

College of Teacher Education

CEBU NORMAL UNIVERSITY

Osmeña Blvd., Cebu City, Cebu, Philippines 6000



Socio-Scientific Issues in Focus:

A Meta-analytical Review of Strategies and Outcomes in Climate Change Science Education

**MARCHEE
PICARDAL**

**JOJE MAR
SANCHEZ**

**SUNNY
FERNANDEZ**

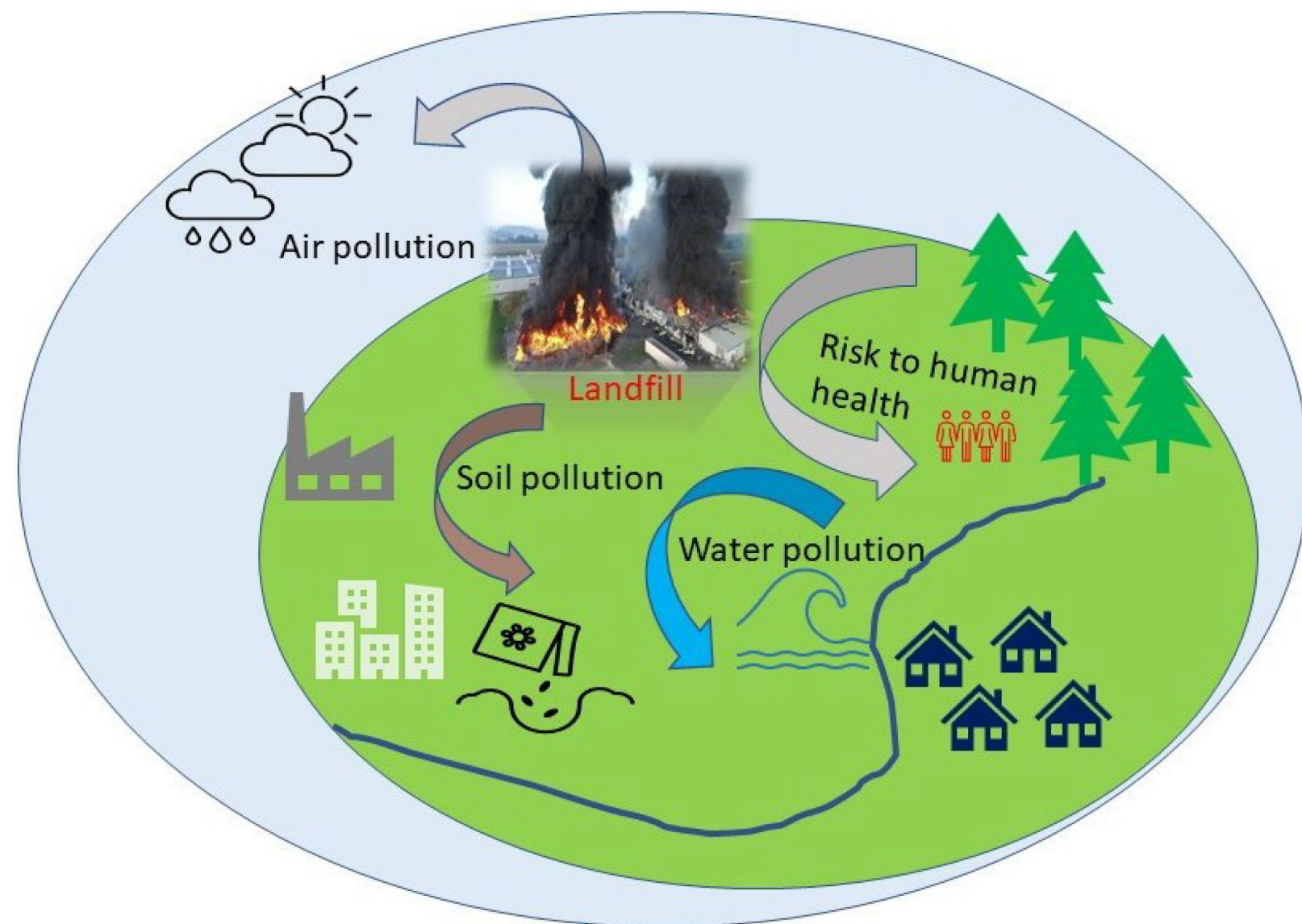
**REGINALD
RAYMUND
CATURZA**

Climate change education requires an interdisciplinary educational framework that develops **scientific knowledge** and **civic skills** (Ho and Seow, 2017).



