Design-based research in higher education: A systematic literature review between 2019 and 2023

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Design-based research is a methodological approach that has been applied in the field of educational technology since the beginning of this century. The main aim of this article was to explore its use in the field of educational research, specifically in the context of higher education during the 5-year period from 2019 to 2023, coinciding with the COVID-19 pandemic and the technological efforts made in response to it. In the current work, 180 documents were analysed after a PRISMA selection procedure. Although the analysis covered documents from a variety of continents, Europe (n = 73) and America (n = 45) are the geographical areas that appear most frequently. Likewise, Social and Legal Science (n = 87) are the knowledge areas in which design-based research is most widely used, followed by Engineering and Architecture (n = 28) and Health Sciences (n = 21). In more qualitative terms, the findings of this work provide important information about the diverse use of this research approach, the data collection processes used and the quality criteria and design principles that appear explicitly in the documents analysed.

Implications for practice or policy:
- Instructional designers can observe examples of educational designs in different content areas.
- Researchers can find a theoretical basis for building research projects aimed at designing educational artefacts in a wide range of scientific areas.
- Policymakers can identify successful practices in other institutions to improve the management of their resources.
- Researchers can access emerging trends and best practices in higher education, helping to update teachers' skills.

Keywords: design-based research (DBR), higher education, design principles, systematic review, educational technology

Introduction

Studies carried out under the umbrella of design-based research (DBR) have been increasingly present in educational research, especially in educational technology, over the last 2 decades. This approach has received various different names with certain nuances, including design research (Edelson, 2001), developmental research (Richey et al., 2004) and educational design research (Van den Akker et al., 2006).

Wang and Hannafin (2005, pp. 2–3) defined DBR as a "systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually sensitive design principles and theories". These studies are versatile and adaptable and are aimed at solving educational problems (Bannan et al., 2016) using horizontal management, where researchers, designers and participants become partners in the research team (Esteve et al., 2019).

In order to clarify the methodological approach of DBR, we describe it from different perspectives: foundations, structure, development and purpose. DBR is based on a pragmatic and transformative worldview, which assumes methodological complementarity in terms of legitimising multiple validities,

and it has a reflective, prospective and consultative nature (Bakker, 2018; Pereira & Oliveira, 2021). DBR demonstrates its pragmatic nature by combining the interpretive quality of qualitative processes with the generation of solid recommendations that can be transferred to other contexts (Hoadley & Campos, 2022). In terms of its structure, it is organised into three standard phases, although they may incorporate changes or nuances: firstly, the preliminary phase, where the conceptual clarification of the study content is carried out and the structural bases are laid down regarding the components of the following phases; secondly, the prototype phase in which the cycles or iterations occur, where successive prototypes of the educational product under construction are tested and refined; and thirdly, the evaluation phase, which is initially carried out at a local level and later becomes extensive or global. Each phase entails its corresponding research questions (RQs) and quality criteria (Plomp & Nieveen, 2009; Reeves & Lin, 2020). Regarding development, DBR is characterised by being collaborative, interventionist, interactive, iterative and enriched by technology. As for its purpose, it has a fundamentally applied approach and is committed to the generation of theory, with a visionary component that can transfer knowledge to different contexts. It is a driving force for well-founded research and forces continuous decision-making based on reflection (Easterday et al., 2018; Philippakos et al., 2021).

Methodologically, DBR involves a systematic, rigorous, yet iterative and flexible process that learns from itself and incorporates these learnings at each stage (McKenney & Reeves, 2013). To this end, each phase requires the use of a variety of data collection methods and strategies to serve different RQs or objectives (Schoonenboom & Johnson, 2017).

As noted above, the methodological approach of DBR is increasingly present in the scientific literature, notably in education, among other areas. In recent years, there has been growing interest in the field on the part of researchers, which has led various authors to carry out systematic reviews on the subject.

The reviews on DBR conducted by Zheng (2015) and Anderson & Shattuck (2012) at the beginning of the century yielded results in which only 29% and 26%, respectively, were studies targeting the higher education context. Furthermore, these studies did not address this context separately, so it is difficult to use them as a reference in any possible discussion or conclusion in this article. More recently, Tinoca et al. (2022) conducted a review, this time focusing on K–12 educational contexts, and, regarding technology, Reeves & Lin (2020) highlighted that most reviews have focused on the study of technological devices and not as much on the learning problems faced by students and teachers.

DBR also establishes a series of quality criteria that aim to ensure the scientific rigour of the research in qualitative and quantitative terms. Following Plomp & Nieeven (2009), the criteria of validity, practicality, local effectiveness and global effectiveness have been taken as a reference in this research, with a slight variation to achieve a better fit. Validity means the verification and conceptual clarification of both the situation/problem to be explored and all the work content to be analysed. Practicality is understood as the verification that the prototypes of the product generated function correctly and are adapted to the users and their context of application. In terms of effectiveness, local effectiveness refers to the fact that the product achieves the objectives set with its use in a nearby context, while global effectiveness refers to the fact that its effect can be transferred to contexts further away from the one where the product is developed, with which it has a certain contextual similarity, in other words, its capacity for generalisation.

The purpose of DBR processes is embodied in their conclusions, that is, end points or outcomes; it is precisely here that the connection between theory and practice, as laid out in their foundations, is clearly identified. Although various types of conclusions are proposed by different scholars, we have adopted the term design principles (hereafter, DPs), meaning heuristics that respond to a particular learning situation and that can be prescribed to other situations as recommendations, advice, criteria or values, always subject to a process of adaptation (Hoadley & Campos, 2022).

However, there are still aspects in which it would be interesting to delve deeper, as in the case of higher education, where this methodology is particularly relevant due to its pragmatic and flexible nature, which

makes it very versatile, for example, in the field of educational innovation and the development of institutional improvement projects. It is also particularly useful to update the analyses carried out to date, focusing on higher education and concentrating on the 5-year period from 2019 to 2023, in which we witnessed great social and educational complexity. The COVID-19 pandemic, especially during 2020 and 2021, led to the design and implementation of multiple educational interventions and digitisation and improvement processes, many of which followed DBR methodologies.

In this context, we consider it relevant, pertinent and useful to propose the objective of this work, which is to systematically review research processes that have used DBR in the field of higher education in the 5-year period from 2019 to 2023.

