Figure 4. Number of publications per year
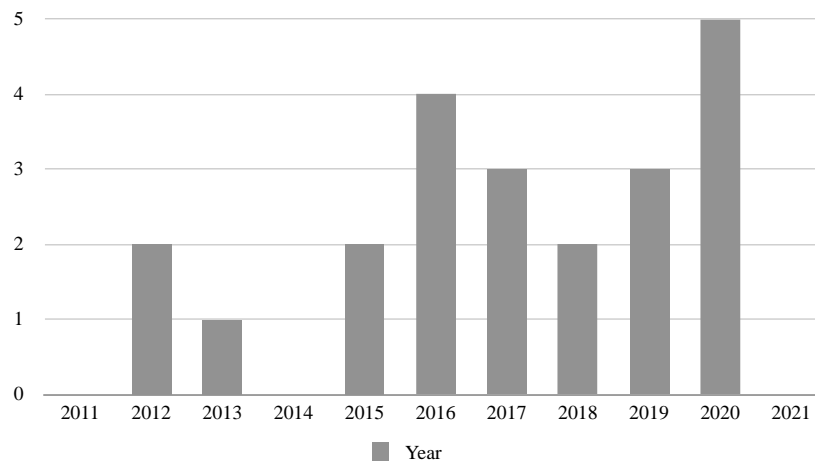
Note: elaborated for the present study.

With regards to the analysis, the first phase consisted of a round in which each member of the team made two in-depth readings of the 22 included documents. This was done to identify correlated dimensions and in order to obtain a map associated with the initial results derived from the clusters displayed by *VOSViewer*. In order to facilitate this work, a document was created to simplify analysis. In the second phase, an initial outline was created which was populated by the categories that would later be used to classify and group content. For this, inductive criteria (Mejía, 2011) and open coding (Strauss and Corbin, 1998) were used. In addition, a triangulation process was used over successive rounds to enable repeated inclusion, modification and deletion of different categories of analysis.

Thus, outcomes are presented according to four conceptual categories related with the specific study objectives. The first and second categories corresponded to the first specific objective, namely, educational MM research and integration of MM. The third category pertained to the second specific objective, namely, the research and transfer team. Finally, the fourth category grouped outcomes pertaining to the third specific objective, namely, current challenges of MM. It should be noted that, due to the magnitude of the second category, the following five sub-categories were used to conceptualise MM research processes: research justification, research design, research questions and objectives, data collection methods, and data analysis.

Results

Educational research and MM

Educational phenomena are characterised by qualities and quantities that are contemplated through social research methods (Bazeley, 2016). Studies carried out within the framework of social sciences must follow structures in line with logical-scientific methods, in which it is essential to avoid the use of synonyms referring to different methodological realities (Anguera et al., 2020). Phenomena are defined as dynamic, open, emergent and multidimensional systems (Uprichard and Dawney, 2016), meaning that research cannot be conceptualised according to a strict dimension (Gobo, 2016). The disparity of thoughts, theories, designs, data analyses and outcome interpretation enriches educational phenomena (Lynam et al., 2019).

The long-standing distinction between QUAL and QUAN research is still valid and can make it difficult for both parts to integrate (Bazeley and Kemp, 2012; Gobo, 2016). The two methodologies contribute to each other during the process, from project planning to the analytical generalisation of results (Bazeley, 2016). The various findings must be combined to achieve a global picture of the

phenomenon. MM tries to reinforce educational sciences whilst avoiding giving the impression of calm and stability. Cuts to research projects have been key to making access messy, disparate and diffuse (Anguera et al., 2020; Tashakkori et al., 2015; Uprichard and Dawney, 2016).

In the 1980s, mixed research started to combine QUAL and QUAN aspects. Currently, the only potential of MM is achieiving effective integration of the research process (Plano-Clark, 2019; Tashakkori et al., 2015), in which both

approaches can contribute to a better understanding of the problem (Anguera et al., 2018). Creswell (2015) defined MM as:

> An approach to research in the social, behavioral and health sciences in which the researcher gathers quantitative (closed) and qualitative (open) data, integrates them, and then extracts interpretations based on strengths (Anguera et al., 2018, p. 2763).