Values, belief systems, and norms shape an individual's behaviors. In addition, the culture and tradition of people in society strongly influence their actions (Ajzen, 1991).

Many K–12 teachers may not have the necessary instructional resources to teach such integrated knowledge successfully, let alone the appropriate array of teaching strategies and techniques that can be utilized by teachers in teaching climate change using SSI-based approach.



Socio-Scientific Issues (SSIs) in teaching have a more contextualized approach, as they link learners to relevant issues that affect their daily lives and the environment. It also calls on their role as citizens and inhabitants of this planet (Hofstein et al., 2011).

METHODOLOGY

This study aimed to examine the effectiveness of SSI- based approaches in climate change teaching.

- Systematic Literature Review Methodology
- Coding Methodology
- Systematic Search on Publications from 2017–2021
- Inclusion and Exclusion Criteria
- Research Quality Assessment
- Coding Procedure
- Analysis Procedure

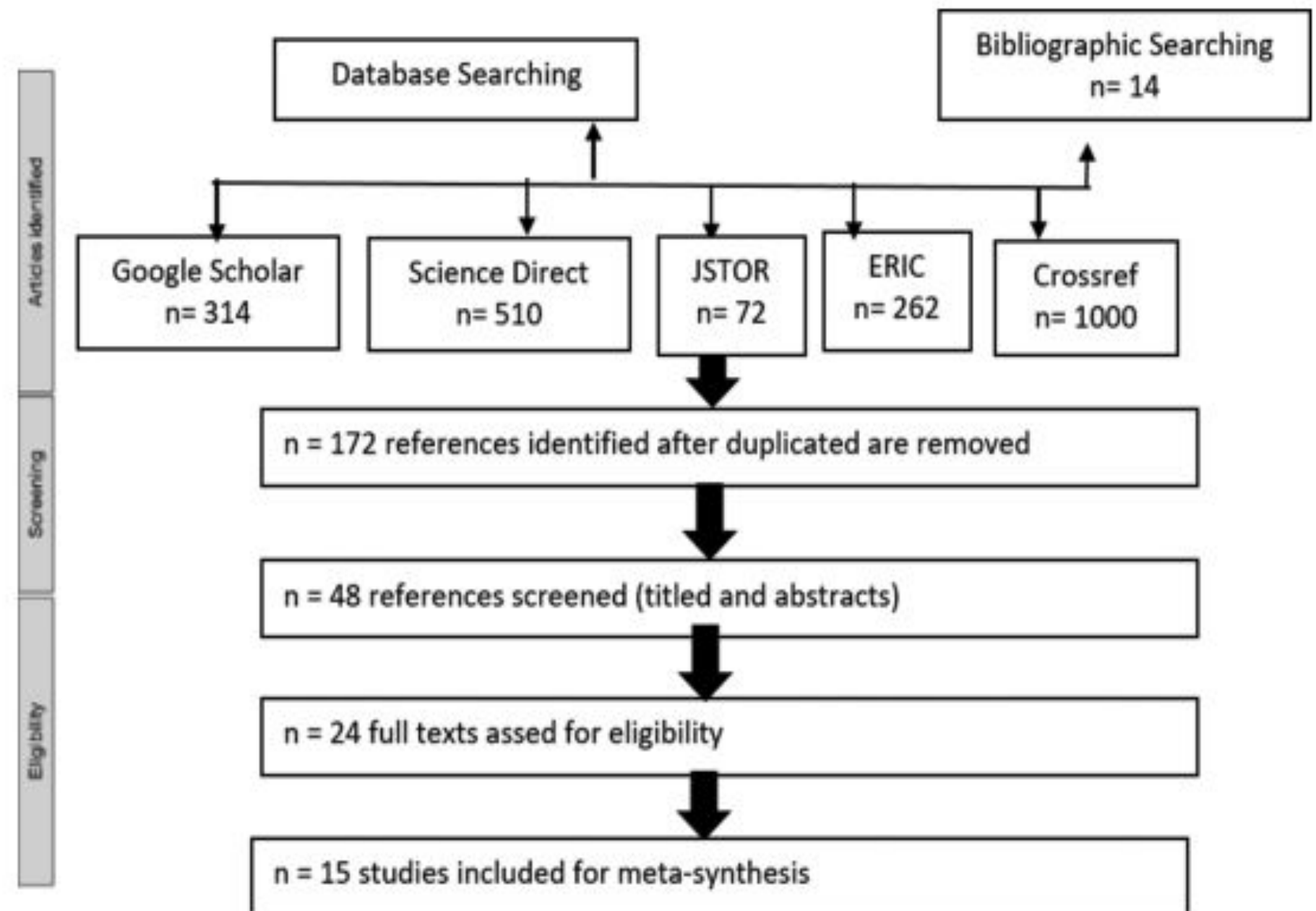


Figure 1: PRISMA table of the meta-analysis

RESULTS AND DISCUSSION

Table 1: General characteristics of studies about the SSI-based approach in climate change education