Method

In accordance with the context and information described above, the main purpose of this article was to explore the use of the methodological approach known as DBR in the field of educational research, specifically in the context of higher education, with the intention of providing a comprehensive overview that allows us to answer the following RQs:

- RQ1. In which higher education contexts is DBR being applied, and what are its characteristics?
- RQ2. What is the data collection process, and who are the participants involved in DBR studies in higher education?
- RQ3. What quality criteria and design principles are identified, and how are they integrated into DBR in higher education?

As mentioned in the Introduction section, there are systematic reviews on DBR addressing different contexts and contents, but this paper aimed to establish an original framework or starting point for the use of DBRs in the specific context of higher education by formulating RQ1 and RQ2. On the other hand, RQ3 sought to delve deeper into key elements of DBR processes that are responsible for connecting theory with practice, which is one of the fundamental aspirations of this methodological approach.

To answer these questions, a systematic literature review (SLR) was conducted. An SLR, as indicated by Vangrieken et al. (2017) and Newman & Gough (2020), can be defined as a systematic process of theory building that aims to review a set of information sources relevant to a specific area of knowledge by analysing documents obtained through searching various databases.

Selection and review procedure

With the intention of carrying out a process that is as ethical, traceable and rigorous as possible to ensure the validity of the results, the criteria established by the PRISMA statement (Urrútia & Bonfill, 2010) were followed. The documents analysed were selected using the following search formula: ("Design-Based Research" OR "DBR" OR "Educational Design Research" OR "EDR") AND ("Higher education" OR "University"). This formula was applied to the Web of Science (WoS), Scopus and Educational Resources Information Center (ERIC) databases, as these were considered to be the three most relevant in the field of education internationally, also filtering for the 5 years from 2019 to 2023 given that there was a large volume of studies that met these characteristics and it was considered appropriate to prioritise the analysis of the most recent ones.

In the identification phase, a total of 540 records were downloaded to the Zotero document manager. After excluding duplicates, 530 documents remained. Next, those whose titles or abstracts were not relevant to the subject matter of the review were discarded (280 documents), leaving a total of 250 for downloading. Of these 250, a total of 180 were fully accessible; however, 46 of these articles were removed because four were in languages not known to us, the authors had retracted another, and the rest did not meet the inclusion criteria (Figure 1).
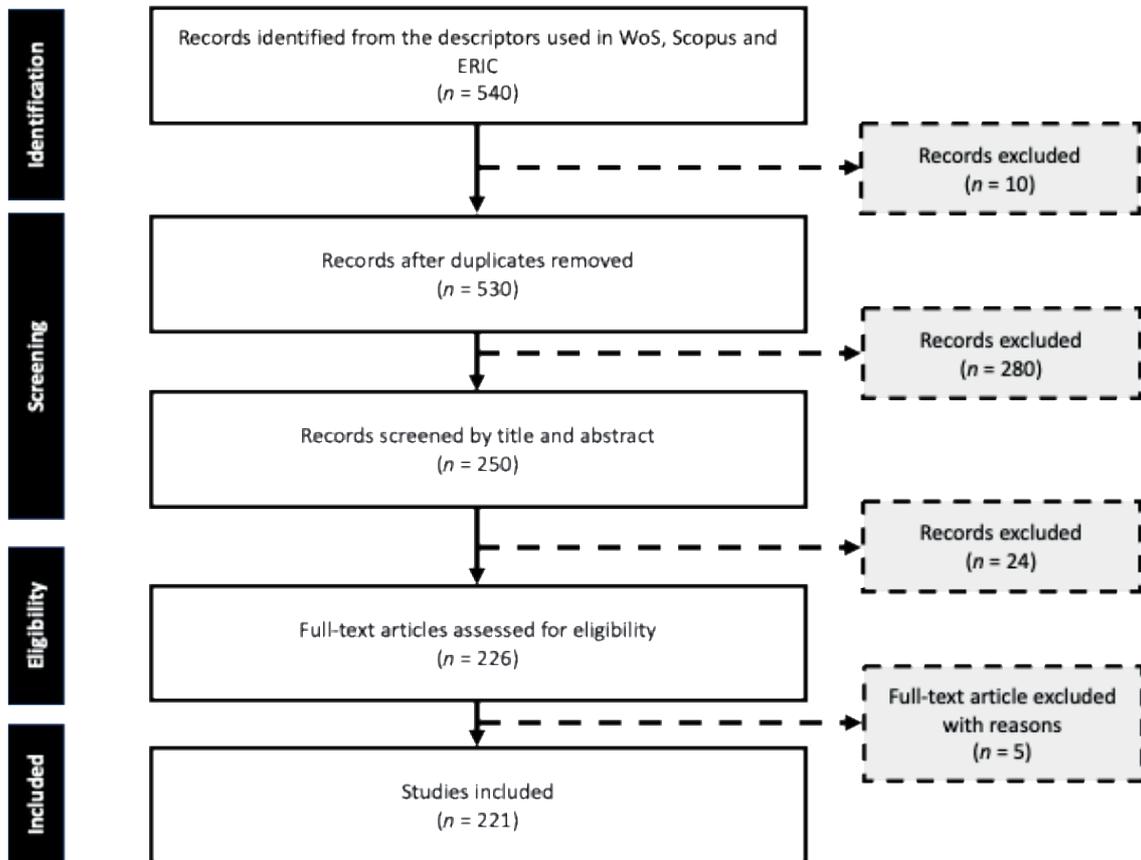
Figure 1. Flowchart of the SLR process following the PRISMA procedure

The documents reviewed in the screening phase (in which they were screened by title and abstract) were analysed by means of peer review by the three of us using three main criteria: relevance, accessibility and language – English, Spanish, Catalan, Portuguese and Italian were defined as eligible for inclusion (Table 1). Furthermore, for the in-depth review, the 2018 version of the MAXQDA software was used collaboratively, carrying out iterative coding phases (Kuckartz & Rädiker, 2019). The open references and the list of articles selected for analysis can be found in an institutional repository (https://uvadoc.uva.es/handle/10324/77079).