Fetters (2018) linked this idea with six equations (Table 3) that describe the characteristics of MM.

Table 3. Definition of MM

Equation	Meaning
$1 + 1 = 1$	QUAL methodology plus CUAN methodology offers a NEW methodology.
$1 + 1 = 2$	Collecting data without considering integration equates to the sum of the individual parts. QUAL added to QUAN achieves independent results.
$1 + 1 = 3$	Integration enables the outcome to be greater than the sum of its parts. Researchers must seek added value.
$1 + 1 = 4$	There are four types of publication: empirical mixed methods, qualitative empirical, quantitative empirical and MM. However, the fourth option, pertaining to empirical results with integrative aspects, should be advocated.
$1 + 1 = 5$	Research using MM requires research teams made up of five or more members with each assuming roles related to their research experience.
$1 + 1 = \infty$	The innumerable possibilities of integrating QUAL and QUAN is the greatness of this methodology.

Note: adapted from Fetters (2018).

What if "one method captures the elephant's ear and another method captures the mouse's tail?" (Uprichard and Dawney, 2016, p. 22). This question refers directly to the inference between MM and mixed or multi-methods. The former is characterised by the union of a set of rules, concepts, norms, methods and ethics pertaining to research. The latter refers to the practice and explicit outcomes of MM, which are guided by QUAL and QUAN aspects. These aspects are defined by dominant poles (QUAL-quan, QUAN-qual, QUAN-QUAL, qual-quan), whose nexus lies in mental attributes that are not inclusive of each other. Mixed methods can fracture the phenomenon since it is assumed that each method is applied to an exclusive aspect of it (Anguera et al., 2018; Bazeley, 2018; Tashakkori et al., 2015).

MM are considered to offer a third type of research option. This pragmatic effect has

been used to justify methods or respond to multidimensional questions (Tashakkori et al., 2015). The distinction between concepts should be perfectly clear (Anguera et al., 2018; Bazeley and Kemp, 2012), identifying integration as the singular element of the social character of MM (Lynam et al., 2019; Upricheard and Dawney, 2016).

Integration

The greatest potential on offer through MM is effective integration of QUAL and QUAN perspectives (Archibald et al., 2015; Plano-Clark, 2019). Integration is understood as a process that encompasses the research as a whole, from study design to the interpretation of results (Akerblad et al., 2020; Guetterman et al., 2020). In this way, QUAL and QUAN aspects should communicate with each other (Plano-Clark, 2019).

Fetters and Molina-Azorin (2017) proposed the *integration trilogy* which is comprised of philosophy, methodology and methods. The global conceptualisation of this is interpreted through specific research features. When each dimension is considered separately, poor integration in just one aspect could affect the others (Zhou and Wu, 2020). Integration is not always effective. Instead, the nature of the study should promote the integration of inter and intra-dimensionally related aspects (Uprichard and Dawney, 2016).

Fetters et al. (2013) proposed three levels of integration. The first referred to the design - sequential exploratory, sequential explanatory and convergent – which has four frames - multiple stages, intervention, study and participation. The second level corresponds to the methods and is operationalised through actions such as connect, build, merge and embed. The third level concerns interpretation and transference through narrative, data transformation and joint visualization.

Plano-Clark (2019) established four integration strategies which respond to formulating integrative questions through mixed methods, aligning QUAL and QUAN data, identifying points of integration and jointly developing mixed interpretations. This helps readers to understand the why, what, when and how of research (Schoonenboom and Johnson, 2017).

When integration is complete, a unique new product is produced that is methodologically equal (Anguera et al., 2020; Gobo, 2016). Bazeley and Kemp (2012) proposed *complementary strategies,* in which strategies are combined to complete and explain a set of findings, and *generative strategies,* in which interactive exchange takes place at the beginning of the process via exploration. That produced is something that could not have been achieved without this integration. Effective integration values the drawing up of projects, convergent validation of results and analytical density of the

researcher (Fielding, 2012). From this perspective, it is conceived as a relational and generative process rather than a logistic process in which methods are mixed (Tunarosa and Glynn, 2017). Fetters and Molina-Azorin (2017) expanded the dimensions of integration (Table 4).

