Revista Minerva

e-ISSN: 2953-6316

UNIVERSIDAD DE GUAYAQUIL

Rev. Minerva Vol. 6 N.º 11 Jun-dic/25

Manuscrito recibido: 25 de octubre de 2025

Aceptado para publicación: 18 de noviembre de 2025

Fecha de publicación: 30 de diciembre de 2025.

Design Thinking in Education: An Approach through Systematic Literature Review Tools

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ABSTRACT

Design Thinking (DT) is a teaching methodology that fosters soft skills in students. To explore new lines of research regarding its application, it is important to rely on high-quality Systematic Literature Reviews (SLRs), which must be developed using appropriate methodological tools. The objective is to analyze the application of SLR tools to DT in education. A qualitative, documentary, exploratory, and descriptive approach was used, employing the databases Scopus, Dimensions, and SciELO, with research lines focused on DT and education. The results identify PRISMA, SPIDER, SALSA, and MMAT as the most commonly used tools in SLRs, though not specifically in DT. The use of MMAT in mixed-method studies on DT is recommended for future research.

***Keywords*:** Design; Thinking; education; tools; creativity

INTRODUCTION

Throughout time, active methodologies in education have transformed the traditional pedagogical approach by positioning the student at the center of the learning process and giving them the role of "architect" of their knowledge (Cabanillas, 2025). The results of this progress have been reflected in increased participation and motivation. The labor market increasingly demands suitable professionals, and academia responds by developing digital, technical (Álvarez, 2022), and soft skills such as critical thinking (Oliveira et al., 2025); by incorporating them into the teaching process to gradually include the student's capacity to solve everyday challenges. However, to meet the demands of the current labor market, it is necessary to go a step further. This is why innovative methodologies emerge, promoting a creative and flexible approach to tackle real challenges (Pernecky, 2007). The study of these methodologies has increased in recent decades in fields such as social research, health, product design and development (Zhang et al., 2014), urban and rural development, higher education (Lacárcel et al., 2022), among others. As (Scott, 2015) points out, these methodologies converge in that their implementation has favored the development of soft skills in teachers and students.

DT emerges in the cradle of innovative methodologies and has evolved significantly since its beginnings in the workplace in the 1960s, driven by Nigel Cross, who called this period the "decade of design science," leading to studies that highlight the importance of training people who generate solutions to business problems (cited by Dam & Siang, 2022). In the late 1990s, it was introduced into the educational field thanks to Tim Brown and David Kelley, founders of the IDEO company in 1991 and professors at the Hasso Design Institute in 2004 (Szczepanska, 2017). The synergy between design thinking-based education and the interdisciplinary nature of the members of this educational project formed the basis of the current foundations of DT (Sell, 2018). According to Brown & Wyatt (2010), "the five main stages for developing DT are: empathize, define, ideate, prototype, and test". Rodríguez (2020) explains each of them in detail and recommends properly managing available resources to ensure reproducible results.

Currently, in secondary education, the implementation of innovative methodologies such as DT is increasing and is developed based on the available means and geographical location (Sun et al., 2023). In Ecuador, DT requires greater attention, as information on field applications is limited, but its research and implementation can promote the development of soft skills in students and respond to the country's current needs (Sell, 2018). Hence, Benavides et al. (2021) highlight the importance of creating resources that can serve as a guide for future implementations of DT in the educational system.

The viability of this study lies in the possibility of analyzing RSL tools applied to DT in the educational field. It is pertinent because its study will help compile the steps to follow to ensure methodological rigor and transparency in the development of RSLs. Tools such as PRISMA, SPIDER, SALSA, or MMAT will likely allow for the structured publication of the most significant findings on the influence of applying DT in teaching-learning processes. Furthermore, it is possible to "map trends, evaluate proven benefits, or detect gaps that guide future research" (Brown & Wyatt, 2010; Sell, 2018). Having rigorous studies that implement RSL tools could facilitate evidence-based decision-making for teachers and administrators. Therefore, the objective of this research is to analyze the application of RSL tools to DT in education.

METHODOLOGY

The present research work used a qualitative approach focused on documentary, exploratory, and descriptive analysis. Scientific articles from the following academic databases were reviewed: Scopus, Dimension, SciELO, and Google Scholar. The search focused on how RSLs DT are reported in national and international scientific article publications and what tools researchers use to ensure the quality of the information.

The following questions were formulated for this purpose:

1. How are the PRISMA, SPIDER, SALSA, and MMAT tools used in DT RSLs in education?
2. What are the characteristics of the research that addresses DT in education?

