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Is the empirical research we have the research we can trust? A review of distance education journal publications in 2021

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Abstract: This study aims to investigate the trustworthiness of empirical research published in distance education (DE) journals, an area that has yet to be systematically explored. The review covers 238 empirical studies which were based on primary data and published in 2021 in eight DE journals listed in Social Science Citation Index (SSCI) or Emerging Sources Citation Index (ESCI). Findings suggest that they are fairly good in terms of clarity in context of study, purpose of study, and duration if a study involves an intervention or is otherwise length-sensitive, albeit the existence of small room for improvement. In contrast, a large proportion of the studies reviewed are less rigorous to different but considerable and even alarming degrees in terms of research approach and design, sampling strategies, source of data, researcher bias, ethical concerns, and limitations. Put specifically, less than one quarter of the sample studies adopted the qualitative approach while over 90% of the quantitative studies followed the survey and correlational designs, resulting in a staggering disproportion from the perspective of diversity in research approach and design. Over 60% of the sample studies did not spell out their sampling strategies and only about 20% of the specified sampling strategies were probabilistic in nature, limiting the generalizability of the findings. Over 90% employed questionnaires/scales/rubrics and/or interview protocols to collect data but over 70% of these two types of instruments were neither reviewed nor piloted before put to use with less than 50% available in full content, hence likely to undermine the value of the findings. Researcher bias, ethical concerns, and limitations were addressed in 10%, 50%, and 70% of the studies respectively. Implications for future research are also discussed in the light of these findings.

Keywords: distance education, empirical research, methodological rigor, journal publication, literature review

Highlights

What is already known about this topic:

- Major research themes and trends in DE journal publications.
- Citation patterns, journal impact, authorship patterns, and co-authorship network.
- Keywords, theoretical/conceptual frameworks, variables, and population/participants.

What this paper contributes:

- The study focus exclusively on the appropriateness and robustness of research design.
- Lack of methodological rigor that has long plagued the field of DE remains unabated to different extents in different aspects today.
- Empirical research in DE needs improving, especially in terms of research approach and design, sampling, data source, and possible weaknesses such as limitations, researcher bias and ethical concerns.

Implications for theory, practice and/or policy:

- More qualitative and mixed-methods research should be encouraged.
- The tendency to favor correlational and survey research over other types of research design should be reduced.
- More longitudinal research is needed.

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Introduction

Based on research findings from 1928 to 1998 concerning the effectiveness of technology-enhanced learning, chiefly distance learning, in comparison with other models of teaching, Russell's (1999) No Significant Difference Phenomenon is often cited as evidence to legitimize distance education (DE). This is because it is taken for granted that the studies included in this work were trustworthy. Similarly, the meta-analysis of Bernard et al. (2009) is often used to support Anderson's (2003) equivalency theorem according to which, among other things, a high level of one type of interaction can result in an effective educational experience even if the other two types are "offered at minimal levels, or even eliminated". Nevertheless, a scrutiny of the empirical studies included in Bernard et al. (2009) shows that not all of them were as rigorously designed as claimed by their authors. "None of the 11 inclusion criteria adopted in this study indicates whether each interaction treatment (IT) (i.e., learner–learner, learner–instructor or learner–content interaction) is independent of the others" (Xiao, 2017, p. 127). In fact, "studies were categorized by the most prevalent interaction type contained in the independent variable" (Bernard et al., 2009, p. 1253). It happened that a study which was grouped into a particular type of interaction actually had more than one type of interaction in it (Xiao, 2017). Therefore, the claim that the other two types were "even eliminated" is not justified.

Systematic reviews of DE journal publications are not uncommon in the field of DE. They are often intended to identify major research themes and trends in the publications over a certain period of time. Bozkurt et al. (2015) explored DE research trends emerging from seven peer-reviewed journals from 2009 to 2013 in terms of "most frequent(ly) indicated keywords, chosen research areas, emphasized theoretical/conceptual backgrounds, employed research designs, used data collection instruments and data analysis techniques, focused variables, targeted population and/or participant groups, cited references, and cited authors" (p. 336). Following up on Bozkurt et al. (2015), Bozkurt and Zawacki-Richter (2021) examined research trends and thematic patterns in the publications of six DE journals between 2014 and 2019. Zawacki-Richter and Naidu (2016) set out to reveal themes and map out trends in DE research from the first 35 years of publications of *Distance Education*. Çakiroğlu et al. (2019) investigated the research trends, major concepts, and cut-off points in the articles published between 2009 and 2016 in five major peer-reviewed journals. Similar studies include Berge and Mrozowski (2001) and Lee et al. (2004). Bibliographic reviews of DE research have also been conducted to explore citation patterns in DE research (Martínez & Anderson, 2015), the impact and significance of DE journals in the field (Zawacki-Richter & Anderson, 2011), and co-authorship network (Gomes & Barbosa, 2018) or with the intention to help policymakers develop quality DE program (Bishop & Spake, 2003). Zawacki-Richter et al. (2009) reviewed 695 articles published in five prominent DE journals (2000 -2008) with the purpose of identifying gaps, priority areas, methods and authorship patterns in DE research. A similar study was conducted with an exclusive focus on the publications (2000-2015) of a single journal - the *International Review of Research in Open and Distance/Distributed Learning* (Zawacki-Richter et al., 2017) while Bozkurt's (2019) bibliometric examination of publications and their references in four DE journals aimed "to investigate and explore the intellectual network and dynamics of the DE field" (p. 499). This group also includes Bozkurt et al. (2015) and Zawacki-Richter et al. (2010). Zawacki-Richter and Bozkurt (2022) is the latest and also very comprehensive review of DE journal publications, the focus of which, however, is not on research design, either.