Attributes	Characteristics	Frequency	Percentage
Locale	Eurasia	10	67
	Americas	5	33
Educational Level	Junior High School	9	60
	Senior High School	2	13
	University Level	5	33
Science Domain	Biology	4	27
	Chemistry	2	13
	Environmental science	7	48
	Geography	1	6
	Agricultural Science	1	6
Total		15	

SSI: Socio-scientific issues

Table 2: Subgroup analysis of studies in SSI-based approach toward conceptual understanding								approach toward environmental attitudes				
Category	Subgroup	n	Test for Heterogeneity			Test for Effect		Test for heterogeneity			Test for effect	
			I ² (%)	Q-stat	p-value	Hedges' g	95% CI	I ² (%)	Q-stat	p-value	Hedges' g	95% CI
Year	2017	6	93.11	72.61	0.000	1.92	1.11, 2.72	99.08	108.53	0.000	5.27	-3.01, 13.55
	2018	2	0.00	0.12	0.730	0.34	0.25, 0.43	31.17	1.45	0.228	0.19	-0.29, 0.67
	2019	2	75.15	4.02	0.004	0.35	-0.34, 1.03	96.30	27.02	0.000	1.05	-0.60, 2.71
	2020	4	80.73	15.57	0.000	0.75	0.16, 1.34	74.60	7.87	0.020	0.78	0.26, 1.30
Locale	Eurasia	7	32.10	8.84	0.183	0.60	0.42, 0.78	84.89	26.48	0.000	0.89	0.23, 1.55
	America	7	94.54	109.94	0.000	1.68	0.78, 2.58	97.93	144.68	0.000	2.31	-1.82, 6.43
Design	Quasi-experimental	2	83.35	6.00	0.014	1.14	0.41, 1.87	89.98	29.93	0.000	0.41	-0.10, 0.91
	Mixed	12	92.09	139.06	0.000	1.11	0.50, 1.72	96.87	127.67	0.000	2.51	-0.62, 5.65
Educational Level	Junior HS	10	92.73	123.88	0.000	1.36	0.68, 2.05	87.63	24.24	0.000	0.57	0.01, 1.12
	Senior HS	2	0.00	0.09	0.768	0.78	0.71, 0.86	99.20	125.04	0.000	4.85	-4.29, 14.00
	Senior HS/College	2	0.00	0.12	0.728	0.34	0.25, 0.43	86.85	15.21	0.000	1.11	0.26, 1.96
Science Domain	Chemistry	2	75.29	4.05	0.044	0.54	-0.06, 1.14	99.26	135.48	0.000	4.84	-4.26, 13.95
	Environmental Science	4	70.29	10.10	0.018	0.89	0.43, 1.36	82.64	11.52	0.003	0.45	-0.28, 1.17
	General Science	2	0.00	0.12	0.728	0.34	0.25, 0.43	68.57	3.18	0.074	0.68	0.13, 1.24
	Other Science	6	94.82	96.47	0.000	1.79	0.81, 2.77	82.12	5.59	0.018	1.47	0.65, 2.28

SSI: Socio-scientific issues

Overall, Hedge's g consistently indicates the favorable impact of the SSI technique on conceptual understanding and environmental attitudes in various scenarios despite varying degrees of variability.