Integration requires reflection on the nature of the phenomenon, as well as analysis of the problem and the degree of inclusion, relating it to the degree of flexibility, training of the research team and employed techniques or methods (Akerblad et al., 2020; Bazeley and Kemp, 2012; Fielding, 2012; Guetterman et al., 2020).

Justification

There are multiple explanations to justify research. MM. Bryman (2007) analysed 232 mixed articles from different social sciences disciplines. Justifications did not always correspond to practice as only 4.3% indicated that the research had been designed to respond to QUAL and QUAN research questions. The main barrier was the publication of articles with mixed findings and, consequently, the lack of understanding of publishers about the reflexivity of researchers (Gobo, 2016).

Archibald et al. (2015) concluded that 52% of empirical articles clearly justified MM. The most common justification was development (21%), followed by complementarity (14%). Triangulation was used rather than expanding, since 66% of studies were sequential and so were developed with different methods without prior linkage. Dupin and Borglin (2020) found that verification of and confidence in the data were the most prominent justifications given that this enables outcomes to be explained at a theoretical level. Lynam et al. (2019) justified integration by the increased probability of achieving social results in different contexts. However, the vast majority of articles did not report the research questions posed, nor the techniques employed.

Table 4. Integration in MM

Dimension	Meaning
Philosophy	Guided by principles and philosophies (pragmatism, critical realism, postmodernism, etc.).
Theory	Broad (feminist theory, social justice theory) or mid-range (health belief model, social cognitive theory, ecological theory, etc.) theoretical frameworks.
Research team	The research team is made up of people from different disciplines -QUAL, QUAN and mixed- in order to favour quality.
Justification	The justification should state why a study is carried out (compare strengths and weaknesses, supplement, expand, build, etc.).
Research questions and objectives	QUAL and QUAN objectives should relate to QUAL and QUAN research questions.
Design	The work must be constructed using basic (explanatory sequential, sequential, or convergent exploratory), advanced (intervention, case study, evaluation, or participation) or emergent designs.
Data collection	Data collection should be related to procedures which compare, diffract, construct, connect, generate, validate, etc.
Data analysis	Analysis can compare within a single model and/or compare advanced analyses (QUAL to QUAL or QUAN to QUAL data transformation, joint visualisations, social networks, comparative QUAL, systems mapping, etc.)
Interpretation	Interpretation of results (meta-inferences or development of conclusions from QUAL and QUAN data) is accompanied by the adjustment of two types of data (complementarity, confirmation, extension, disagreement). In cases where conflict arises, processes can be used to reconcile or exclude data.
Dissemination	Wide publication enhances results. A publication must include the integration of results. Inter-publication can refer to any combination of publications; QUAL, QUAN and / or mixed.
Research integrity	Integrity must be defended regardless of the plan's composition (validity, reliability and legitimacy).

Note: adapted from Fetters and Molina-Azorin (2017).

The most commonly accepted justifications for integration are (Doyle et al., 2016):

- *Triangulation/Convergence*: outcomes are mutually corroborated via QUAN and QUAL approaches.
- *Expansion*: preliminary outcomes are detected at an early phase which need to be explained.
- *Exploration:* instruments or observations are required in the first phase of research to identify variables and / or develop hypotheses.
- *Completeness:* the most complete and exhaustive description of the phenomenon is given.
- *Understanding weaknesses:* the weaknesses of each method are minimised.
- *Diversity of research questions:* QUAN, QUAL or mixed questions are asked at the first phase of results.
- *Illustration:* QUAL results illuminate QUAN data.

The concept of triangulation is one of the most widely used and, perhaps, most exploited justifications. Historical use of the term is found in 1959 in an article published by Campbell and Fiske. These authors proposed a multi-feature-multi-method correlation matrix to evaluate the validity of research through a reliability diagonal. Later, Webb et al. (1966) used, for the first time, the concept of triangulation, referring to two or more independent confirmations of a research process. Practice was subsequently popularised by Denzin's qualitative studies (1970, 1978). In 1989, the author stated that the mixing of techniques and methods was not sufficient for study validation. In the new millennium, Kelle (2001) presented the term stating that "it does not represent a single integrated methodological concept, but a

metaphor with a wide semantic field" (p. 1). He identified the three triangulation typologies of mutual validation and integration of perspectives, in addition to the original trigonometric meaning. However, Creswell et al. (2004) stated that most work using triangulation as a justification for MM, later produced publications of the constituent methods independently (Bazeley and Kemp, 2012; Tonon, 2019).