Table 1
SLR inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Focusing on the higher education context (bachelor's or master's degrees)	Not focusing on the higher education context
Application of the DBR methodology	No clear application or explanation of the DBR methodology
Written in English, Spanish, Catalan, Portuguese or Italian	Written in other languages
Publication within the last 5 years at the time of the search (2019–2023)	Publication prior to 2019

As for categorisation, this began with the RQs posed and included identifying information on the articles, mainly authorship, year of publication, area of knowledge and country. Table 2 shows all the categories used in the analysis, together with a detailed description. It should be noted that, as indicated by Saldaña (2015), based on the review of the content, the codes had to be refined and other subcategories were added to the procedure. Specifically, subcategories related to type of intervention and data collection

techniques and tools were added, as these aspects emerged progressively in accordance with the descriptions provided in the articles, allowing for a more nuanced and precise classification.

Table 2
Description of the categories analysed

Category	Description
Country	Country where the research was carried out.
Area of knowledge	Subject area linked to the research: (a) sciences; (b) health sciences; (c) social and legal sciences; (d) engineering and architecture; (e) arts and humanities; (f) not specified.
DBR phase	The part or phase of the DBR on which the study under analysis focuses: (a) initial or front-end phase; (b) one or more iterations; (c) initial phase and iteration; (d) complete studies of all iterations; (e) other.
Type of intervention	Type of intervention designed, developed and/or evaluated in the study: (a) a teaching-learning strategy (focusing on content, methodologies or assessment); (b) a process strategy (micro: course or module design; meso: programme or strategy implementation; macro: involving strategic processes at a university level); (c) an educational artefact. It also identified whether the intervention included any significant information and communications technology-related aspects.
Methodological perspective	Methodological approach or focus of the study analysed: (a) quantitative; (b) qualitative; (c) mixed.
Data collection techniques and tools	Techniques and/or instruments used in the data collection of the study analysed: (a) record; (b) evidence; (c) notes; (d) checklist; (e) observation; (f) focus group; (g) interview; (h) questionnaire.
Participants	The type of participants in the study were identified (students, technical staff, teachers, other) and classified by intervals according to their number (1–5; 6–20; 21–50; 51–100; 101–200; 201–500; 501–1000; 1001≤).
Quality criteria	Aspects of methodological rigour reviewed or assessed in the study: (a) validity; (b) practicality; (c) local effectiveness; (d) global effectiveness.
Design principles	Specific and explicit synthesis of the connection between the learning generated by practice and the theory generated from it in the form of recommendations, advice or other formulations.

Description of documents analysed

Consistent with its exploratory descriptive approach, this paper aims to offer a structured overview of the current use of DBR in higher education, avoiding explanatory conclusions that go beyond the scope of this review.

As shown in Figure 2, the selected studies are unevenly distributed throughout the 2019–2023 period, mainly concentrated in 2021 ($n = 50$) and 2022 ($n = 52$), but with no identifiable trend over time. Geographically, the majority of the publications come from European countries ($n = 73$), followed by North America ($n = 45$) and Asia ($n = 30$) (see Table 3).
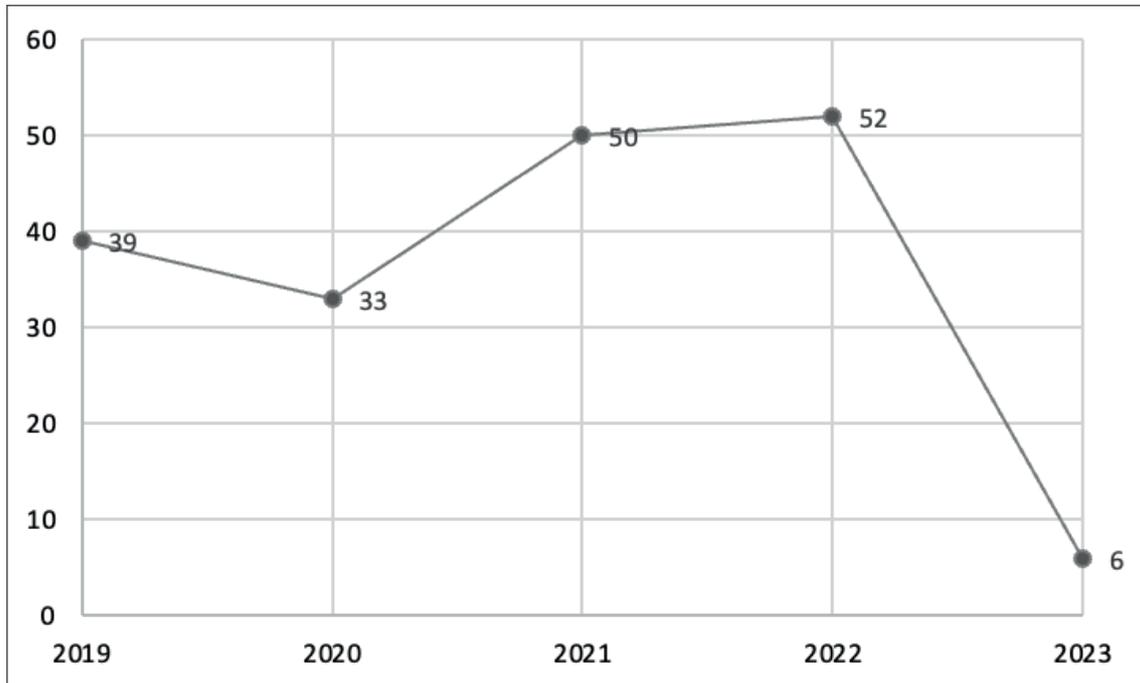
Figure 2. Frequency of publication by year analysed

Table 3 also shows the distribution by subject area, where the social sciences and legal disciplines clearly predominate (*n* = 87). This could be because the field of education is integrated into social sciences and a connection could be established in quantitative terms. In any case, this analysis suggests that, as DBR is an approach aimed at generating educational products, these can be developed in any subject area.

