PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title page. The title identifies the manuscript as a systematic review.
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract.
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Section 1. Introduction.
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Section 1. Introduction; Research Questions RQ1–RQ4.
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Section 2. Materials and Methods; Table 1. Inclusion and exclusion criteria.
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Section 2. Materials and Methods. Web of Science, Scopus, and reference checking are described; the search period covered publications from January 2012 to June 2025.
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Section 2. Materials and Methods. Search formulas for Web of Science and Scopus are reported.
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Section 2. Materials and Methods; Figure 1.

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Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Section 2. Materials and Methods; “Data extraction, methodological quality appraisal, and interrater reliability”.
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Section 2. Materials and Methods; Supplementary Table S1.
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Section 2. Materials and Methods; Supplementary Table S1.
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Section 2. Materials and Methods; Section 3.1; Supplementary Table S1. Methodological quality and potential sources of bias were appraised using MMAT.
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Not applicable. No meta-analysis or pooled effect estimates were conducted due to heterogeneity of designs, educational stages, digital tools, outcome measures, and statistical reporting. See Section 2 and Section 5.
Synthesis	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention	Section 2.

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methods		characteristics and comparing against the planned groups for each synthesis (item #5)).	Materials and Methods; Section 3. Results. Studies were synthesized descriptively and interpretatively according to the research questions and outcome categories.
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Section 2. Materials and Methods; Supplementary Table S1. Extracted data were organized using the PICOS framework and additional descriptive variables.
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Section 3. Results; Figure 1; Supplementary Table S1.
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Section 2. Materials and Methods; Section 3. Results. A descriptive and interpretative synthesis was conducted.
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Section 2. Materials and Methods; Section 5. Limitations. Heterogeneity prevented meta-analysis and was considered in the interpretation of findings.
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable. No

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			sensitivity analyses were conducted because no meta-analysis or pooled quantitative synthesis was performed.
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Not applicable. Formal reporting bias or publication bias assessment was not conducted because of the heterogeneity of study designs and the descriptive nature of the synthesis. Limitations related to database coverage and grey literature are discussed in Section 5.
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Section 2. Materials and Methods; Section 3.1; Supplementary Table S1. No formal GRADE certainty assessment was conducted; methodological quality and potential sources of bias were appraised using MMAT.
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Section 2. Materials and Methods; Figure 1.
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Not applicable. No excluded study

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			requiring individual citation was identified. Excluded reports are summarized by exclusion criteria in Section 2. Materials and Methods and Figure 1.
Study characteristics	17	Cite each included study and present its characteristics.	Section 3. Results; Supplementary Table S1.
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Section 3.1. General description of the studies; Supplementary Table S1. Methodological quality and potential sources of bias are reported for each included study.
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Section 3. Results; Supplementary Table S1. Individual study findings are summarized narratively in the Results section and in structured form in Supplementary Table S1. No pooled effect estimates were calculated.
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Section 3.1. General description of the studies; Sections 3.2–3.5; Supplementary

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			Table S1. Study characteristics and MMAT-based methodological limitations are summarized across the descriptive syntheses.
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Not applicable. No statistical synthesis or meta-analysis was conducted. Results were synthesized descriptively and interpretatively in Sections 3.2–3.5.
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Section 3.3; Section 3.4; Section 5. Limitations. Possible sources of heterogeneity, including study design, educational stage, digital tools, outcome measures, implementation quality, and statistical reporting, were considered narratively. No subgroup analysis or meta-regression was conducted.
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable. No sensitivity analyses were conducted because no meta-analysis or pooled quantitative synthesis was performed.

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Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable. Formal reporting bias or publication bias assessment was not conducted because of the heterogeneity of study designs and the descriptive nature of the synthesis. Related limitations are discussed in Section 5. Limitations.
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Section 3.1. General description of the studies; Section 5. Limitations; Supplementary Table S1. No formal GRADE certainty assessment was conducted; confidence in the evidence was interpreted considering MMAT-based methodological appraisal, potential sources of bias, and study heterogeneity.
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Section 4. Discussion.
	23b	Discuss any limitations of the evidence included in the review.	Section 3.1. General description of the studies; Section 5. Limitations.
	23c	Discuss any limitations of the review processes used.	Section 5.

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			Limitations.
	23d	Discuss implications of the results for practice, policy, and future research.	Section 6. Recommendations; Section 7. Conclusions.
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Section 2. Materials and Methods. The review was not registered.
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Section 2. Materials and Methods. No separate review protocol was prepared or published.
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Not applicable. The review was not registered, and no separate review protocol was prepared or published.
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Funding section.
Competing interests	26	Declare any competing interests of review authors.	Conflicts of Interest section.
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Data Availability Statement; Supplementary Table S1; Supplementary File S2. Extracted data are available in Supplementary Table S1. No analytic code was generated.

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