The document selection was based on the following inclusion and exclusion criteria:

Table 1: [44]Inclusion and exclusion criteria for the research

Criteria	Inclusion	Exclusion
Access	Open Access Articles	Paid Articles
Type of research	Must be an RSL or qualitative and use the PRISMA, SPIDER, SALSA, or MMAT tools.	Must not be an RSL or qualitative and must use another type of tool or not use them.
Content of results	Based on the use of DT in education.	Not about DT in education.
Source	Articles in indexed journals.	Works without evaluation.
Quantity	One scientific article per author or authors.	Duplicate articles.

The search was performed individually with each tool and all other inclusion criteria. Subsequently, the results found for each tool are detailed.

RESULTS AND DISCUSSION

Tools to support an RSL

An RSL offers significant benefits, provided that its methodology for searching, selecting, meta-analyzing, and reviewing follows rigorous processes that guarantee the quality of the information provided and serve as a guide for decision-making (Shahzad et al., 2020). Therefore, the use of article systematization tools is essential within the structure of a theoretical investigation. The perspectives of DT research applied in education that have used methodologies such as PRISMA, SPIDER, SALSA, and MMAT will be addressed to find convergences and divergences among them.

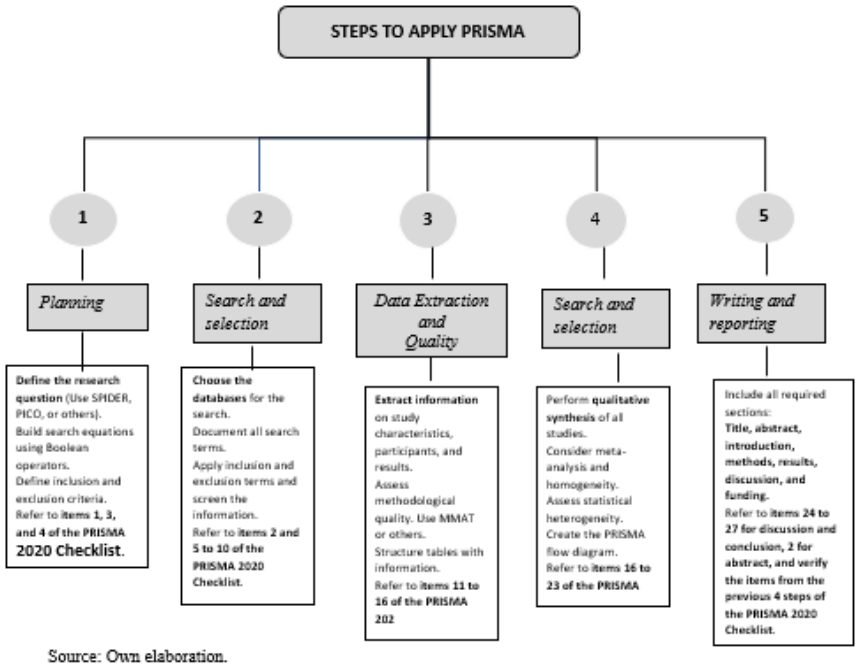
Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Preferred Reporting Items for Systematic Reviews and Meta-Analyses is a guide designed to improve the quality in the systematization, writing, presentation, and review of RSL reports. (Page et al., 2021; Urrútia & Bonfill, 2010) highlight that this tool provides checklists to ensure compliance with methodological criteria and flow diagrams that represent the study selection process and mechanisms to validate the applied research protocol. It originated with the name QUOROM, whose main activity was the meta-analysis of clinical trials in medicine; then it was called PRISMA 2009 and included the meta-

analysis of RSLs in new fields of research, and currently, it is called the "PRISMA 2020 statement" and encompasses a wide spectrum of guides and diagrams that adapt to user requirements. This evolution has been documented and explained by (Moher et al., 2009), which evidences its constant adaptation to the needs of the scientific field. It currently has extensions such as: PRISMA-NMA used for RSLs that incorporate network meta-analysis, PRISMA-DTA to evaluate the pressure of diagnostic tests, PRISMA-E 2012 evaluates equity in the health area, PRISMA-ATCM applied in animal experiments in traditional Chinese medicine, PRISMA-COSMIN for reviewing outcome measurement instruments (Elsman et al., 2022; Hutton et al., 2015; Welch et al., 2016; Zhang et al., 2014; Zhao et al., 2016), and it is likely that more will emerge adapted to certain research fields. In the educational field, reports such as those by Pacheco et al. (2025) propose adaptations to PRISMA 202 to reduce biases during its application.

To apply PRISMA in an RSL in the educational field, it is necessary to follow a series of steps based on the quality criteria checklist. One of the fundamental requirements is to report the "PRISMA flow diagram" of the study selection process and structure the document according to the 27 items established by PRISMA 2020 (Page et al., 2021). Below is the protocol for applying PRISMA in an RSL.

Figura 1.



Source: Own elaboration.