RESULTS AND DISCUSSION

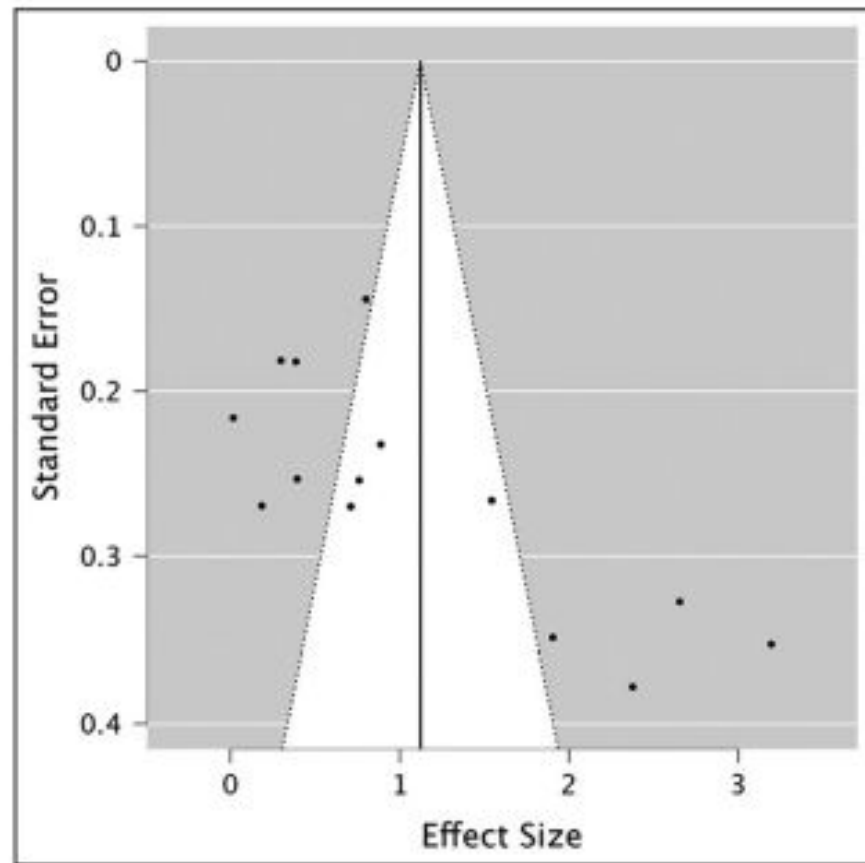


Figure 3: Funnel plot of publication bias of socio-scientific issues-based approach in terms of conceptual understanding