Table 3
Distribution of publications by continent and area of knowledge

Continent	*n*
Asia	30
Europe	73
Africa	12
America	45
Oceania	20
Knowledge area	*n*
Sciences	12
Health sciences	21
Social and legal sciences	87
Engineering and architecture	28
Arts and humanities	18
Not defined	16

Results

Type of intervention and phase of DBR described

Regarding the DBR phase and as presented in Table 4, most of the articles reviewed either described one or more iterations (*n* = 94) or analysed a complete DBR process (*n* = 54). To a lesser extent, 18 of the 180 articles focused exclusively on the initial phase or front-end analysis of the DBR process, while 14 articles focus on other aspects. In the case of the articles on the initial phase, there are some, such as that by Laranjeiro et al. (2021), which carried out a review of the literature prior to the implementation of the

iterative design and development process, or which analysed the characteristics of the context, as is the case of McMahon et al. (2019).

Of the articles describing one or more iterations, 28% (*n* = 26) of them also added the initial or front-end phase results, while 72% (*n* = 68) focused only on the iteration itself and its results.

Table 4
Frequency of the phase of the DBR process and the type of intervention

Phase of the DBR process	*f*
Initial phase	18
Iterations	94
Iteration(s) only	68
Iteration + initial phase	26
Complete	54
Other	14
Type of intervention	*f*
Teaching-learning strategy	157
Contents	87
Methodology	74
Evaluation	11
Process strategies	155
Micro	122
Meso	28
Macro	5
Educational artefact	46
Includes information and communications technology	81

Many studies focused on the iteration phase, suggesting that researchers often prefer to explore intermediate or iteration-specific outcomes. This poses the challenge of more comprehensively documenting the entire DBR cycle, from preliminary analysis to final evaluation.

As for the type of intervention, 157 of the articles analysed correspond to teaching-learning strategies, such as interventions carried out within the framework of subjects for the renewal or improvement of study contents (*n* = 87), methodological improvements in subjects or courses (*n* = 74) or the introduction of new assessment methods and strategies (*n* = 11). In the latter case, there are articles such as that of Fouche et al. (2021), which implemented and analysed new forms of assessment through portfolios, or that of Cerro Martínez et al. (2020), which used learning analytics.

The lower presence of process strategies and educational artefacts may be due to the fact that such interventions require greater organisational complexity, involve different levels of intervention and are usually more closely linked to institutional management or the creation of technological tools.

In addition, 155 of the articles analysed deal with the design and development of process strategies. The vast majority of these (*n* = 122) correspond to micro-level interventions (course or module design), 28 address meso-level strategies (e.g., programme or strategy implementation) and only five articles concern the macro level, involving strategic university processes. In the case of meso-level programmes, we find strategies for university teacher training (Alain Botaccio et al., 2020) and quality assessment (Schellekens et al., 2023), among others. At the macro level, we find institutional strategies to enhance online degrees (Joshi, 2022), innovation and transfer (Chanyawudhiwan & Mingsiritham, 2021) and quality systems (Ali et al., 2020).

The distribution of these studies across different types of intervention suggests a predominance of initiatives focusing on specific actors, courses or learning processes, which can be categorised as micro-level interventions. A smaller number of studies address broader institutional practices (meso level) or

system-level changes (macro level), although these are less detailed and less frequent. This distribution provides an additional perspective on the scope of DBR applications in higher education.

Finally, it should also be noted that 46 of the 180 articles analysed consist of the design and development of educational artefacts, and 81 include some type of information and communications technology element, whether it be the design of online courses (Devonshire et al., 2022), learning management systems (Pérez-Sanagustín et al., 2022), apps or gamified systems (Perry, 2021), among others.

Method, data collection strategies and participants

The analysis of the articles reveals a notable preference for adopting a mixed-methods perspective (*n* = 76), highlighting the tendency to integrate quantitative and qualitative approaches to address the complexity of the phenomena under investigation. Likewise, a significant number of articles opted for a qualitative perspective (*n* = 61), allowing us to delve deeper into the experiences and perceptions of the participants. On the other hand, the quantitative perspective was the least employed (*n* = 45) (Table 5).

Table 5
Frequency of use of the methodological perspective

Methodological perspective	*f*
Mixed	76
Qualitative	61
Quantitative	45

The large number of studies with a mixed and qualitative methodological perspective shows the suitability of DBR for exploring complex and dynamic educational contexts, where a deep understanding of the participants' experiences and intervention implementation processes is essential.

In relation to the data collection process, a wide variety of data collection techniques and instruments can be observed (Table 6). The most frequently used options are questionnaires (*n* = 104), followed by interviews (*n* = 76). With a lower frequency of use, we find log analysis (*n* = 43), focus groups (*n* = 40), evidence analysis (*n* = 35) and observation (*n* = 31). Finally, the least frequently used options are notes (*n* = 12) and checklists (*n* = 5).

Table 6
Frequency of use of data collection instruments

Data collection techniques and tools	*f*
Record	43
Evidence	35
Notes	12
Checklist	5
Observation	31
Focus group	40
Interview	76
Questionnaire	104

The predominant use of questionnaires and interviews indicates a desire for complementarity and diversification to capture the complexity of the educational phenomena to be addressed.

In this context, it is important to highlight that data collection techniques were used in combination in most of the articles for the purpose of triangulating the information. The table of co-occurrence presented below shows that the most frequent combinations are those of interviews and questionnaires (*n* = 45), standing out notably in comparison with other combinations (Table 7). In contrast, certain combinations never occur, such as observation and checklist, notes and observation, notes and checklist, and record

and checklist. It is worth mentioning that checklists and notes are precisely the least used techniques, as shown in Table 6.

Table 7
Table of co-occurrence between data collection instruments

Data collection instruments	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Questionnaire (a)								
Interview (b)	45							
Focus group (c)	14	15						
Observation (d)	15	15	7					
Checklist (e)	2	1	1	0				
Notes (f)	5	3	4	0	0			
Evidence (g)	12	11	9	10	1	4		
Record (h)	22	19	11	8	0	2	11	

In terms of the type of participants consulted, three main profiles can be considered: students (n = 143), technicians (n = 14) and teachers (n = 72). In addition, in some cases, other profiles (n = 14), such as experts (Ali et al., 2020) or stakeholders (Schellekens et al., 2023) have been consulted, among others (Table 8).

Table 8
Frequency of use of study participant profiles

Participants	f
Students	143
Technicians	28
Teachers	72
Other	14

In the different documents analysed, co-occurrence between different profiles has also been noted when collecting data. As can be seen in Table 9, the most common co-occurrence between participants is that of students and teachers (n = 53). On the other hand, the least common co-occurrence is that of technicians and other profiles (n = 4).