Research design

Research designs using MM are conceptualised as being *exploratory sequential, explanatory sequential, mixed parallel* and/or *convergent* (Fetters et al., 2013; Tashakkori et al., 2015). Any combination of these must have at least one point of integration (Plano-Clark, 2019). However, some studies go beyond these basic designs with hybrid, complex and fully integrated designs emerging which provide more information. These are now considered as a new category of MM (Schoonenboom and Johnson, 2017; Tashakkori et al., 2015).

Schoonenboom and Johnson (2017) have proposed that different questions must be considered during the elaboration of a robust and integrative mixed design:

- *Phenomenon:* does the project address one aspect of the phenomenon of various?
- *Social scientific theory:* will the study generate new theory, test an already constructed theory, or achieve both? Is the researcher interested in substantive

theory formulated using empirical data?
- *Methods:* which QUAL and QUAN methods will be used and how will they be combined?
- *Research team:* how heterogeneous is the research team?
- *Validity:* what validity criteria will be considered to defend the study and make conclusions?
- *Completeness of the study:* will there be one study or more than one? How will the research plan be structured?

In *sequential designs*, each research phase is developed using other phases as a basis (Fetters et al., 2013). It implies two points of integration. The first is found between the first and second phase, whilst the second is found at the end of the second phase (Plano-Clark, 2019). These designs predict certain outcomes prior to the initiation of a study phase (Tashakkori et al., 2015).

There are two types of sequential designs (Figure 5): *explanatory* and *exploratory*. The former consists of a broad QUAN phase, followed by a shorter QUAL phase, with this QUAL phase depending on outcomes produced in the earlier phase (Doyle et al., 2016; Fetters et al., 2013; Plano-Clark, 2019). On the other hand, in exploratory sequential designs, QUAL data are first collected and analysed. The results of this are then used to prepare CUAN data collection (Fetters et al., 2013; Plano-Clark, 2019), which helps to evaluate and test an instrument or generate new results to reach other populations (Doyle et al., 2016).

Figure 5. Mixed sequential design
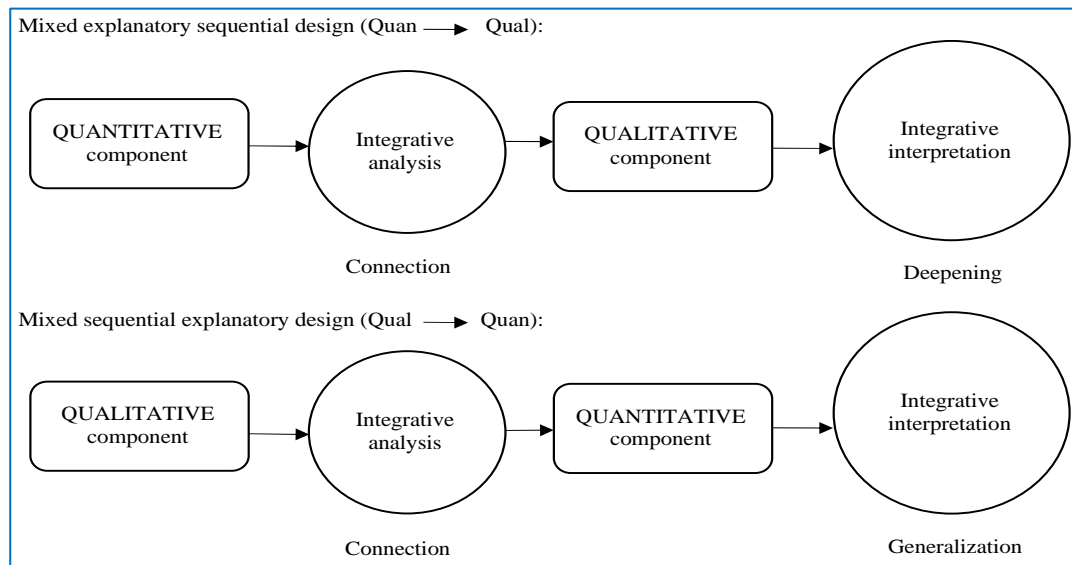
Note: own elaboration.