It seems that no previous systematic reviews of DE literature focus exclusively on the appropriateness and robustness of research design although a few studies did cover this topic. For example, based on the same sample of Zawacki-Richter et al. (2009), Zawacki-Richter and von Prümmer (2010) explored how gender, collaboration and research methods relate to each other. Issues of research design were also "quantitatively" reported in Bozkurt et al. (2015) and Zawacki-Richter et al. (2009). No doubt, identification of research themes and trends and bibliometric analysis of journal publications can contribute to the development of the field. Nevertheless, it is equally relevant to evaluate the rigor and trustworthiness of research design adopted by DE studies, because whether a research design is rigorous and trustworthy and whether it is administered appropriately directly determine the validity,

reliability, dependability, believability as well as generalizability of the findings. For example, unless the empirical studies analysed are rigorous in design and appropriately administered, results of a meta-analysis may not be trustworthy. Bernard et al. (2009) mentioned above is a case in point. Also, if the findings of a study are unreliable, it may misguide and misinform further research and practice, possibly doing more harm than good to the field. This is a gap that has yet to be filled and the current study aims to fill this gap by answering the following research question: how trustworthy are empirical studies published in major DE journals in terms of research design and administration?

Methodology

Sampling

The first step is to select journal samples. The primary concern is to ensure the representativeness of the samples in terms of quality, impact, and internationality. With this basic principle in mind, the following inclusion criteria are developed and used in this study:

- Listed in Social Science Citation Index (SSCI) or Emerging Sources Citation Index (ESCI);
- Published in English;
- Had a major focus on DE;
- Peer-reviewed;
- Had an international editorial team.

There are eight journals meeting these criteria:

- *American journal of distance education* (AJDE);
- *Distance Education* (DE);
- *International Journal of Distance Education Technologies* (IJDET);
- *International Review of Research in Open and Distance Distributed Learning* (IRRODDL);
- *Online Learning* (OnL);
- *Open Learning* (OL);
- *Open Praxis* (OP);
- *Turkish Online Journal of Distance Education* (TOJDE) (see Table 1).

Table 1: Sample journals (statistics latest until June 22, 2022).

	Citation index	Peer-reviewed	Editor	Associate editor	Editorial board
AJDE	ESCI	Yes	1 (USA)	3 (USA and Spain)	21 (8 countries)
DE	SSCI	Yes	1 (Australia)	4(China, USA, Germany and Canada)	30 (11 countries)
IJDET*	ESCI	Yes	1 (Canada)	6 (Saudi Arabia, China, Italy, US, Canada, Cyprus)	40 (18 countries)
IRRODDL	SSCI	Yes	1 (Canada)	2 (Canada)	20 (12 countries)
OnL**	ESCI	Yes	1 (USA)	17 (USA and Germany)	18 (4 countries)
OL	ESCI	Yes	3 (UK)		12(7 countries)
OP	ESCI	Yes	1 (Spain)		7 (7 countries)
TOJDE ***	ESCI	Yes	1 (Turkey)	1 (Turkey)	75 (32 countries)

Notes: * IJDET has a Managing Editor from Taiwan, China.
** OnL has an Advisory Board with 7 members from USA, Ireland, UK and Canada and an Editorial Review Board with 67 members from 11 countries.
***TOJDE has an Honorary Editorial Board with 11 members from Turkey, Sweden, Canada, Ireland, USA and Australia.

The next step is to select articles published in these journals. There is no software to process data for the purpose of this study, which means data has to be manually analysed. To avoid being overwhelmed by the workload, the scope of selection was limited within the timeframe of one year. The Year 2021 was chosen in order to reflect the latest scenario of DE research. Inclusion criteria are:

- Empirical study;
- Primary/first-hand data;
- Published in 2021;
- Full-text available.

With these criteria in mind, the researchers visited the websites of the sample journals, making preliminary assessment by reading article titles, abstracts and keywords. 245 promising articles were then shortlisted for further examination. Seven of them were excluded for being based on secondary data (4 studies), not empirical (1 study) and not available in full-text (2 studies) despite repeated efforts to locate them. The final sample consists of 238 articles (see Table 2).