Table 9
Table of co-occurrence between participant profiles

	Students	Technicians	Teachers	Other
Students				
Technicians	18			
Teachers	53	16		
Other	9	4	9	

In terms of the number of participants involved in the research, there is a close relationship with the profile of the study. In the case of students, the samples are mainly concentrated in smaller intervals, specifically in the first four: 6–20, 21–50, 51–100 and 101–200. However, there are also articles covering larger samples with more than 1000 participants, such as the one used by Haack & Jambor (2021) with 6029 participants.

In the case of technicians, the most frequent intervals are 1-5 (n = 8) and 6-20 (n = 9) participants, and the maximum number of participants does not exceed 50 in any study. With teachers, a situation similar to that of technicians is detected, given that the range with the highest frequency in the studies analysed is 1–5 participants (n = 17), and the number of participants does not exceed 200 in any case.

Finally, when considering other profiles, there is a similar trend to that of teachers and technicians in terms of the maximum number of participants. In this case, the maximum number of participants does

not exceed 100 in any study. Despite this, no clear trend is evident in this particular context in relation to the intervals. However, it is noteworthy that most of the papers have samples of fewer than 20 participants (Table 10).

Table 10
Frequency table according to intervals of participant groups

Interval	Frequency of students	Frequency of technicians	Frequency of teachers	Frequency of other profiles
1–5	1	8	17	3
6–20	19	9	14	8
21–50	32	3	12	0
51–100	21	0	3	2
101–200	20	0	3	0
201–500	14	0	0	0
501–1000	4	0	0	0
1001≤	9	0	0	0

Quality criteria and integration of design principles

Regarding quality criteria, it can be considered that these are not an aspect that is systematically recorded explicitly in the documents. In fact, identifying and including these criteria in the analysis has been a costly task and the result of our subjective interpretation. To overcome this challenge, we did not use a strict framework but drew on general definitions and concepts taken from the literature to guide the interpretation of these elements and ensure their consistency throughout the work.

Table 11 shows the quality criteria presented in a disaggregated and aggregated manner so that we can extract some ideas from this analysis, even if they are limited and the reading does not go beyond quantitative aspects. In this sense, from a disaggregated viewpoint, we can see how local effectiveness and practicality are the most common criteria, followed by validity, which, despite appearing in a smaller number, is also taken into account to a large extent; this recurrent appearance of validity also reinforces the idea and aspiration that an intense effort should be made in the preliminary phase of DBR processes.

Table 11
Quality criteria

Disaggregated quality criteria	*f*
Overall effectiveness	3
Local effectiveness	97
Practicality	96
Validity	61
Aggregated quality criteria	*f*
Local validity and effectiveness	2
Validity, practicality and local effectiveness	28
Practicality and local effectiveness	30
Validity and practicality	11

When the criteria are read in the aggregated form, it seems logical to expect to find practicality grouped with effectiveness (Sansone et al., 2021) or to see validity added as a precedent to the previous criteria (Mukarromah et al., 2019). Despite the difficulties noted above that have hindered the development of this article, the analysis has been undertaken from a comprehensive position. The estimated cost of this breadth of analysis is offset by the achievement of a review that can take a proactive approach to categorisation rather than merely providing a descriptive view.

Regarding the analysis of DPs, the first consideration is that not all the documents present them explicitly and, unlike the quality criteria, it is very difficult to make an interpretation of the text. The absence of this

information is sometimes justified since not all the documents report on the part or parts of the DBR process that allow DPs to be extracted. On the other hand, and with specific reference to the present analysis, these DPs can be found in different sections of the documents: Introduction, Results, Conclusions, Discussion or distributed throughout the text (Table 12).

The predominance of criteria of local effectiveness and practicality reflects the applied purpose of DBR, which seeks specific and contextualised solutions to specific educational problems. In contrast, the lack of attention to validity and especially overall effectiveness suggests a lack of systematisation of the results and their transferability to other settings.

Table 12
Frequency of DPs by section

Sections	*f*
Introduction	6
Results	8
Conclusions	5
Discussion	12
Entire manuscript	8

Of the manuscripts analysed, 48 explicitly present the formulation of DPs. From a structural point of view, if we look at the sections individually, it is the Discussion section where DPs appear most frequently (*n* = 12); when we analyse the presence of DPs in several sections of the manuscripts, we observe a double grouping as either the Introduction and Results sections are grouped together (*n* = 4) or the Results and Discussion sections are grouped together (*n* = 3). It can also be seen that there are eight manuscripts in which the DPs are distributed throughout all the sections.

If we analyse DPs from a more qualitative point of view, we can extract some ideas about their formulation in the different documents. In this way, we can observe articles where DPs constitute the central question of the document (Dewantara & Dibia, 2021). It is common to see how DPs are introduced in the preliminary phase and refined throughout the DBR process (van den Berg, 2019). These DPs are also presented throughout the Results section, grouped by categories and phases (Marden & Herrington, 2020). It is interesting to note the cumulative way in which Smith et al. (2021) presented the DPs, or the approach taken by Miah & Solomonides (2021) in the form of a skeleton in the Results section.

If we refer to the formulation of DPs in terms of format, characteristics or name, apart from the most common in terms of recommendations, we can highlight some of them, such as their formulation in terms of innovations (Di Maso & Ligorio, 2019), differentiating between substantive and procedural principles (Karsten & van Zyl, 2022), distinguishing between requirements, principles and architecture by adding a contextual or general nuance (Verstege et al., 2021) or incorporating a temporal nuance into the formulation (Marín, 2021).

The scattered presence of DPs in different sections of the studies reviewed shows the diversity of approaches to presenting the results and aligning theory with practice. This demonstrates the flexibility of DBR, although it also suggests a certain lack of consistency in the formulation and presentation of the DPs.

Discussion

Over the last 20 years, there has been a significant increase in the presence of studies linked to educational research that adopt the DBR approach (Reeves & Lin, 2020; Tinoca et al., 2022; Zheng, 2015). As previously mentioned, various terminologies have been used and numerous studies have attempted to describe this type of DBR approach. It is a pragmatic methodology aimed at analysing and treating complex problems through a systematic, iterative process, often requiring various methods and strategies for collecting information and different participant profiles (Esteve et al., 2019). Due to their particular

characteristics, DBR studies usually set a series of quality criteria that ensure their systematicity and seek not only to solve the problem generated by the educational intervention created but also to generate DPs that are transferable to other contexts.