In a *mixed parallel* design, methodologies are applied independently at each phase, whether concurrently or with a time lag (Doyle et al., 2016). Results are not dependent on each other and the research is characterised by greater flexibility. The point of integration occurs during the final research phase (Tashakkori et al., 2015).

Convergent or *concurrent triangulation* designs are founded on global research questions. The collection of QUAL and QUAN data is carried out simultaneously and in parallel in order to merge the various phases (Figure 6). Findings produced from one phase are not dependent on another and the interpretation of results is merged. A barrier to this design is met when results are divergent (Doyle et al., 2016; Fetters et al., 2013; Plano-Clark, 2019).

Figure 6. Converging mixed designs
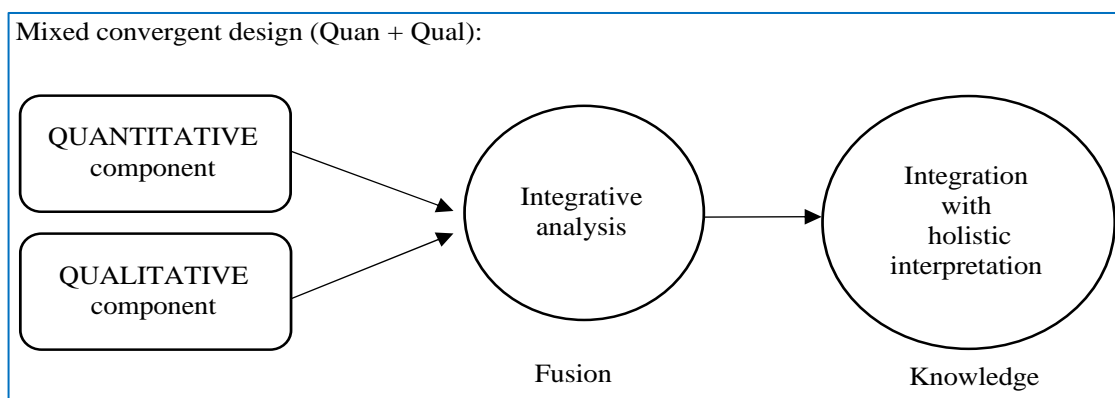
Note: elaborated for the present research.

Fully integrated designs represent a combination of those discussed above. The main characteristic of these designs is that they fuse dynamism and interaction. Integration forms the premise on which a solid design is configured. Designs are complex and / or creative depending on the course of the process (Tashakkori et al., 2015). In addition, it is important to contemplate basic designs which help to answer research questions (Plano-Clark, 2019).

Integration favours the discovery of emerging components. Researchers must include and adhere to unforeseen results which had not been contemplated a priori (Schoonenboom and Johnson, 2017). Integration is not about transgressing the scientific method but about understanding that data can make researchers vulnerable and that research questions can completely study objectives (Uprichard and Dawney, 2016).

Research questions and objectives

Relevant questions depend on the type of research being conducted. If the approach combines MM characteristics, it is necessary for the research question to integrate QUAL and QUAN aspects (Doyle et al., 2016). It is imperative to understand that questions are flexible in nature and vary with contextual observations and emerging data (Akerblad et al., 2020). Likewise, objectives can be QUAL, QUAN or mixed, depending on the fusion of methods (Bazeley, 2016; Bazeley, 2018; Fetters and Molina-Azorin, 2017).

Tashakkori et al. (2015) proposed the following research question as giving a good illustration of integration: "How do the two sets of responses contribute to a global understanding of the phenomenon?" (p. 620). This question is linked to the integrative nature of research. Instead, an explicit question could be: "What are the perceptions and constructions of participants in groups A and B regarding teaching method X and its impact?" (p. 620). Research questions with integrative approaches are multifaceted and include the what, how and why of studying the behaviour of phenomena.