Table 2: Sample articles.

	Number of articles	**Number of issues**
AJDE	15	4
DE	21	4
IJDET	18	4
IRRODDL	32	4
OnL	66	4
OL	8	3
OP	19	3
TOJDE	59	4
Total	238	30

Assessment rubric development

Although the second author is an experienced reviewer and editor, in an attempt to overcome researcher bias, a review of research design literature was conducted to serve as the foundation upon which an assessment rubric was to be developed.

Put specifically, the rubric proposed (Table 3) is informed by Azevedo et al. (2011), CASP (2006), Cathala and Moorley (2019), Chenail(2010), Cohen, Manion and Morrison (2007), Creswell (2012), Drummond and Murphy-Reyes (2018), Jack et al. (2010), and Penn State University Libraries (2021). The draft rubric was then evaluated by two experienced DE researchers and editors whose feedback was adopted to improve the rubric.

Table 3: Assessment rubric.

	Hints	
Context of study	Was the context of study clearly stated?	
Hypothesis, research question or purpose	Was there a clear statement of the hypothesis, research question or purpose of the study?	
Approach	Did the study adopt a quantitative, qualitative or mixed approach?	
Design	Experimental	If the study was designed as an experiment, was it a true experiment or quasi-experiment?
	Non-experimental	If it was not an experimental study, what was it? Identify the design used in the study in line with Creswell's (2012) typology. If a study does not fit into any of the eight types in Creswell (2012), did the author name the research design used? If yes, add it as a new category to Creswell's (2012) list; otherwise, look for evidence, classify it into a proper category and add to the existing list.
	Duration	If it involved an intervention/treatment or was length-sensitive, was the duration specified?
Sampling strategy	Was the sampling or grouping strategy clearly stated? If yes, what strategy was used?	
Data collection	Sources of data	What kind of data was collected to answer the research question(s)?
	Most frequently-used Instruments	What instrument was most frequently used? Was it developed exclusively for the study or adapted from an existing one by the researcher? Or was it an existing instrument developed elsewhere? Was the instrument reviewed and

		piloted, or only reviewed, or only piloted, or neither reviewed nor piloted, before it was used to collect data for this study? Was the content (for example, questionnaire items or interview protocol) available in its entirety?
	Administration	Was data collection, including the how, who and when, clearly stated?
	Cross-sectional or longitudinal	Was the data collected only at one point in time or over a period of time?
Data analysis	Was the method of analysis appropriate? Was the analysis process rigorous?	
Researcher bias	Did the researcher explain how his/her own potential bias and influence was managed throughout the study, including sampling, data collection, and/or intervention administration?	
Ethical issue	Were ethical issues, if any, adequately addressed? For example, informed consent, confidentiality, anonymity, or approval from an ethics committee?	
Limitation	Was there any limitation acknowledged by the researcher?	

Analysis procedure

Given the purpose of the study, the method of directed content analysis was adopted to analyze the sample (Hsieh & Shannon, 2005). The two researchers used the assessment rubric to analyze five articles independently. The results were highly identical with only three discrepancies concerning clear statement of research purpose and type of design, showing that the rubric was operable. With the discrepancies solved, the researchers began to review the remaining 233 articles independently. When all the analysis was done, the results per article were then compared and discrepancies solved by re-reading and discussing the section(s) of the article in question to reach a consensus. Meanwhile, to further ensure the reliability and validity of the analysis as well as reduce possible researcher bias, a researcher independent of the study was invited to randomly choose 30 articles and review them using the rubric. The results of his analysis were compared with our own analysis of the same articles. The agreement rate was 94.7% and disagreements were solved through negotiation.

Limitations

Only empirical studies published in 8 high-impact DE journals in the year 2021 were included in the sample. Empirical DE research published in other journals or in languages other than English was not taken into account in this review. Therefore, findings from the study may not reflect the overall picture of empirical research in the field of DE. That said, the internationality in terms of editorial team, reviewers, and contributors may, to some extent, compensate for these limitations. Future research may extend the scope of the samples, namely published within a longer timeframe and in more journals or in other languages. Additionally, a finer-grained analysis may better reflect the true picture of empirical studies in the field. For example, when it comes to an intervention, how was blinding in terms of participants, investigators and/or assessors? How was confounding controlled? How was intervention integrity ensured? Future research will definitely benefit from finer-grained analysis.

Findings

Context and purpose of the study

Over 90% (n = 220) studies provided their context of study. It would be difficult to contextualize the interpretation of findings without a clear description of this context. For example, Kohnke (2021) aimed to investigate “Hong Kong tertiary English teachers’ attitudes and beliefs towards various modes of professional development in ICT skills to enhance their teaching” (p. 39). However, no description of English language teaching at tertiary institutions in Hong Kong was given, which means the findings are de-contextualized.