Despite the large number of studies that use this methodology and reviews of the methodology itself, its use in higher education requires further exploration, especially because of its versatility in applied research and educational innovation that is often carried out in this setting, as well as the large number of projects for the design and implementation of educational interventions resulting from the crisis generated by the COVID-19 pandemic. For all these reasons, in this article, we have set out to explore in depth the use of the DBR methodology in higher education over the last 5 years.

In relation to RQ1, about the type of research and part of the DBR described in the study, most studies focused on the iterative process and, to a lesser extent, analysed the whole process or focus on the initial phase. As we saw in the Introduction, such methodologies are extensive and complex, with a variety of phases, instruments and participants, making it difficult to synthesise all the research in a single publication, and it is common to find papers that focus on a single iteration.

This review also confirms that most interventions reported in the selected studies target the micro level, focusing on specific actors or teaching-learning processes, with fewer cases addressing broader institutional (meso) or systemic (macro) dimensions, an observation already reflected in the typology described in the Results section.

The published work on DBR in the context of higher education is often partial and largely focuses on improvement cycles within the classroom, rather than broader institutional processes. This indicates its practical utility, although it can also limit its transformative potential if its application is not extended to the initial and strategic phases.

As far as the data collection procedure (RQ2) is concerned, as explained in the Results section, there is an inclination to triangulate the information, which, as indicated by Forni & De Grande (2020), denotes the complementarity of the different strategies. This tendency is manifested in the preference for using a mixed approach, combining instruments and data collection techniques – with questionnaires and interviews being the most frequently used, both jointly and individually – and carrying out consultations with various profiles – tending to take larger samples of students than of teachers and technicians. This broad methodological perception that combines diverse strategies and methods coincides with the perspective of DBR exhibited by authors such as Anderson & Shattuck (2012), who consider this methodological amalgam as a step towards understanding an unknown and plural reality.

As far as RQ3 is concerned, the cataloguing of quality criteria has not been straightforward, and, on occasions, it is necessary to resort to interpretation at the risk of certain subjective bias. From their analysis, it can be said that in one way or another, validity, practicality and local effectiveness appear in the different manuscripts. However, global effectiveness appears only rarely and in a somewhat forced interpretation. This is because global effectiveness occurs when principles derived from local effectiveness are applied in different contexts, i.e. when they are intended to be generalised. We could say that the academic production analysed tends to share experiences of local applications where the aspiration to generalise DBR processes has not yet been realised. Based on this situation, it would not be unreasonable to suggest that the clear and explicit appearance of quality criteria is a criterion in itself or, at the very least, a requirement for DBR publications.

Regarding design principles, their analysis reveals some coherence with the quality criteria; the DPs that appear mostly refer to processes that only have a local impact. The dynamic, flexible and cyclical nature of DBR processes means that the DPs can appear in all parts of the manuscripts, although it is in the discussion that they seem to appear most frequently. The emergence of different ways of formulating the DPs is also noteworthy; not only does this diversity not represent a problem, but from a conceptual point of view, it adds richness and relevant nuances to DBR processes.

There is a clear weakness in the systematisation of quality and DP criteria in the studies. It would be desirable to strengthen their methodological explanation in the literature, promoting the use of shared criteria and standardised formats, as this could improve the scientific quality and reproducibility of the studies and their impact on the educational community.

Conclusions

This systematic review of the literature covered a broad sample of academic papers, which means that two sides of the same coin can be considered. On the one hand, such an extensive review allows us to obtain an overview of the situation of the last 5 years in research using this methodology in the context of higher education. On the other hand, this same breadth of documents has made it difficult to go deeper into certain elements. In this sense, it should be noted that one of the greatest difficulties is the lack of precision and use of terminology specific to the methodology on the part of some authors, for example, when defining phases or quality criteria, suggesting an added difficulty for cataloguing information. From this point on, there are two main possibilities for continuing with the research topic: (a) to continue with the literature research, limiting the search to a more specific topic at a specific educational level in order to be able to delve deeper into the type of practices that are carried out and (b) to use all the information gathered as a model to design a research proposal to be applied at the respective universities of the authors participating in this SLR.

Today's society, aggravated by the pandemic in 2020, constitutes a complex situation requiring the work of a connected, multidisciplinary team to generate a useful, simple, generalisable and future-oriented solution. All these qualities pose a challenge for those of us in education who are convinced of its capacity to transform and have an impact on society. The higher education setting could be an ideal place to carry out initiatives consistent with this methodological option. All these experiences remain confined to a specific context if they are not shared with the wider scientific community through vehicles such as the publication of articles in specialised journals.

In fact, the review carried out in this paper has sought to analyse documents where DBR has been used in the last 5 years precisely in the context of higher education. Apart from what has already been described in the article, in general terms, it can be said that DBR processes are fertile ground for generating justified innovations that respond to the complexity and diversity of today's society. However, the versatility and dynamism of this methodological approach must be compatible with the challenge of producing clear publications that highlight both the richness of each experience and the essential and identifiable elements that are characteristic of DBR. This will improve the processes of the methodological approach itself and result in attempts to analyse its research output, as is the purpose of this article.

The most striking limitation of the study was the limited explicitness of the quality criteria and DPs in many of the articles analysed, which required an interpretive process by us to classify them. This situation made it difficult to systematise the information and could have introduced some bias into the analysis.

Prior to presenting specific limitations or offering future proposals, we must emphasise one of the key findings of this SLR: the need to strengthen the consistency of nomenclature and structural reporting in studies on DBR in higher education. Diversity in the description of interventions, design processes and outcomes makes it difficult to compare studies and make theoretical advances. Greater terminological consistency and more attention to describing the process would allow the DBR community to move towards a more unified and impactful methodological approach.

Regarding future suggestions, the first proposal for future research is to select articles, incorporating as an inclusion criterion that the research documents must fully document all phases of the DBR process, including the preliminary design, iterations and overall evaluation, as well as the quality criteria and DPs applied, thus improving transparency and methodological comparability.