Sample, Phenomenon of Interest, Design, Evaluation, Research Type (SPIDER)

The "Sample, Phenomenon of Interest, Design, Evaluation, Research Type" tool, SPIDER, is used in qualitative and mixed research to structure and guide RSLs and meta-analyses based on a guiding question. Its use is directed towards qualitative and mixed approaches in RSLs of social sciences, education, nursing, among others (Cooke et al., 2012). SPIDER is ideal for exploring the "how" and "why" certain phenomena occur and not just whether they occur. It is also necessary to highlight that this methodology is considered a conceptual framework whose objective is to provide a systematized question aimed at obtaining data on a very specific phenomenon. Gustavsen, (2022) explains that its generic structure is offered by certain universities for a fee.

It originated from the adaptation of Patient, Intervention, Comparison, and Outcome (PICO), used as a research tool in medicine; subsequently, this tool evolved due to the need to include research that has worked with samples instead of a population, exclude the clinical focus and change it to a qualitative and mixed one, and include other research disciplines that require analyzing content that goes beyond observation in clinical trials (Cooke et al., 2012). The possibility of generating RSLs based on a structured question with a high level of sensitivity positioned SPIDER as an efficient alternative in research. It does not have updated versions, but its structure usually adapts according to the objective of the review. Gustavsen (2022) mentions that to apply the SPIDER tool in an RSL focused on the educational field, the following 5 steps must be followed:

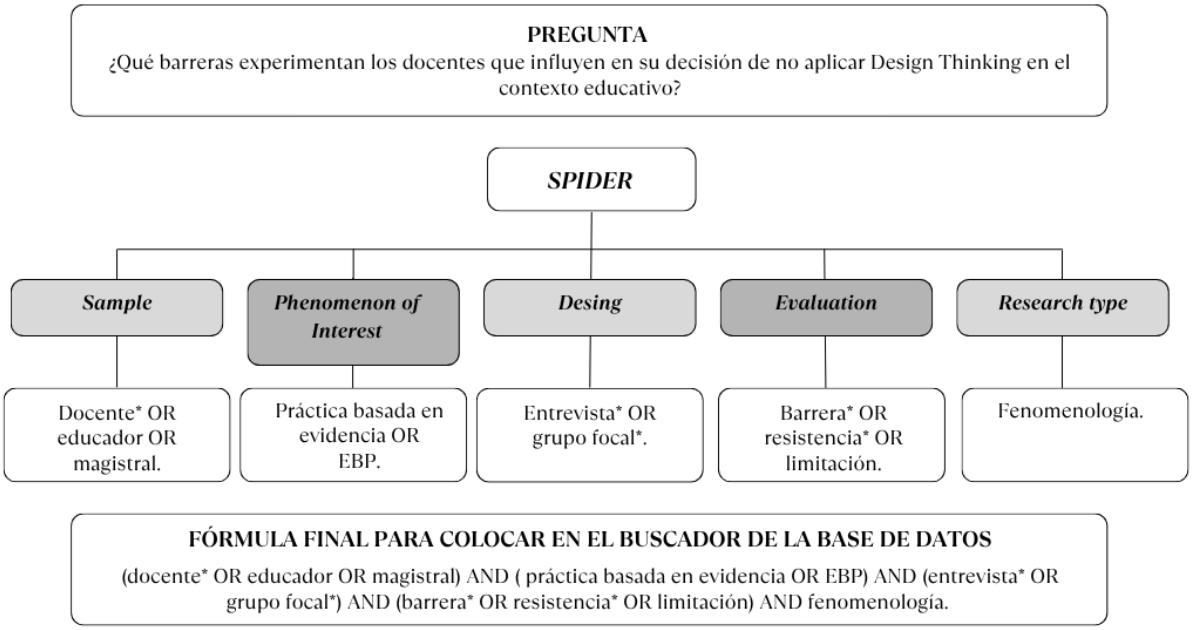
1. State the objective of the review. This defines the focus and guides the terms to be used during the process.
2. Formulate the research question using the SPIDER structure. Figure 2 presents an example of a structured question using this methodology.
3. Introduce the words obtained in step 2 into the academic databases using Boolean operators ("AND", "OR"), and examine the results obtained.

4. Analyze the information obtained from sources that answer the question posed. Insert or delete certain words to optimize the search.

5. Start the structured development of the RSL with the obtained sources.

To start with RSLs, it is necessary to establish objectives and formulate guiding questions. For this purpose, an example of a question applied to education has been created (see figure 2) to extract the keywords and perform an effective search:

Figure 2: SPIDER structure to break down keywords from a guiding question.