All the studies contained clear statements of the purpose of study, research questions and/or hypotheses except ten articles which were somewhat obscure in this regard (for example, Johnson &

Barr, 2021; Liu & Shirley, 2021; Van & Thı, 2021). However, it is worth noting that not all the research questions were adequately framed. For example, “To what extent does online peer-feedback training in a MOOC positively influence students’ perception of peer-feedback and peer-feedback training?” (Kasch et al., 2021). The use of the word “positively” implies that peer feedback is good for learning. This is a popular assumption. Nevertheless, it does not tell the whole story. There is good peer feedback and poor peer feedback. Poor peer feedback, if wrongly regarded as useful and blindly adopted, may do more harm than good to learning. Also, training of peer feedback skills is not the only factor affecting the quality of feedback. The quality of feedback is, perhaps to a greater extent, correlated with reviewers’ level of subject knowledge concerned.

The purpose of a study determines its participants and source(s) of data. For example, of the four research questions raised by Lindecker and Cramer (2021, p. 146), two of them would require involving student participants: “What is the prevalence of student self-disclosure to faculty members?” and “Do students self-disclose equally to both male and female faculty members?” This is because no one else is in a better position to answer these questions. Other people can at best do guesswork. Unfortunately, only faculty members were surveyed in this study. It is the same case with Mac Domhnaill et al. (2021). Zhu and Chikwa (2021), a study of China-Africa cooperation in open and distance higher education, is another example. There was a research question about open and distance learning development in Chinese higher education institutions but no research question aimed to investigate this development in Africa. Furthermore, the study “employed a combination of qualitative interviews and critical literature review” (Zhu & Chikwa, 2021, p. 8). However, there is no telling what documents were reviewed and why only Chinese educators were interviewed in this study.

Research approach and design

Of the 238 studies reviewed, 106 are quantitative (44.5%), 55 qualitative (23.1%) and 77 mixed (32.4%) in terms of research approach. As regards research design, only 8 (3.4%) are experimental with the majority (n = 6) being quasi-experimental, and 96.6% (n = 230) are non-experimental (see Table 4).

Table 4: Research design (n = 238).

Category	Subcategory/type of design		number
Experimental (n = 8; 3.4%)	True experiment		2
	Quasi-experiment		6
Non-experimental (n = 230; 96.6%)	Survey design		53
	Correlational design		45
	Mixed-methods (n=61; 26.5%)	Convergent parallel	22
		Exploratory sequential	22
		Explanatory sequential	8
		Embedded	6
		Multiphase	3
	Ethnographic design (including case study and netnographic design)		34
	Content/thematic analysis design		18
	Grounded theory design		4
	Narrative research design		4
	Design-based research design		4
	Phenomenological research design		3
	Action research design		3
	Self-study design		1

Of the 230 non-experimental studies, slightly over one quarter (n = 61; 26.5%, or 25.6% in relation to the entire sample) can be categorized as mixed-methods design. The second most dominant design is survey research (n = 53; 23%, or 22.3% in relation to the entire sample), followed by correlational design (n = 45; 19.6%, or 18.9% in relation to the entire sample) and ethnographic design (including case study and netnographic design) (n = 34; 14.8%, or 14.3% in relation to the entire sample) and content/thematic analysis (n = 18; 7.8%, or 7.6% in relation to the entire sample). These five groups represent 88.7% (n

= 211) of all the studies reviewed. The remaining 10% can be classified into a miscellaneous group, including research designs such as grounded theory, narrative research, design-based research, phenomenological research, action research, and self-study research.

For those studies which involved an intervention/treatment or were length-sensitive, the duration ranged from as long as six years and four months (Bose, 2021) to about one hour (Arnò et al., 2021; Juarez & Critchfield, 2021) and even as short as 480 seconds (Stadler et al., 2021). However, 10 studies did not specify the duration explicitly although it directly impacted the effectiveness of an intervention or the reliability of survey results. For example, "An online survey was conducted at the end of the semester… The questionnaire … was distributed to students via the student information system, and data were surveyed from April 20 to May 10, 2020" (Zheng et al., 2021, p. 43). The length of a semester differs considerably in different contexts. By the way, given that this study was conducted in China, 'the end of the semester' should be towards the end of June at the earliest. Similarly, some studies used the concept of course to indicate duration (for example, Heflin & Macaluso 2021), which may also be puzzling because the duration of a course varies a great deal across different countries or educational institutions, and even within an institution.

Sampling strategy

It is noteworthy that 62.6% (n = 149) did not explain what sample strategy was used to recruit participants, instead saying, for example, "a total of 97 students (48 face-to-face and 49 online students) submitted a Web-based survey at the end of the semesters…" (Lee & Nuatomue, 2021, p. 5) and "approximately 300 of them responded to the survey…" (Khan et al., 2021, p. 87). As for the 37.4 % (n = 89) that specifically named the sampling strategies used, only 18% (n = 16) were probabilistic and 80.9% (n = 72) non-probabilistic with one using a mixture of probabilistic and non-probabilistic sampling (Lee et al., 2021) (Table 5).

