

# INPLASY PROTOCOL

To cite: Robledo et al.  
Characteristics and  
psychometric properties of  
computational thinking  
assessments in children and  
adolescents: A systematic  
review. Inplasy protocol  
202340069. doi:  
10.37766/inplasy2023.4.0069

Received: 20 April 2023

Published: 20 April 2023

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**Support:** None.

**Review Stage at time of this  
submission:** Data extraction.

**Conflicts of interest:**  
None declared.

## Characteristics and psychometric properties of computational thinking assessments in children and adolescents: A systematic review

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**Review question / Objective:** This systematic review had the objectives of: 1) collecting the measurement instruments that evaluate computational thinking in children and adolescents; 2) examining the psychometric properties and characteristics of these instruments.

**Eligibility criteria:** Inclusion criteria: Articles discussing results of empirical studies in which CT was evaluated; articles with results of validation studies presenting and testing new TC assessment tools; K-12 Education Student Sample. Exclusion criteria: Abstracts or proceedings are excluded, review articles or theoretical articles are excluded; articles reporting research in which CT assessment is performed by instruments that measure self-efficacy, attitudes or other constructs; articles reporting research in which CT assessment is performed by instruments that assess teachers' rather than children's knowledge or skills

**INPLASY registration number:** This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 20 April 2023 and was last updated on 20 April 2023 (registration number INPLASY202340069).

### INTRODUCTION

**Review question / Objective:** This systematic review had the objectives of: 1) collecting the measurement instruments that evaluate computational thinking in children and adolescents; 2) examining the psychometric properties and characteristics of these instruments.

**Rationale:** Computational thinking means solving problems using computing principles so that a computer agent can execute the solution. Computational thinking involves different cognitive abilities such as abstraction, decomposition, algorithmic thinking, debugging, and generalization (Shute et al., 2017), through which the subject analyzes

the problem, divides it into smaller parts, formulates a sequence of steps or algorithm, evaluates and corrects the execution, and finally manages to generalize the solution to other contexts. In the last decade, computational thinking has been positioned as a fundamental skill for the 21st century, sparking a growing interest in teaching computational thinking in K-12 curricula. This initiative has also resulted in the creation of various instruments that evaluate computational thinking, sometimes even equating computational thinking with programming or digital skills. However, there is no consensus among the authors on the constructs to be assessed, and many instruments lack adequate psychometric validation. For this reason, we aim to conduct a systematic review that collects the computational thinking evaluation instruments designed to date, extracting their characteristics, psychometric properties, and the theoretical constructs on which they are based.

**Condition being studied:** Computational Thinking Assessment Instruments.

## METHODS

**Search strategy:** The primary sources used were electronic databases and publishing platforms (Science Direct, Springer, Taylor, Sage, IEEE). The descriptors used were Computational thinking, coding learning, Assessment, Measurement, and Test. All descriptors and conceptual terms were combined using the Boolean operators "AND" and "OR." The string of words selected was: ["Computational thinking" OR "coding learning") AND (Assessment OR Measurement OR Test)], although this had some variations depending on the characteristics of the search engine.

The chain was executed in June 2022 in the different databases, resulting in 1696 articles. To include all relevant research, the references of the included studies were also reviewed, and seven more articles were added for a total of 1703 articles. The total result of the search records in each database was transferred to the Mendeley web application, and all duplicates were

eliminated. The study selection process was based on screening the titles and abstracts of all the articles retrieved by reviewer 1. The first list of selected articles was passed to a second reviewer who confirmed whether the titles and abstracts met the eligibility criteria. Afterward, two of the reviewers carried out an exhaustive reading of each article; from this reading, the articles that confirmed the inclusion criteria related to the research question were filtered. A group of five reviewers reviewed the second list of articles in plenary. In case of disagreement, the researchers can request external arbitration.

**Participant or population:** Preschool, primary school, and high school children.

**Intervention:** No intervention is performed. The systematic review focuses on the assessment of CT.

**Comparator:** None.

**Study designs to be included:** Psychometric validation studies and empirical studies.

**Eligibility criteria:** Inclusion criteria: Articles discussing results of empirical studies in which CT was evaluated; articles with results of validation studies presenting and testing new TC assessment tools; K-12 Education Student Sample. Exclusion criteria: Abstracts or proceedings are excluded, review articles or theoretical articles are excluded; articles reporting research in which CT assessment is performed by instruments that measure self-efficacy, attitudes or other constructs; articles reporting research in which CT assessment is performed by instruments that assess teachers' rather than children's knowledge or skills.

**Information sources:** The electronic databases and editorial platforms selected were: Science Direct, Springer, Taylor, Sage, and IEEE.

**Main outcome(s):** The validity, reliability, components of computational thinking

evaluated, characteristics of the tests, and population in which the instrument has been validated.

**Additional outcome(s):** None.

**Data management:** A documentary matrix was built, and the following data were extracted: author, title, year of publication, the country where the study was conducted, description of the sample (size, age, level of education), study objectives, characteristics of the instrument (Type of measures, Type of items, Device or platform, Type of Instruments, time), evaluated computational thinking component, validity measure (type of validity, Fleiss' kappa or Gwet's Coefficient of agreement, correlation coefficient, Exploratory, and confirmatory factor analysis) and reliability measures (Kuder-Richardson coefficient, Cronbach's alpha coefficient, intraclass correlation coefficient ICC, Inter-rater reliability, coefficient of variation), type of analysis performed and stated conclusions.

**Quality assessment / Risk of bias analysis:** None.

**Strategy of data synthesis:** None. This is a systematic review.

**Subgroup analysis:** None.

**Sensitivity analysis:** None.

**Language restriction:** English, Italian, Spanish.

**Country(ies) involved:** Italy and Colombia.

**Keywords:** Computational Thinking, Code Learning, Assessment, Measurement.

**Dissemination plans:** An article with the research results is expected to be published in a high-impact journal.

**Contributions of each author:**

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