Mixed Methods Appraisal Tool (MMAT)

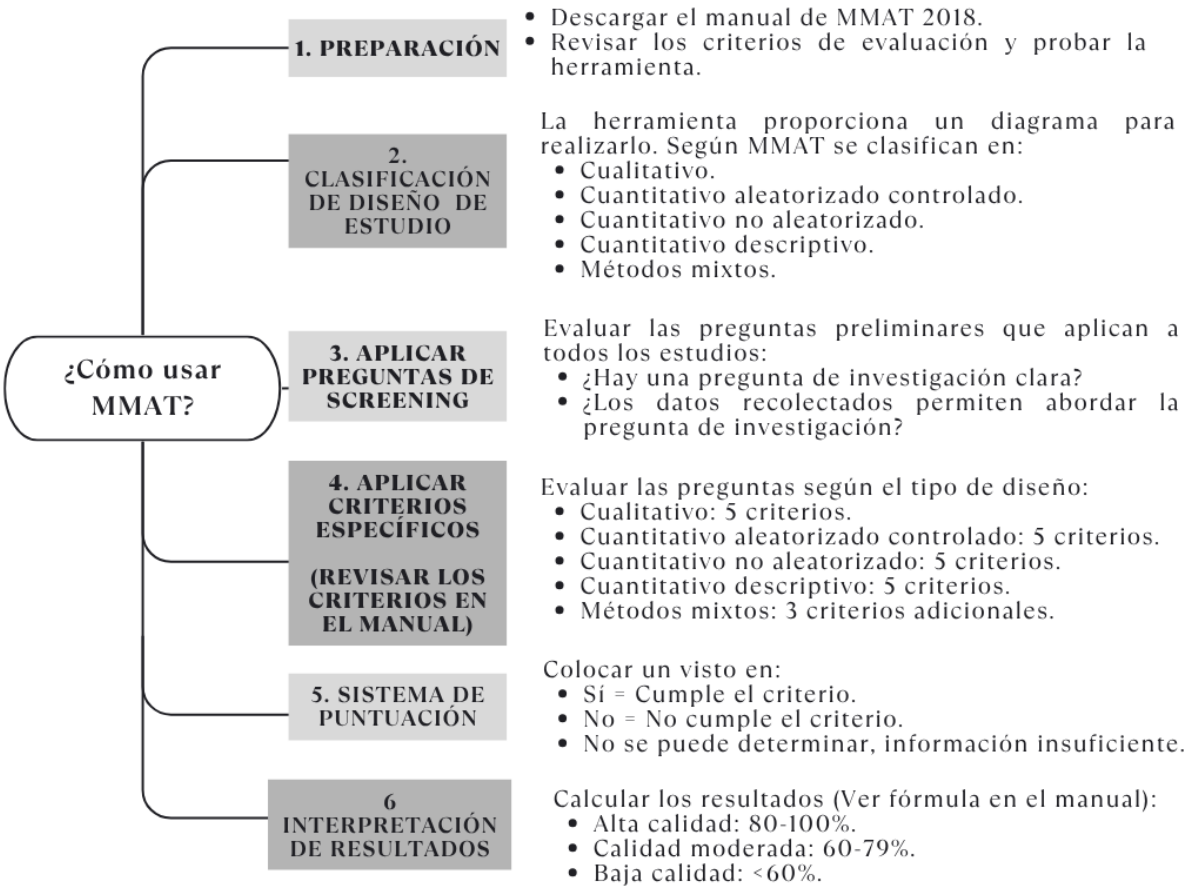
MMAT (Mixed Methods Appraisal Tool) is a standardized evaluation tool specifically designed to assess the methodological quality of studies with different research designs within the same RSL (Pluye et al., 2009). According to Hong et al. (2018), this tool "allows the simultaneous evaluation of qualitative, quantitative (which can be randomized controlled, non-randomized, and descriptive), and mixed-method studies based on specific compliance criteria for each type of methodological design".

MMAT was developed by Pierre Pluye and collaborators at McGill University, Canada, due to the increase in mixed-methods research and the need to integrate quality qualitative and quantitative evidence

into RSLs (Pluye et al., 2009). Its development was based on an extensive literature review on methodological quality and iterative validation processes with international experts (Fàbregues et al., 2018). It has gone through the versions: MMAT 2009, MMAT 2011, MMAT 2013, and MMAT 2018, each subjected to efficiency, reliability, and utility tests (Hong et al., 2018; Souto et al., 2015) and has received proposals for improvement with greater scientific rigor to be applied.

The implementation of MMAT in research requires a systematic process that begins with the preparation of evaluators and ends with the calculation of the MMAT score (see figure 3). It is recommended to carry out the evaluation by at least two reviewers and reach a consensus to resolve discrepancies (Hong et al., 2018; Pluye et al., 2009). Fàbregues et al. (2018) provide the updated MMAT 2018 manual on their platform, which includes the criteria checklist, the 5 study domains, and video tutorials for its application. Similar to the previous tools, a simple structure is proposed for the application of MMAT in the evaluation of quality criteria of the methodology applied in qualitative and mixed studies.