Table 5: sampling strategies used (n = 89).

Probabilistic Sampling	**Number**	**Non-Probabilistic**	**Number**	**A mixture of probabilistic and non-probabilistic sampling**	**Number**
stratified random sampling	5	purposive sampling & snowball	3	Stratified random sampling and snowball	1
random sampling	7	purposive sampling	34		
cluster random sampling	3	convenience sampling	26		
probability-based sampling	1	convenience and purposive sampling	2		
		convenience and snowball	3		
		snowballing	4		
Total	**16**	**Total**	**72**	**Total**	**1**

Data collection

Sources of data were many and varied (n = 339). Note that the number of sources is more than the number of studies because many studies collected data from more than one source. However, it is worth noting that some studies did not give the rationale for this mixture. For example, Byrne et al. (2021) used semi-structured interview and focus group to collect data but did not explain the intended role of each. It is the same case with Paredes et al. (2021) which collected data via questionnaire and interview.

Data is most frequently collected from surveys using questionnaire, scale or rubric (n = 148; 62.2%) with more than half of them closed-ended in nature. Interview (n = 73; 30.7%) is the second most frequent source of data. The other sources are far less significant (see Table 6).

Table 6: Sources of data (n = 339).

Source of data	Number
Questionnaire/scale/rubric (closed-ended)	90
Questionnaire/scale /rubric (open-ended)	14
Questionnaire/scale/rubric (closed- and open-ended)	44
Subtotal	**148**
Interview (closed- and open ended question)	1
Interview (open-ended)	73
Subtotal	**74**
Test score/course grade	26
Log statistics	15
Observation	12
Discussion forum post	11
Document review	11
Focus group	8
Reflection	8
Course artefact/e-portfolio	6
Course /activity evaluation	4
Tweet	3
Learning journal	3
Semi-structured discussion	2
Debrief	2
Meeting notes	2
Email/phone call	1
Vignettes	1
Administrative data	1
Logbook	1

Questionnaire/scale/rubric and interview protocol were the two most frequently-used instruments, with a total number of 280 because many studies employed more than one instrument to collect data. 225 of them (80.4%) were either newly developed or adapted from existing ones by the researcher(s), and only roughly 20% (n = 55) used existing instruments to collect data. Furthermore, only 13.9% (n = 39) instruments were both reviewed and piloted and 14.3% (n = 40) were either reviewed or piloted, before they were put to use in the current study. In other words, over 70% (n = 201) were neither reviewed nor piloted. Furthermore, less than half of the instruments (n = 124; 44.3%) were available in entirety (see Table 7). Some studies provided little useful information about the content of the instrument used. For example, “The tool includes 5 Likert type questions, 8 closed-ended questions - three of which are yes-no questions- and 2 open-ended questions” (Karadag et al., 2021, p. 182). It is also worth mentioning that only the data of the 5 Likert type questions and three yes-no questions were reported in this study. Van and Thı (2021) claimed to be a mixed-approach study, but the only instrument we know was a 41-item-Likert-scale questionnaire. No information about the qualitative part was available.

Table 7: questionnaire/scale/rubric and interview protocol (n = 280).

Instrument	Number
Newly-developed or adapted (reviewed and piloted)	37
Newly-developed or adapted (reviewed)	27
Newly-developed or adapted (piloted)	9
Newly-developed or adapted (neither reviewed nor piloted)	152
Content availability in entirety	114
Existing (reviewed and piloted)	2
Existing (reviewed)	1
Existing (piloted)	3
Existing (neither reviewed nor piloted)	49
Content availability in entirety	10

Availability of specific items/protocols is essential to judging the appropriateness of the instruments used. For example, Bai and Gu (2021) used the Community of Inquiry Scale (Arbaugh et al., 2008) to survey a blended course. However, some items of the scale may not be fit for a blended context, for example, “Getting to know other course participants gave me a sense of belonging in the course” and “I

was able to form distinct impressions of some course participants". In Wong and Ghavifekr (2021), " 'Ethnic Relations' and 'Islamic Civilization and Asian Civilization' are two MOOCs taught as university general courses at a Malaysian public university, and all undergraduate students at all public universities are required to take them" (p. 58). In other words, students had no choice but to accept them. Given this reality, the following survey items may not be appropriate: "I study MOOC because I want to learn about new subject", "I study MOOC because I am curious about MOOC", "I study MOOC because I want to increase my knowledge on something that I have learned before", and "I study MOOC because of my personal challenge" (Wong & Ghavifekr, 2021, p. 59).

Nearly 80% (n = 189) of the studies collected data once at a single point of time, hence cross-sectional in nature, and a quarter (n=59) did not explain the when, where and how of data collection. For example, students and teachers were interviewed in Wang et al. (2021). However, it is not known how the interview was conducted, how the interview data was collected and processed, and what method was used to analyze the data collected.