When different questions that directly correspond to one or more methodologies coexist, it appears that integration is not considered as an important premise (Anguera et al., 2020; Guetterman et al., 2020; Plano-Clark, 2019). In fact, questions designed to answer explicit and non-integrated questions are the most prevalent in MM (Gobo, 2016).

Methods and data collection

In the early days of MM, the integration of methods tended to be hierarchical with subordination of one method to another. That is, QUAL methods acted as a complement to QUAN methods (Tunarosa and Glynn, 2017). Currently, the intersection of methods is considered to be crucial for integrating data and creating dialogue around conclusions and inferences (Fielding, 2012).

Method integration is linked to study design. This is established according to: a) *connection*, where one dataset is linked to another through sampling, b) *construction*, where a dataset informs the subsequent data collection approach, c) *fusion*, where two datasets are merged for analysis, and d) *embedding*, where data collection and analysis are merged at various points. Integration can take place at one or more of the previous points (Fetters et al., 2013; Plano-Clark, 2019).

Researchers must collect QUAL and QUAN data or converge one of these types as a way of developing an analytical strategy in relation to the other. This is referred to as an *inter-method strategy*. Data can also be collected via a single method, such as the administration of open questionnaires. This is related to *intra-method strategies* (Tashakkori et al., 2015). Fetters et al. (2013) detailed the evaluation of data integration adjustment through:

- *Confirmation:* conclusions produced from both data types confirm the outcomes produced by another data collection.

- *Extension:* conclusions pertaining to data diverge and help to understand different approaches.
- *Discordance:* QUAL and QUAN findings are contradictory, incoherent or inconsistent with each other.

Data integration gives the option to go beyond what has historically been contemplated (Bazeley and Kemp, 2012). The implicit assumption of MM is that "as long as the results of two or more methods are brought together in an adequate or sufficient way, we will be able to delve into a truer truth of the object" (Uprichard and Dawney, 2016, p. 25).

When mixed sampling is to be carried out, four sampling strategies should be considered. I*dentical strategies* refer to the collection of QUAL and QUAN data throughout the study. In *added strategies*, QUAN data is collected from a larger sample and QUAL data is collected from a sample subgroup. In *separate strategies*, a sample group is used to collect one data type and another group that is similar with regards to sociodemographic traits is selected to collect the next data type. Finally, *multilevel strategies* report different social levels separately (Fetters and Molina-Azorin, 2017).

The real distinction between methodologies is not explained by the difference between the numerical and the textual. Instead, it is found between making sense of the world according to variables and correlations, and making sense of the world according to events and interactions. Both points of view are essential for understanding the social phenomenon (Fielding, 2012), in consideration of the unpredictability that can occur during the integration of methods and data via MM (Arkeblad et al., 2020).

Data analysis

Researchers must exhibit integrative and analytical thinking in order to visualise data and be able to interpret QUAL and QUAN together (Plano-Clark, 2019). In this way, it becomes possible to expand and understand the completeness of the phenomenon by linking it to multiple aspects that are governed by different theories (Tashakkori et al., 2015). It reflects a crucial step towards contributing to research quality, since integration develops the interdependent aspects of different perspectives and, in this way, stimulates the generation of complex hypotheses related to the social phenomenon (Dupin and Borglin, 2020). Fetters et al., (2013) described data adjustment as the consistency of QUAL and QUAN results.

How would another person view the same findings? This question emerges from the analysis of mixed data. A priori, analysis usually follows an initial structure made up of data coding, the creation of conceptual categories, grouping categories into variables, statistical analysis, and creation of a line of argument based on the results (Guetterman, 2020).

Analysis is classified into; a) *intra-method analysis*, which considers the independent associations and contrasts within data groups, b) *basic fusion analysis*, which considers links between data, and c) *advanced fusion analysis*, which uses complex procedures and employs software to link and intercept data (Fetters and Molina-Azorin, 2017). Comparative analysis can be performed via matrices, quantitative rating scales or conversion of QUAL coding into case tables or similarity matrices (exploratory cluster, correspondence or multidimensional analysis) (Bazeley, 2016).