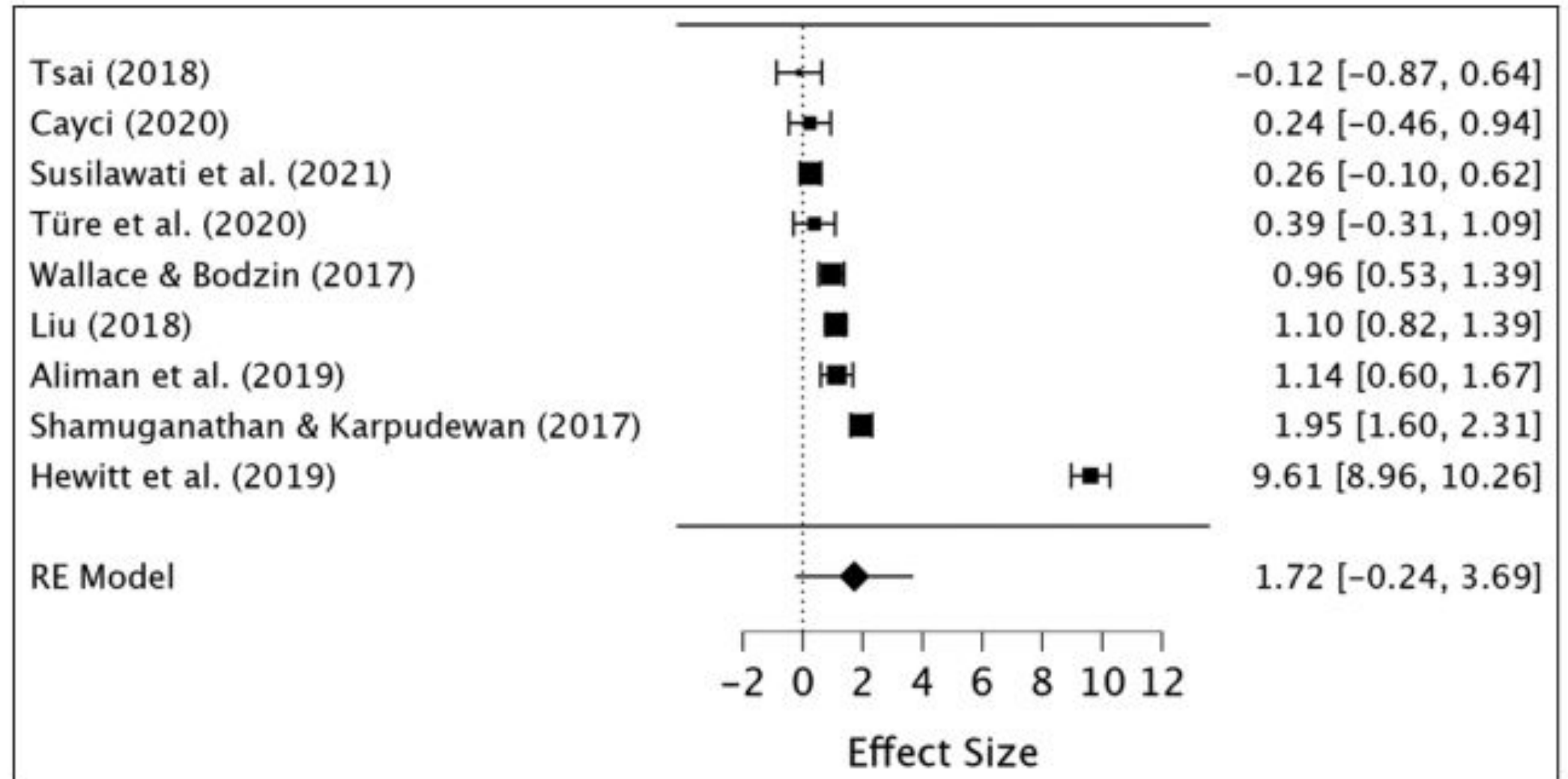


Figure 4: Effect sizes for environmental attitudes

Table 3: Results of the moderator analysis on conceptual understanding

Moderator	R ² (%)	ES	SE	T ²	95% CIs		B	Z-value	p-value
					Lower	Upper			
Year	27.79	1.11	0.17	0.56	-0.76	-0.03	-0.40	-2.37	0.018
Locale	29.70	1.10	0.41	0.51	0.16	1.92	1.04	2.55	0.011
Design	0.04	1.11	0.66	0.69	-1.36	1.47	0.05	0.08	0.935
Educ. Level	16.05	1.11	0.28	0.55	-1.13	0.10	-0.51	-1.82	0.069
Science Domain	22.49	1.11	0.20	0.62	-0.02	0.83	0.40	2.04	0.041

Table 5: Results of the moderator analysis on environmental attitudes

Moderator	R ² (%)	ES	SE	T ²	95% CIs		B	Z-value	p-value
					Lower	Upper			
Year	12.87	1.39	0.27	0.99	-1.28	-0.04	-0.66	-2.46	0.014
Locale	6.21	1.41	0.74	1.12	-0.49	2.93	1.22	1.64	0.101
Design	15.46	1.36	0.66	0.89	-3.38	-0.32	-1.84	-2.79	0.005
Education Level	22.68	1.39	0.46	1.01	-2.56	-0.43	-1.49	-3.24	0.001
Science Domain	6.09	1.42	0.36	1.18	-1.40	0.26	-0.57	-1.59	0.111

Table 7: Results of the moderator analysis on pro-environmental behavior

Moderator	R ² (%)	ES	SE	T ²	95% CIs		B	Z-value	p-value
					Lower	Upper			
Year	23.44	0.93	0.22	0.37	-0.51	0.88	0.19	0.86	0.391
Design	68.76	0.94	0.45	0.13	-2.35	0.49	-0.93	-2.08	0.038
Education Level	21.87	0.93	0.72	0.45	-2.84	1.74	-0.55	-0.77	0.444
Science Domain	21.87	0.93	0.72	0.45	-2.84	1.74	-0.55	-0.77	0.444

Table 8: Strategies for using SSI-based approach in climate change education

Strategy	Frequency	Percentage
Argumentation	4	27
Case/controversy oriented	4	27
Problem/project-based	3	20
Model-based	2	13
Mobile/online learning	2	13
Film/role-play	2	13
Curriculum-based	2	13
Integrated materials	2	13
Heuristics	1	7

SSI: Socio-scientific issues

IMPLICATIONS FOR TEACHER EDUCATION

The findings of the meta-analysis on the SSI-based approach in climate change education have important implications for teacher education.

- ✓ The approach's significant favorable influence on learners' conceptual knowledge of climate change highlights the need for teacher preparation programs to incorporate thorough instruction on SSI-based strategies.
- ✓ The subgroup analysis reveals notable variations in the effectiveness of SSI-based strategies according to **science domains, educational attainment, and geographic locations**. For example, specific geographic areas may have particular climate-related issues that can be immediately resolved with localized SSI-based strategies.
- ✓ The beneficial effects of the SSI-based approach on environmental attitudes and behaviors highlight how crucial it is to incorporate these strategies into teacher preparation to foster positive environmental attitudes and motivate learners to act in ways that are beneficial to the environment.
- ✓ In climate change education, teacher education programs should incorporate SSIs to improve learners' conceptual understanding, environmental attitudes, and pro-environmental behaviors.

THANK YOU!