Data analysis

Roughly 80% (n = 189) of the studies explained explicitly how data was analysed, but 16.8% were not very clear in this regard. For example, accounts are unhelpful such as "Thematic analysis was employed to identify, analyse and report the key patterns in both secondary data and interviews in order to address the research questions" (Zhu & Chikwa, 2021, p. 9) and "SPSS was used for the statistical analysis, while the qualitative technique involved identifying codes, themes and sub-themes from the qualitative data" (Aluko, 2021, p. 24). Furthermore, there are 9 studies (3.8%) that did not mention data analysis at all.

Researcher bias and ethical concern

Finally, over 90% (n = 218) did not explain how to reduce or avoid researcher bias and about a half (n=116) did not address potential ethical concerns. Explanation may also be desirable even if a study causes no ethical issues. Dixon et al. (2021) is a good example which clearly stated that their study

> did not require IRB approval because it gathered data that was publicly available, did not require the researchers to observe, interact, or intervene with individuals to gather the data, nor did any of its analysis, results, or conclusions utilize any personal identification data. (Dixon et al., 2021, p. 255)

Another case in point is Azıonya and Nhedzı (2021) who exempted themselves from ethical review and approval by stating clearly that "no ethical approval was required as all data (tweets) were retrieved from the public domain and would not constitute an ethical dilemma in internet research" (p. 168).

Limitation

30.7% (n = 73) studies did not acknowledge existence of limitations and their possible influence on research findings. For those with limitations stated, there are occasional cases when the limitations were not adequately identified. For example,

> The research subjects of this study were students from a university located in an economically developed area in South China, considering differences in economic conditions, information technology literacy, academic performance, and the influence of China's unique cultural and educational system, this study may have limitations in the representativeness of the samples and some deficiencies in the adaptability of the conclusions. (Zhao et al., 2021, p. 94)

Students from a university in Guangdong do not necessarily come from Guangdong. This limitation is misguiding. Students' residential locations as well as family socio-economic conditions should have been included in the survey. Another case in point is Mac Domhnaill et al. (2021). To answer the research question "Is student access to high-speed broadband and to ICT devices at home associated with the impact of the shift to distance learning on student engagement?", the researchers surveyed "school principals and deputy principals, rather than teachers or students" (Mac Domhnaill et al., 2021, p. 479). Although it was acknowledged as a limitation and a case was made for this sampling, this is more than a limitation.

Discussion

"Scientific inquiry, conducted with rigorous attention to correct procedures, is the key to success of this field" (Simonson et al., 2011, p. 125). Unless rigorously designed, an empirical study may not be able to bear useful and trustworthy fruit (Azevedo et al., 2011). Findings from this study may reveal, to some extent, the rigorousness and trustworthiness of empirical research in the field of DE.

Descriptions of the context of study are essential because education is situated and contextual factors are key to interpreting research findings (Bem, 2004). Overall, this is not a serious problem in our samples with only about 10% less desirable in this regard. Similarly, clear statements of the purpose, research questions or hypotheses of an empirical study are necessary in that they "provide critical information to readers about the direction of a research study…also raise questions that the research will answer through the data collection process" (Creswell, 2012, p. 109). As such, they also define the most appropriate participants, source of data, and method of data analysis for the study. Given this importance, they should be carefully framed to avoid implying researcher bias or misleading assumption, as is the case with Kasch et al. (2021). Our samples are praiseworthy except for a few unclear accounts (e.g. Johnson & Barr, 2021; Liu & Shirley, 2021; Van & Thı, 2021) and occasional mismatches between purpose and participants or sources of data (e.g. Lindecker & Cramer, 2021; Mac Domhnaill et al., 2021; Zhu & Chikwa, 2021). Another aspect relatively well handled in our samples is duration. For studies which are sensitive to the length of a treatment/intervention or a phenomenon, the duration should be explicitly stated because it may affect the interpretation of findings (Cohen et al., 2007; Creswell, 2012). Only 10 studies were less desirable in this regard.

Research approach and type of design determine how data should be collected, analysed, and interpreted as well as how the study should be implemented. The most popular approach adopted by our samples is quantitative (44.5%), followed by mixed (32.4%) and qualitative (23.1%). This finding is somewhat different from previous studies. In Zawacki-Richter et al. (2009) which reviewed publications in five DE journals (2000-2008), the order was quantitative (47%), qualitative (32.1%) and mixed (20.9%), not including conceptual/theoretical research articles. In Bozkurt et al. (2015) which covered publications from seven DE journals (2009-2013), it was the qualitative approach which came first (47%), followed by quantitative (37%) and mixed (16%), including conceptual/theoretical research articles. These differences may be partly due to the differences in the sample inclusion criteria. Both previous studies did not distinguish primary from secondary data and included meta-analyses while our study focused on empirical research with primary data. One thing is certain, though, that there was a significant increase in the use of the mixed approach. This can be seen as a positive response to the *cri de coeur* by Garrison and Shale (1994) because this approach integrates advantages and overcome disadvantages of both quantitative and qualitative methods. However, the drop in qualitative approach merits our concern because this approach may generate richer and deeper data (Minnes, 1985; Saba 2000).