Figure 3: Steps to apply the MMAT tool in an RSL.



Search, AppraisaL, Synthesis and Analysis (SALSA)

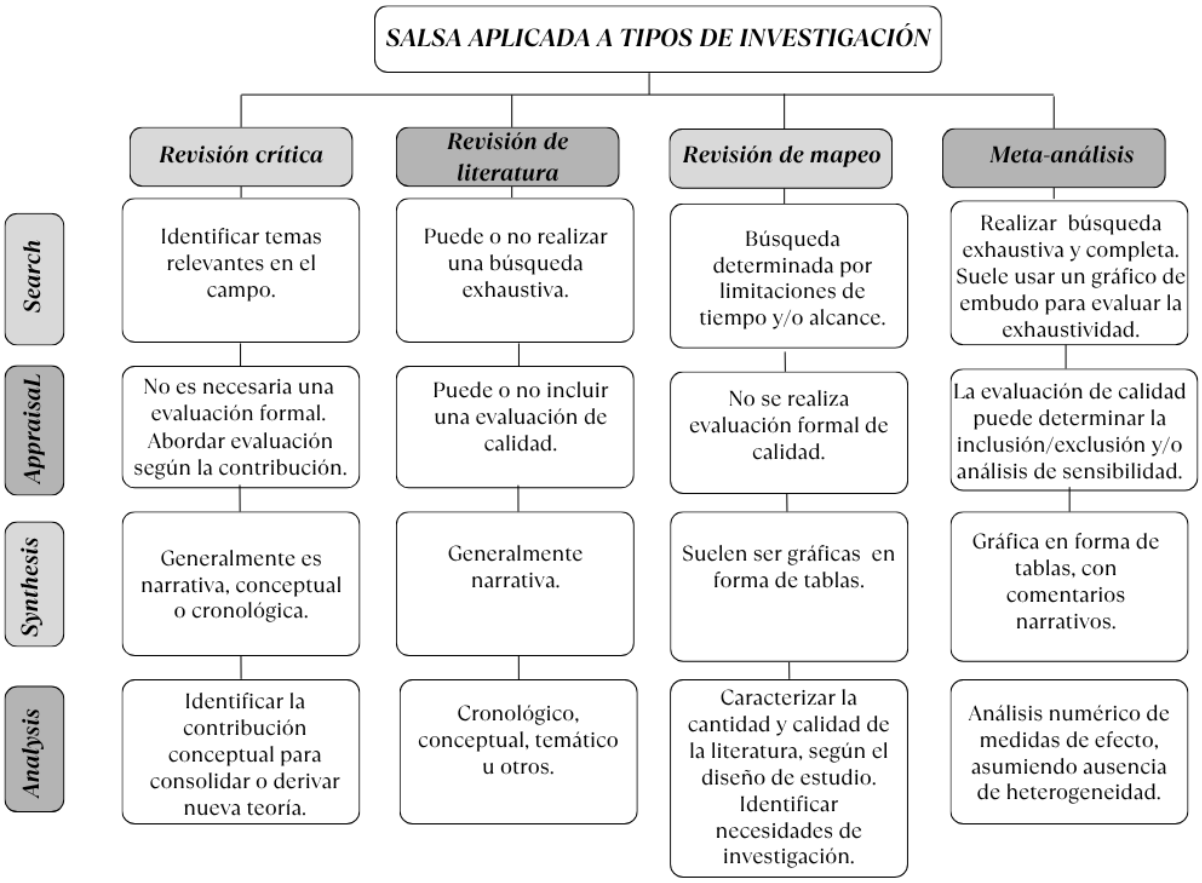
The SALSA framework (Search, AppraisaL, Synthesis and Analysis) is used as a useful methodology in RSLs in the area of Human and Social Sciences. It provides a methodical route to address research questions with a relatively higher level of complexity, ranging from the identification of databases to meta-analysis and the presentation of evidence (Codina, 2020) and (Manterola et al., 2023).

It emerges as an improved tool proposed by María Grant and Andrew Booth in 2009 by adapting its structure from clinical trials (Codina, 2020). Its use is increasing in the educational field focused on reporting evidence of various methodologies such as the flipped classroom (Castro & Vargas, 2024; Rodríguez et al., 2021), the development of soft skills such as leadership (Tapia, 2025), evaluating models in special education (Matamoros & Cubillo, 2025), or variations such as PSALSAR in environmental

sciences (Mengist et al., 2020), demonstrating that its structure allows it to adapt to a wide variety of research fields.