Research and knowledge transfer team

Research teams that propose MM studies identify themselves as eclectic and integrative, with a pragmatic and cyclical vision of the social world. They tend to have exceptional potential with regards to the creation of knowledge and scientific innovation. They promote integration through an open and reflective mindset, holistic interpretation, and rejection of extreme standpoints (Akerblad et al., 2020; Fetters and Molina-Azorin, 2017; Lynam et al., 2019; Tashakkori et al., 2015; Tonon, 2019).

Doubts have been raised about single researchers conducting examinations through multiple lenses. A research team is, therefore, required to get to the core of integration (Tashakkori et al., 2015). The personal and professional experiences of all researchers lead to meaningful conclusions which make sense of educational phenomena. Integration of the research team is defined as the orchestrated creation of a team of professionals who work to achieve effective research based on various methods (Akerblad et al., 2020; Fetters and Molina-Azorin, 2017).

Paraphrasing Anguera et al. (2018), specific training in methodology is essential to adapt mixed designs. The effectiveness of integration in all its aspects, as well as both analytical and critical decision-making, help to overcome any potential disorder caused by MM (Akerblad et al., 2020; Tunarosa and Glynn, 2017).

In another sense, the main contribution of a research team is knowledge transfer. In general terms, this refers to the degree of applicability and generalisation of conclusions to other individuals or entities - *population transferability* -, to other contexts - *ecological transferability* -, to other periods of time - *time transferability* -, to other methods *-operative transferability* - or to other sub-populations - *complexity transferability* (Tashakkori et al., 2015). The level of interpretation and transfer is classified as integration through narration, integration through data transformation or integration through joint visualisation (Fetters et al., 2013).

Peer review offers an integrative mechanism when it is understood that a publication forms part of an integrated set (Lynam et al., 2019). A study by Archibald et al. (2015) concluded that only 2% of publications in scientific journals described mixed integrative studies, with 14% indicating the concept of MM in their title.

It should be remembered that research quality is determined by the evaluation criteria applied to QUAL and QUAN data, and its integrated components, as well as the consistency and coherence of design elements, construct validity and the inferences of made by researchers (Tashakkori et al., 2015; Zhou and Wu, 2020).

Challenges of MM

Currently, MM faces three major challenges. The first refers to the dividing forces elucidated in the QUAL-QUAN debate which could limit scientific innovation (Bazeley and Kemp, 2012; Lynam et al., 2019). The use of MM terminology must be reinforced in order to advance knowledge of educational sciences methodology and concepts (Anguera et al., 2018; Tonon, 2019). Researchers must recognise that phenomena contain inherent QUAL and QUAN elements which need to be analysed and interpreted (Bazeley, 2016).

The second challenge pertains to effective integration throughout research. This requires learning methods, procedures and techniques which have traditionally been identified as either QUAL or QUAN (Archibald et al., 2015; Tashakkori et al., 2015). Researchers must identify their theoretical, technical and methodological position so as not to impose a strict viewpoint and to be able to make research more flexible (Tonon, 2019). Integration goes beyond the mere use of QUAL and QUAN data, since it requires different theoretical perspectives to address a single research issue (Akerblad et al., 2020). This is useful for addressing and resolving social problems (Lynam et al., 2019). For this, the training of research teams should focus on the use of methods, planning and strategies which are applicable to the context or transfer of integrated results (Archibald et al., 2015; Bazeley, 2016; Fetters et al., 2013; Tonon, 2019). Thus, marked and rigid conceptualisations of researchers in opposition to MM, form barriers to integration (Tunarosa and Glynn, 2017). The third challenge concerns debate about the quality of MM research. In this sense, evaluation criteria are separated according to

QUAL and QUAN, potentially overshadowing the nature of MM (Fetters et al., 2013; Plano-Clark, 2019; Zhou and Wu, 2020).

Discussion and Conclusions

Interpretation of results

When analysing the empirical research that has approached MM as a potentiator of the research process in education, it is evident that main findings highlight the greatest potential of MM as effective integration of QUAL and QUAN aspects throughout the entire research process (Creswell and Plano, 2018; Fetters, 2020; Ivankova, 2014). When integrative strategies are proposed, research is understood as a proactive process that, not only involves bringing together QUAL and QUAN aspects but, also, considers active and reflective relationships, alongside their various interrelationships (Akerblad et al., 2021).