In terms of design, experimental research has always been less favoured, for example, constituting 6% in Berge and Mrozowski (2001), 2.5% in Bond et al. (2021), 11% in Bozkurt et al. (2015), and 12% in

Lee et al. (2004). Our study is no exception with only 3.4% (quasi-)experimental design. The scarcity may be due to the characteristics of education. Unlike many other disciplines, it may be difficult to conduct educational experiments, if not impossible. However, there are other options that can compensate for this shortage (Reeves & Lin, 2020). Unfortunately, our findings show that designs such as action research, designed-based research, narrative research, grounded theory research, phenomenological research were disproportionately adopted, together representing only 8.3% (n=19), and so was ethnographic design (n=34; 14.8%). These two proportions were slightly higher in Bozkurt et al. (2015). Survey research (n = 53) and correlational design (n = 45) accounted for 50% and 42.5% of the quantitative studies in our samples, or 42.6% of the broader non-experimental category. Unless more (quasi-)experiments are conducted, this proportion should be reduced to allow for more qualitative and mixed-methods research. After all, education is not an objectively-measured process or phenomenon. Obviously, there is a need for a balanced variety of research designs to be employed in DE research (Minnes, 1985).

Sampling is another issue of concern, with over 60% failing to account for what strategies were used to recruit sample. Who participated in the study? How were they recruited? Were they the most appropriate participants for the purpose of the study? These questions not only determine whether data are from the right sources but also "the limits that are placed on the generalizations that can be made regarding the study results" (Bulfin et al., 2013, p. 235), hence needing to be adequately addressed. Care should be taken when judging the generalizability of findings from a study, always bearing in mind not only whether it employed a sampling strategy but also what strategy was used. Do not take it for granted that research findings are universally applicable. For example, of the sampling strategies used in our study, only about 20% were probabilistic in nature, suggesting that findings from the majority of studies were less generalizable and should be applied elsewhere with caution.

Many studies collected data from more than one source. This may contribute to the reliability and validity of research findings through triangulation. Nevertheless, a case should be made for using more than one type of data, explaining the intended role of each in the study. This rationale was missing in some studies.

Questionnaire/scale/rubric (n = 148; 62.2%) and interview (n = 74; 30.7%) accounted for the data sources of over 90% sample studies, higher than 72% as found in Bozkurt et al. (2015). Compared with Bozkurt et al. (2015) and Davies et al. (2010), both of which also identified document analysis, observation, test scores, and log statistics as sources of data, a greater variety of data was utilized in our sample, albeit their insignificant share. This is definitely a positive sign and deserves promotion in future research.

Similarly, many studies employed more than one instrument to collect data. 80% of questionnaires/scales/rubrics and interview protocols, the two most frequently-used instruments, were either developed exclusively or adapted from existing ones for the current study. To ensure instrument appropriateness, it would be desirable to have it evaluated by experts and, more importantly, pilot tested before it is formally administered in a study (Cohen et al; 2007; Creswell, 2012). Reviewing and piloting are also required for "old" instruments when they are intended to be used in new contexts and/or among new participants. Our samples leave much to be desired in this regard, with over 70% of the two most frequently-used instruments neither reviewed nor piloted. Moreover, the specific content and exact wording of an instrument may also directly affect its appropriateness. As shown above, if wrong questions are asked or the wording is biased, the data collected may not be what the participants really have in mind. Furthermore, a study cannot be replicated or verified unless the instrument used is presented in its entirety. Regrettably, less than 50% of the two most frequently-used instruments were available in full, hence undermining the value of research findings. Administration of data collection is another issue that may jeopardize methodological rigor. Therefore, it is important to state clearly when, where, how, and by whom data was collected. A quarter of our samples did not provide this information.

Other issues that impact negatively on research rigorousness include the ways data is analysed, researcher bias avoided or reduced, and ethical concerns addressed (Chenail, 2010; Jack et al., 2010). Researchers' positionality may affect their neutrality throughout the research process, their relationship with the participants, and the interpretation of findings (Werth & Williams, 2021). How to ensure "pursuit of truth" and protection of participants' "rights and values potentially threatened by the research" is always an ethical concern for education researchers (Cohen et al., 2007, p. 51), which, unless properly addressed, may lead to resistance from participants and consequently data inaccuracy. Methods of data analysis were clearly explained in over 80% of our sample studies. However, researcher bias and ethical concerns were ignored in over 90% and 50% of the studies, respectively. Last but not least, about 80% of the studies were cross-sectional. This is a "long-established" weakness of educational research and should be taken seriously. For example, 92.9% studies were cross-sectional in Bond et al. (2021).