Below details the protocol proposed by Grant & Booth for using the SALSA tool based on the type of research.

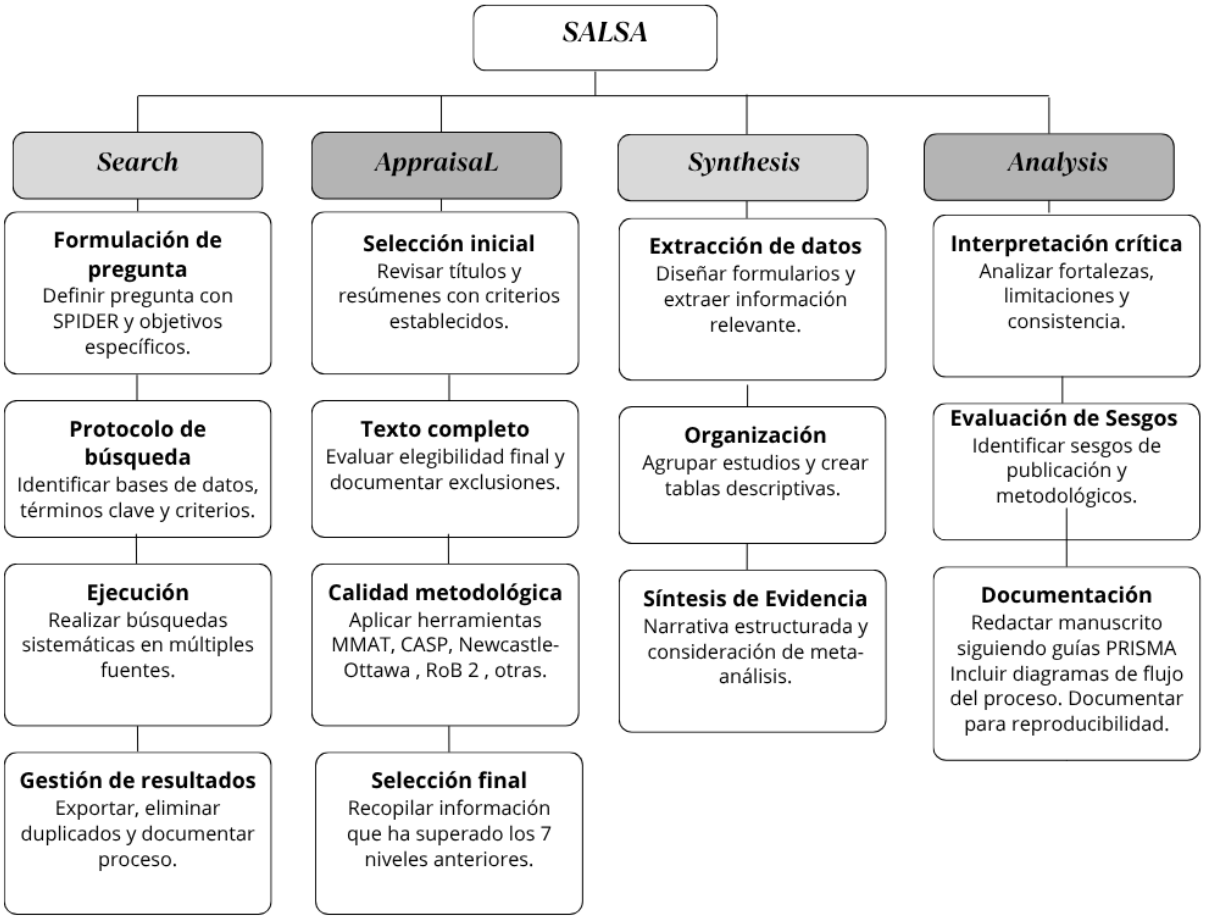
Figure 4: Types of research and proposed SALSA structure for application.



Once the type of research to be carried out has been identified, it is suggested to apply the SALSA tool with the following steps. It is important to note that this resource can be modified or adapted according to the researcher's requirements.

Figure 5:

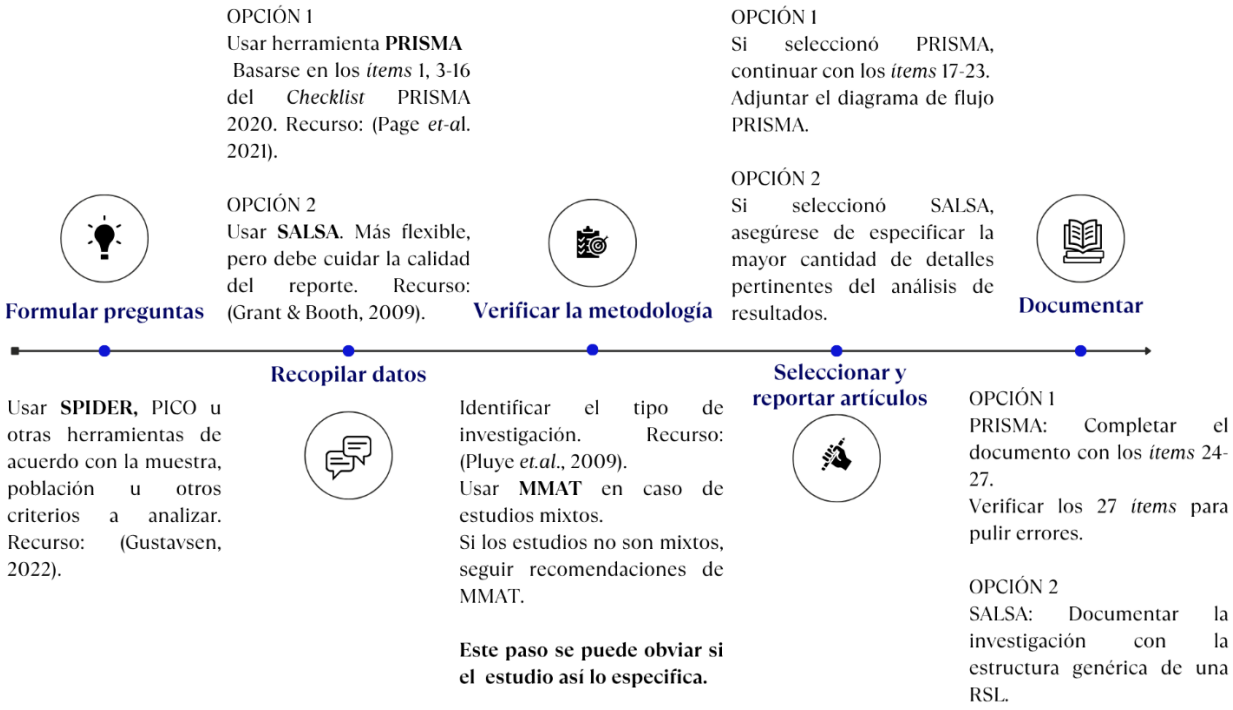
Steps to apply the SALSA tool in an RSL.



Source: (Codina, 2020).

Once the tools for an RSL have been analyzed, it is possible to determine that, for an RSL to meet high-quality criteria, it requires applying at least one of the 4 tools detailed in this article in its construction process. Sometimes, depending on the focus of the research, combinations can be used, such as using SPIDER to break down the research question and then PRISMA or SALSA to continue with systematization and meta-analysis. It is important to remember that the evaluation of the methodology, especially if it is mixed research, may or may not be evaluated, even though the MMAT authors provide the correct steps in their guide to know if it is necessary or not. In any case, this article has provided the necessary steps, which can be adapted, to be guided by one tool or another. Below is a summary of the 4 tools, as well as a timeline with the possible steps to follow in an RSL and which of them to implement that is of interest. This answers the first research question.

Figure 6: How PRISMA, SPIDER, SALSA, and MMAT are applied in an RSL.



On the other hand, the most relevant information from DT RSLs that have used at least 1 of the 4 analyzed tools has been collected. The goal is to specify how the findings of DT in education are being reported and how reliable they are.

Table 2: DT RSLs that have followed a PRISMA methodology.

Authors	Problem	Results
(Li et al., 2019)	Lack of integration of DT in STEM education to enhance creativity and innovation in students.	DT is important for creativity and innovation in STEM education. Highlights the need for systematic studies to strengthen students' skills in secondary school.
(Man et al., 2022)	Few studies on the application of DT in primary mathematics and the importance for the development of innovative skills in students.	DT is rarely addressed in Primary Mathematics. Studies focus on European countries, while Asia and Latin America have few and they are in higher education. Recommends using it from an early age.

(Rahman et al., 2023)	Need to analyze how the integration of DT with TPACK can improve the learning process and skills in Indonesia.	Analyzes the fusion of DT with TPACK to develop skills. DT integrated with TPACK increases students' critical thinking and creativity.
(Deng & Liu, 2023)	Difficulty in training engineers to apply DT creatively, due to the inconsistency between theory and practice in education.	Explore the educational environment, curriculum design, and student learning achievements through a concurrency analysis. Provides pedagogical guidance and projections for future research.
(Sun et al., 2023)	Lack of a structured vision on research topics and trends in DT in education and teacher training worldwide.	Interest in DT has increased in the USA (country of origin) due to its impact on educational research. Australia, China, and Brazil are promoting this methodology in other areas of education.
(Bent et al., 2023)	Challenges for higher education teachers in developing co-creation competencies.	The co-creation process in lesson design improves teaching competencies and educational conceptualization.
(Samaniego et al., 2024)	Lack of analysis on methodologies and traits to foster creative thinking in artistic and design education from an early age. Lack of clarity about DT benefits and applications.	Emphasizes the use of methodologies such as experiential learning, STEAM, and interdisciplinary approaches to develop creative thinking. The applied techniques provide originality and flexibility. Highlights the need to apply research in Latin America to strengthen education.
(Alvarado, 2025)	Lack of identification of DT benefits and applications as an active methodology in higher education.	DT is effective in improving the student learning experience, as it encourages active participation, critical thinking, and interdisciplinary collaboration.
(Bathla et al., 2025)	Absence of a consolidated profile of the impact and trends of DT in education, due to the dispersion of existing evidence.	Argues that DT reinforces creativity, problem-solving, and academic performance; proposes theoretical frameworks and future lines of research.