The research team must apply a generative and global process, leaving behind the identification of conceptions that are considered separately in line with each methodology. Indeed, these phenomena are characterised by their changing nature which is affected by an infinite number of open variables which cannot be ignored. This has been highlighted by Kallemeyn et al's. (2020) study on complex theory in mixed methods studies in the field of education.

Present research shows that integration must be considered from the justification of the research to the transfer capacity of the research team, which must be made up of researchers who work together to integrate designs, methods, analyses and results. This point has been made by Akerblad et al. (2020) and Fàbregues et al. (2021). Specifically, the validity of methods affects the effectiveness of research (Fielding, 2012), provided that results are merged and interpreted in an integrated way. In this sense, a systematic review conducted by Coates (2021) discovered that only 7.9% of articles with mixed methods in the educational field

presented arguments regarding the research method. However, Gutiérrez-Braojos et al. (2020) detailed that 72% of articles analysed in a systematic review of *Knowledge Building* were designed through the combination of QUAL and QUAN approaches.

Analytical thinking of the research is the crucial step to effective integration. Although different studies, such as those reported by Guetterman et al. (2020), propose models for effective integration processes which present relevant challenges to rigor. For instance, a study by Harrison et al. (2020) of publications in six journals, concluded that 9.7% of articles were partially or highly rigorous, whilst 65.6% had a low degree of rigour.

Currently, a change of perspective is required. Instead of justifying why a MM approach is necessary, the reasons for avoiding an integrated approach should be stated (Fetters and Molina-Azorin, 2020). This will adhere to the challenges posed to conducting critical evaluation, in terms of the rigor of MM studies and emerging discussions around integration criteria restrictions in MM studies (Johnson et al., 2007; Nha and Pluye, 2018).

Limitations

Three limitations to the present study are recognised. The first is linked to the method of the study itself, due to the fact that criteria for excluding documents were defined with the aim of expressly focusing on the keywords of *mixed methodology* and *integration*. This may have led to the exclusion of articles belonging to educational sciences which used MM as a means rather than an end in itself. As a future proposal, MM research should be explicitly evaluated as a method for achieving outcomes in educational sciences.

The second limitation pertains to the time restrictions applied to search. These were proposed in order to analyse the most recent research produced between 2011 and 2021. Nonethless, opening up the time period could

have led to a more exhaustive historical overview of the evolution of MM.

Finally, identification of publications with theoretical content pertaining to MM at a national level was limited. Despite this, a large number of documents were found to use MM as a research process. There is a need to establish common theoretical bases in the field in order to provide national researchers with clear strategies for integrating both QUAL and QUAN aspects.

Conclusion

Research in educational sciences comprises complex, dynamic and multidimensional phenomena which need to be approached from different methodological perspectives. Despite the fact that debate has now existed for decades around the MM standpoints, the current state of the issue is still unclear. The present systematic review reveals not only applications of MM but, also, its potential to analyse an educational phenomenon and propose elements to effectively integrate QUAL and QUAN.

Nevertheless, it is concluded that researchers must understand research as a generative and global process, leaving behind the characteristic conceptions of each methodology. Research in education has advanced exponentially in recent decades. However, aspects related to its composition, organisation and roles within research teams have yet to be contemplated in-depth. It is necessary to create interdisciplinary teams in which all members follow open and flexible paradigms related with their specialties in order to integrate other perspectives. This fusion of researchers, beliefs and paradigms is the main milestone that must be reached to achieve effective research.

In addition, research ethics are promoted from knowledge of the nature of the phenomenon and the ethics of the research team itself. It is necessary to advocate for research training, especially for novice researchers. The ontological and epistemological paradigm or reflective practice invites researchers to analyse its potential, whilst also justifying MM use.

Integration must be considered from the moment at which research is planned to the transfer of outcomes. The validity of methods has repercussions on the effectiveness of projects as long as results are interpreted in an integrated way through analytical thinking. This is crucial step for applying MM optimally.

Current challenges to MM are seen in the dividing forces still found between QUAL and QUAN research teams, effective integration of research processes and debate around research quality. There is also a need to consolidate a basis from which the entire scientific community can consider the validity, quality and efficacy of MM.

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