It would also be interesting to explore ways to standardise the presentation of conclusions or recommendations based on a theoretical framework such as that proposed by Hoadley & Campos (2022); this work in itself could be considered an independent research project.

Author contributions

Jose Cela-Ranilla: Conceptualisation, Writing – original draft, Writing – review and editing, **Francesc M. Esteve-Mon**: Investigation, Formal analysis, Writing – review and editing, **Anna Sánchez-Caballé**: Data curation, Writing – review and editing.

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References

Alain Botaccio, L., Gallego Ortega, J. L., Navarro Rincon, A., & Rodriguez Fuentes, A. (2020). Evaluation for teachers and students in higher education. *Sustainability, 12*(10), Article 4078. https://doi.org/10.3390/su12104078

Ali, E. Y., Munir, M., Permana, J., & Kurniady, D. A. (2020). Improving the quality of academic services in higher education by the development of SIMANTAP. *Universal Journal of Educational Research, 8*(2), 371–386. http://doi.org/10.13189/ujer.2020.080206

Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher, 41*(1), 16–25. https://doi.org/10.3102/0013189X11428813

Bakker, A. (2018). *Design research in education: A practical guide for early career researchers*. Taylor & Francis.

Bannan, B., Cook, J., & Pachler, N. (2016). Reconceptualizing design research in the age of mobile learning. *Interactive Learning Environments, 24*(5), 938–953. https://doi.org/10.1080/10494820.2015.1018911

Cerro Martínez, J. P., Guitert Catasus, M., & Romeu Fontanillas, T. (2020). Impact of using learning analytics in asynchronous online discussions in higher education. *International Journal of Educational Technology in Higher Education, 17*, Article 39. https://doi.org/10.1186/s41239-020-00217-y

Chanyawudhiwan, G., & Mingsiritham, K. (2021). Using design-based research to develop innovation in open university in Thailand. *International Journal of Interactive Mobile Technologies, 15(*4), 126–134. https://doi.org/10.3991/ijim.v15i04.19007

Devonshire, E., Dodds, S., Costa, D., Denham, R., Fitzgerald, K., & Schneider, C. R. (2022). Educating and engaging a new target audience about the problem of pain for society. *British Journal of Pain, 16*(6), 641–650. https://doi.org/10.1177/2049463722111656

Dewantara, I. P. M., & Dibia, I. K. (2021). The principles of blended learning design with heutagogy approach through e-ganesha moodle in Indonesian language learning. *Journal of Physics: Conference Series, 1810,* Article 012048. http://doi.org/10.1088/1742-6596/1810/1/012048

Di Maso, R., & Ligorio, M. B. (2019). An example of innovative university teaching: the model of Constructive and Collaborative Professional Participation. In J. Domenech (Chair), *Proceedings of the 5th International Conference on Higher Education Advances* (pp. 415–421). Editorial Universitat Politècnica de València. https://doi.org/10.4995/HEAd19.2019.9293

Easterday, M. W., Rees Lewis, D. G., & Gerber, E. M. (2018). The logic of design research. *Learning: Research and Practice*, *4*(2), 131–160. https://doi.org/10.1080/23735082.2017.1286367

Edelson, D. C. (2001). Design research: What we learn when we engage in design. *Journal of the Learning Sciences, 11*(1), 105–121. https://doi.org/10.1207/S15327809JLS1101_4

Esteve, F. M., Cela, J. M., & de Benito, B. (2019). DBR: una estrategia metodológica para investigar en tecnología educativa [DBR: A methodological strategy for research in educational technology]. In M. Gisbert, V. Esteve, & J. L. Lázaro (Eds.), *¿Cómo abordar la educación del futuro? Conceptualización, desarrollo y evaluación desde la competencia digital docente* (pp. 79–92). Octaedro.

Forni, P., & De Grande, P. (2020). Triangulación y métodos mixtos en las ciencias sociales contemporáneas [Triangulation and mixed methods in contemporary social sciences]. *Revista mexicana de sociología, 82*(1), 159–189. https://doi.org/10.22201/iis.01882503p.2020.1.58064

Fouche, I., Dison, L., Andrews, G., & Prozesky, M. (2021). Pedagogical and decolonial affordances of group portfolio assessments for learning in South African universities. *Critical Studies in Teaching & Learning, 9*(1), 76–98. https://doi.org/10.14426/cristal.v9iSI.1808

Haack, M., & Jambor, T. N. (2021). Evaluation of a learner-centered activating learning situation with large cohorts in the university. In Á. Rocha, R. Gonçalves, F. Garcia Peñalvo, & J. Martins (Eds.), *Proceedings of the 2021 IEEE Frontiers in Education Conference* (pp. 1–9). IEEE. https://doi.org/10.1109/FIE49875.2021.9637371

Hoadley, C., & Campos, F. C. (2022). Design-based research: What it is and why it matters to studying online learning. *Educational Psychologist*, *57*(3), 207–220. https://doi.org/10.1080/00461520.2022.2079128

Joshi, M. S. (2022). Holistic design of online degree programmes in higher education–a case study from Finland. *International Journal of Educational Management, 36*(1), 32–48. https://doi.org/10.1108/IJEM-12-2020-0588

Karsten, I., & van Zyl, A. (2022). Design-based research (DBR) as an effective tool to create context-sensitive and data-informed student success initiatives. *Journal of Student Affairs in Africa*, *10*(1), 15–31. http://doi.org/10.24085/jsaa.v10i1.3706

Kuckartz, U., & Rädiker, S. (2019). *Analyzing qualitative data with MAXQDA: Text, audio, and video*. Springer. https://doi.org/10.1007/978-3-030-15671-8

Laranjeiro, D., Moreira, A., Balula, A., Vasconcelos, S., & Moreira, G. (2021). Teacher training in innovative practices in higher education, using a MOOC: Preliminary Study. In Á. Rocha, R. Gonçalves, F. Garcia Peñalvo, & J. Martins (Eds.), *Proceedings of the 16th Iberian Conference on Information Systems and Technologies* (pp. 1–4). IEEE. https://doi.org/10.23919/CISTI52073.2021.9476524