(Orbe et al., 2025)	Need to identify innovative pedagogical strategies, such as DT, that foster soft skills in educational and work environments.	States that implementing methodologies such as DT could promote the increase of skills such as creative thinking and real problem-solving.

The reported investigations converge on the fact that DT has the potential to transform education by incorporating soft skills. However, many institutions are still not prepared to apply it, which is why its study has been reduced in recent years, especially in subjects such as mathematics in primary school. Even so, it is insisted that this methodology should be implemented from an early age because it helps to awaken creativity, originality, flexibility, co-creation, and problem-solving in students. Furthermore, it encourages exploring different ways of teaching. The most significant finding reported in DT is the increase in motivation in class; they develop critical thinking, collaboration, and ensure meaningful learning.

Table 3: DT RSLs that have followed a SPIDER methodology.

Authors	Question	Results
(Withell & Haigh, 2013)	What capabilities does DT strengthen in the student?	DT grants positive perceptions, increases creativity and student success probabilities, improves academic performance.
(Nurhayati et al., 2023)	How does reflective thinking contribute to transformative science education?	Reflective thinking is relevant because it facilitates learning from the student's experience and knowledge. It is applied in DT and other innovative methodologies.
(Barbosa & Estupiñán, 2023)	What do active methodologies contribute to the teaching-learning process?	Active methodologies such as DT provide confidence and creative capacity in students and can be involved at all educational levels.

The studies reflect that DT contributes to the development of skills in students, such as creativity; it improves self-esteem, confidence, and reflective thinking. Furthermore, an increase in academic

performance was observed. It can be affirmed that a student-centered education, using DT, can generate a positive impact on their performance compared to traditional methods.

The reason why the tables of research with the SALSA and MMAT tools have not been included is that, with the criteria and platforms described above, there were no findings of works that used DT and these tools in education. This is a gap that can be used in future reviews, especially in mixed-method studies. While the state of the art is important, it is also important to analyze the quantitative results of these field applications and determine if the strategies used are providing favorable results.

CONCLUSIONS

The PRISMA, SPIDER, SALSA, and MMAT tools are essential for constructing an RSL with high-quality standards. After the review, it can be stated that PRISMA is used in qualitative research and provides transparency and quality to the report. SPIDER allows breaking down research questions and aids in the design of the conceptual search. SALSA is more flexible than PRISMA; it contributes to qualitative research by guiding the review process. SPIDER and MMAT are used in a specific part of the RSL, while PRISMA and SALSA cover the entire process to generate a qualitative investigation. Finally, MMAT helps evaluate the methodology used in mixed-method research. Although the latter is not widely used, its contribution to the selection of mixed works provides greater certainty in the data to be reported in the RSL.

DT in education is a research topic that has been developed in diverse approaches. However, analyzing it in RSLs that have used at least one of the 4 tools described above drastically limited the amount of information obtained with the mentioned inclusion criteria. The limitation was such that no information on DT in education using SALSA or MMAT was found. This particularity is a significant finding, as it may show that, under personal criteria, using PRISMA instead of SALSA guarantees a higher level of quality, since PRISMA is much stricter in all phases of the RSL construction. On the other hand, finding no RSLs with MMAT may be due to two scenarios: 1: It is not possible to perform RSLs with qualitative or mixed data, or 2: It is possible to do so, but there is still not enough information to use

it as a guide. In any case, this could be a potential field of study that, of course, would generate more specific information about the success or failure cases of DT in education.

Finally, it is necessary to specify that the reported research, which uses PRISMA and SPIDER, focuses on identifying DT trends and analyzing how it is implemented in the education of each country. Furthermore, they detail recommendations on its application in Latin America, the skills it fosters in both students and teachers, and the trends of using DT in conjunction with research subjects to achieve better reach. The skills that, according to the authors, DT promotes are creativity, originality, flexibility, co-creation, critical thinking, and reflective thinking.

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