All research is flawed one way or another. Hence, limitations, that is, potential weaknesses or problems related to the design and implementation of a study, are part and parcel of any empirical study, be it quantitative, qualitative or mixed (CASP, 2006; Creswell, 2012). Proper acknowledgement of limitations may help understand research findings more accurately and even serve as directions for further research. The scenario is less optimistic with 30% of the sample studies failing to mention their limitations, a defect that should be avoided in future research.

Conclusions and Implications

Lack of methodological rigor has long plagued the field of DE (Panda, 1992; Simonson et al., 2011). Our research indicates that the situation continues to be less ideal, to different extents in different aspects, especially in terms of research approach and design, sampling, data source, and possible weaknesses such as limitations, researcher bias and ethical concerns (see Table 8 for a summary of main findings).

Table 8: Main findings.

	Percentage		
Context of study specified (n = 238)	92.4%		
Hypothesis, research question or purpose specified (n = 238)	95.8%		
Types of approach used (n = 238)	Quantitative	44.5%	
	Qualitative	23.1%	
	Mixed	32.4%	
Types of design used (n = 238)	Experimental	3.4%	
	Non-experimental	Survey design	22.3%
		Correlational design	18.9%
		Mixed-methods	25.6%
		Ethnographic design	14.3%
		Content/thematic analysis design	7.6%
		Miscellaneous	8%
	Duration required and specified	90.4%	
Sampling strategy specified (n = 238)	37.4%		
Types of sampling strategy (n = 89)	probabilistic	18%	
	non-probabilistic	80.9%	
	Mixture	1.1%	
Data collection (n = 238)	Most frequent sources of data	Questionnaire/ scale/rubric	62.2%
		Interview	30.7%
	Administration specified	75.2%	
	Cross-sectional	79.4%	
	Longitudinal	20.6%	
Data analysis (n = 238)	Clearly specified	79.4%	
	Somewhat specified	16.8%	

	Not known	3.4%
Researcher bias addressed (n = 238)	8.4%	
Ethical issue addressed (n = 238)	51.3%	
Limitation acknowledged (n = 238)	69.3%	

Findings from this study carry implications for future research. First, as a human enterprise, education is most often the result of interplay between numerous factors that can be very difficult or even impossible to be objectively identified and measured, hence a need for more qualitative and mixed-methods research to enable more insights into educational events and phenomena. Second, despite the difficulties in conducting (quasi-)experiments in education, especially in distance education, the insignificant presence of this research design needs to be significantly enhanced. So is the case with numerous other types of research design which are "out of favour" but probably a better fit for educational research, given the nature and characteristics of education mentioned above. Included in this group are action research, design-based research, narrative research, phenomenological research and grounded theory research. Third, the importance of sampling cannot be over-emphasized. Given that over 60% studies failed to explain their sampling strategies and that only about one-fifth named strategies were probabilistic, research findings should be interpreted and generalized with great caution. This situation should be changed. Similarly, future research should avoid over-relying on questionnaire/scale/rubric and interview to collect data. This may be due to the tendency to favour correlational and survey research over other types of research design. As indicated in the findings, there is a great variety of data that can be used for educational research. Fourth, no research is immune to potential weaknesses or problems, including researcher bias, ethical issues and other limitations. Future research needs to pay more attention to these issues. Finally, cross-sectional research is a one-off and isolated in nature while education is dynamic and ever-changing. Therefore, more longitudinal research is needed to generate insightful findings. Equally needed are replication, i.e. repeating a previous study to verify its findings, and extension, i.e. building on the findings of a previous study with the aim of refining, enriching and/or expanding its findings, given the situatedness of education. It is worth noting that our samples include only one replication study and 12 extension studies, although they do not fall within the aims and scope of the current study.

Findings from this study also have implications for reviewers and editors who are gatekeepers with great responsibilities for the healthy and sustainable growth of our field. All reviewers deserve respect for their altruistic contributions. However, it is hoped that reviewers accept only requests for review which are their areas of expertise and assess a study and give constructive feedback in line with the established criteria of good research. Reviewers may be regarded as the keepers of the first "gate" while editors play a decisive role in the publication of an article. Needless to say, editors have to balance the needs, wants, and demands of related parties, withstanding pressures from various sources. There is no denying that "a lot of factors contribute to the publication of an article", as admitted by an editor. Nevertheless, the principle of quality assurance should never be compromised. If the defects can be remedied, editors should insist on having them corrected by providing necessary guidance and assistance to the author(s), for example, describing the context in clearer terms or reflecting on limitations of the study. If the errors are irreversible, the only solution is to ask the author(s) to start afresh from where they went wrong, in the right way. No compromise should be allowed in this case.

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Author's Contributions (CRediT)

Yiwei Peng: Conceptualization, Investigation, Formal analysis, Writing – original draft; Junhong Xiao: Conceptualization, Methodology, Supervision, Writing – review & editing

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