Marden, M. P., & Herrington, J. A. (2020). Design principles for integrating authentic activities in an online community of foreign language learners. *Issues in Educational Research, 30*(2), 635–654. http://www.iier.org.au/iier30/pais-marden.pdf

Marín, V. I. (2021). Using concept maps to structure a small-scale literature review: an approach to research-based learning in pre-service teacher education. *Research in Education and Learning Innovation Archives, (27)*, 1–18. http://doi.org/10.7203/realia.27.20492

McKenney, S., & Reeves, T. C. (2013). Systematic review of design-based research progress: Is a little knowledge a dangerous thing? *Educational Researcher, 42*(2), 97–100. https://doi.org/10.3102/0013189X12463781

McMahon, K., Yeh, C. S. H., & Etchells, P. J. (2019). The impact of a modified initial teacher education on challenging trainees' understanding of neuromyths. *Mind, Brain, and Education, 13*(4), 288–297. https://doi.org/10.1111/mbe.12219

Miah, S. J., & Solomonides, I. (2021). Design requirements of a modern business Master's degree course: perspectives of industry practitioners. *Education and Information Technologies*, *26*, 763–781. https://doi.org/10.1007/s10639-020-10285-2

Mukarromah, I., Beratha, S., Artawa, K., & Budiarsa, M. (2019). Designing morphosyntax material for EFL students: Indonesian case. *English Language Teaching*, *12*(6), 140–145. https://doi.org/10.5539/elt.v12n6p140

Newman, M., & Gough, D. (2020). Systematic reviews in educational research: Methodology, perspectives, and application. In O. Zawacki-Richter, M. Kerres, S. Bedenlier, M. Bond, & K. Buntins (Eds.), *Systematic reviews in educational research* (pp. 3–22). Springer. https://doi.org/10.1007/978-3-658-27602-7_1

Pereira, A., & Oliveira, I. (2021). Pragmatismo, design-based research e investigação-ação [Pragmatism, design-based research and action research]. *Revista Pesquisa Qualitativa, 9*(21), 445–467. https://doi.org/10.33361/RPQ.2021.v.9.n.21.453

Pérez-Sanagustín, M., Pérez-Álvarez, R., Maldonado-Mahauad, J., Villalobos, E., & Sanza, C. (2022). Designing a Moodle plugin for promoting learners' self-regulated learning in blended learning. In I. Hilliger, P. J. Muñoz-Merino, T. De Laet, A. Ortega-Arranz, & T. Farrell (Eds.), *Lecture notes in computer science*: Vol. 13450. *Educating for a new future: Making sense of technology-enhanced learning adoption* (pp. 324–339). Springer. https://doi.org/10.1007/978-3-031-16290-9_24

Perry, B. (2021). Gamified mobile collaborative location-based language learning. *Frontiers in Education, 6,* Article 689599. https://doi.org/10.3389/feduc.2021.689599

Philippakos, Z., Howell, E., & Pellegrino, A. (2021). *Design-based research in education: Theory and applications*. Guilford Press.

Plomp, T., & Nieveen, N. (2009). *An introduction to educational design research*. Netherlands Institute for Curriculum Development.

Reeves, T. C., & Lin, L. (2020). The research we have is not the research we need. *Educational Technology Research and Development*, *68*, 1991–2001. https://doi.org/10.1007/s11423-020-09811-3

Richey, R., Klein, J., & Nelson, W. (2004). Developmental research: Studies of instructional design and development. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 1099–1130), Routledge. https://doi.org/10.4324/9781410609519

Saldaña, J. (2015). *The coding manual for qualitative researchers.* SAGE Publications.

Sansone, N., Cesareni, D., Bortolotti, I., & McLay, K. F. (2021). The designing and re-designing of a blended university course based on the trialogical learning approach. *Education Sciences*, *11*(10), Article 591. https://doi.org/10.3390/educsci11100591

Schellekens, L. H., van der Schaaf, M. F., van der Vleuten, C. P., Prins, F. J., Wools, S., & Bok, H. G. (2023). Developing a digital application for quality assurance of assessment programmes in higher education. *Quality Assurance in Education, 31*(2), 346–366. https://doi.org/10.1108/QAE-03-2022-0066

Schoonenboom, J., & Johnson, R. B. (2017). How to construct a mixed methods research design. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 69*(2), 107–131. https://doi.org/10.1007/s11577-017-0454-1

Smith, C., Onofre-Martínez, K., Contrino, M. F., & Membrillo-Hernández, J. (2021). Course design process in a technology-enhanced learning environment. *Computers and Electrical Engineering*, *93*, Article 107263. https://doi.org/10.1016/j.compeleceng.2021.107263

Tinoca, L., Piedade, J., Santos, S., Pedro, A., & Gomes, S. (2022). Design-based research in the educational field: A systematic literature review. *Education Sciences*, *12*(6), Article 410. https://doi.org/10.3390/educsci12060410

Urrútia, G., & Bonfill, X. (2010). Declaración PRISMA: Una propuesta para mejorar la publicación de revisiones sistemáticas y metaanálisis [PRISMA declaration: A proposal to improve the publication of systematic reviews and meta-analyses]. *Medicina clínica, 135*(11), 507–511. https://doi.org/10.1016/j.medcli.2010.01.015

Van den Akker, J., Gravemeijer, K., McKenney, S., & Nieveen, N. (2006). *Educational design research.* Taylor & Francis.

van den Berg, C. (2019). Teaching innovation to strengthen knowledge creation in a digital world. *Electronic Journal of Knowledge Management*, *17*(2), 144–157. https://academic-publishing.org/index.php/ejkm/article/view/1137/1100

Vangrieken, K., Meredith, C., Packer, T., & Kyndt, E. (2017). Teacher communities as a context for professional development: A systematic review. *Teaching and Teacher Education, 61*, 47–59. https://doi.org/10.1016/j.tate.2016.10.001

Verstege, S., Vincken, J. P., & Diederen, J. (2021). Blueprint to design virtual experiment environments. *Computers and Education Open*, *2*, Article 100039. https://doi.org/10.1016/j.caeo.2021.100039

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development, 53*(4), 5–23.

Zheng, L. (2015). A systematic literature review of design-based research from 2004 to 2013. *Journal of Computers in Education*, *2*, 399–420. https://doi.org/10.1007/s40692-015-0036-z

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