Appendix – Supplementary Material

The appendix contains supplementary tables referenced in the main text.

Contents:

Table S1. The comparison of different frameworks of learning outcomes in environmental education

Table S1. The comparison of different frameworks of learning outcomes in environmental education

AMFs as extended EE outcomes [22,26,27]			EE21 [23]	Positive youth development Assets [19]	EE and K-12 student outcomes [24]	Advancing Environmental Education Practice [25]
Environmental learning	**Environmental awareness**	The environment	**Environmental Attitudes**: Sensitivity towards the environment		Environmental awareness, Environmental sensitivity	
		Environmental problems			Environmental issue awareness	
		Environmental protection			Awareness of global connections, Awareness of social activism	
		Environmental exploration				
	Environmental knowledge	The environment	**Learning**: Knowledge regarding the interconnectedness and interdependence between human and environmental systems	**Intellectual development**: Content knowledge (e.g., energy efficiency, plant science, earth science, butterfly metamorphosis)	Environmental knowledge, Ecological knowledge, Chemistry knowledge, Conceptualizations of the environment, Geography content, Science content, Academic achievement, Action competence, Mental models	Knowledge, System knowledge
		Environmental problems			Knowledge of environmental issues, Knowledge of health effects of inhalants, Knowledge of health effects of pollution, Risk knowledge, Academic achievement, Action competence	Knowledge, System knowledge
		Environmental protection			Perceived knowledge of action, Career knowledge, Academic achievement, Action competence	
		Environmental exploration			Perceived knowledge of action, Career knowledge, Understanding of science methods, Academic achievement, Action competence	
	Environmental skills	Environmental protection	**21st Century Skills**: Critical thinking and problem solving	**Physical development**: Healthy habits (e.g., nutrition, fitness); health risk management (e.g., protecting self 'from the wrong') **Intellectual development**: knowledge of vocational skills (e.g., video production, conducting scientific experiments, public speaking)	Knowledge for action, Knowledge of citizen action skills, Knowledge of environmental actions, Knowledge of environmental action skills, Skill knowledge, Environmental problem solving, Monitoring environmental problems, Decision-making skills, Critical thinking, Perceived skill in use of action skills, Problem-solving, Systems thinking, Action planning, Analytical skills, Career planning, Computer skills, Cyclic thinking, Higher-order thinking skills, Internet skills, Issue analysis, Issue evaluation, Issue identification, Metacognitive skills, Reading skills, Self-directed learning, Technology skills, Writing skills, Academic achievement, Action competence	Thinking, Action-related knowledge, Effectiveness knowledge
		Environmental exploration	**21st Century Skills**: Critical thinking and problem solving	**Intellectual development**: knowledge of vocational skills (e.g., video production, conducting scientific experiments, public speaking)	Knowledge for action, Knowledge of citizen action skills, Knowledge of environmental actions, Knowledge of environmental action skills, Skill knowledge, Fishing skills, Gardening skills, Geography skills, Land subsistence skills, Outdoor skills, Research skills, Safety skills, Science process skills, Decision-making skills,	Thinking, Action-related knowledge, Effectiveness knowledge

				Critical thinking, Perceived skill in use of action skills, Problem-solving, Systems thinking, Action planning, Analytical skills, Career planning, Computer skills, Cyclic thinking, Higher-order thinking skills, Internet skills, Issue analysis, Issue evaluation, Issue identification, Metacognitive skills, Reading skills, Self-directed learning, Technology skills, Writing skills, Academic achievement, Action competence	
Environmental attitudes	The environment	**Place connection**: The development of appreciation for and positive personal relationships with the physical location and its story **Environmental Attitudes**: concern, and positive dispositions towards the environment		Environmental perceptions, Environmental attitudes, Environmental concern, Preservation values, Task value, Utilization values, Value of nature, Connectedness with nature, Sense of place, Connection to land, Environmental identity, Relationship to environment, Attitudes toward school, Attitudes toward computers, Attitudes toward the Internet, Attitudes toward traditional teaching, Reinforcing factors, Academic achievement, Action competence	Values, Beliefs, and Attitudes, Nature Connectedness, Sense of Place, Identity, Personal Norms
	Environmental problems			Attitudes toward inhalants, Priorities for resource management, Risk attitudes, Reinforcing factors, Academic achievement, Action competence	
	Environmental protection		**Intellectual development**: job preparation, value of hard work	Civic responsibility, Environmental responsibility, Personal responsibility to manage risks, Sense of environmental stewardship, Reinforcing factors, Academic achievement, Action competence	
	Environmental exploration	**Interest in Learning**: Enhanced curiosity, increased interest in learning about science and the environment	**Intellectual development**: job preparation, value of hard work	Interest in science, Science attitudes, Attitudes toward experiential learning, Interest in chemistry, Interest in environmental issue under study, Interest in fishing, Interest in gardening, Interest in geography, Interest in learning and discovery, Interest in natural world, Reinforcing factors, Academic achievement, Action competence	
Environmental behaviors	Environmental protection	**Actions: Environmental Stewardship**: Motivations to perform stewardship related behaviors **Actions: Cooperation/Collaboration**: Motivation to collaborate more with others **Actions: School**: Motivation to work harder in school	**Physical development**: Healthy habits (e.g., nutrition, fitness); health risk management (e.g., protecting self 'from the wrong') **Social development**: commitment to civic engagement	Environmental behavioral intentions, Personal commitment to aquatic environments, Environmental behavior, Water conservation, Battery recycling, Energy savings and carbon emissions reduction, Academic achievement, Action competence, Environmental stewardship	Environmental Behaviors Collective Environmental Action
	Environmental exploration	**Actions: Cooperation/Collaboration**: Motivation to collaborate more with others	**Social development**: commitment to civic engagement	Environmental behavioral intentions, Personal commitment to aquatic environments, Environmental behavior, Fishing participation, Academic achievement, Action competence, Environmental stewardship	Environmental Behaviors Collective Environmental Action

			Actions: School: Motivation to work harder in school			
Social interaction	**Social skills**	Interpersonal networks				Social Capital
		Communication skills	**21st Century Skills**: communication	**Social development**: ability to navigate in multiple cultural contexts (e.g., when to 'talk street and talk correctly')	Social skills, Oral communication	
		Teamwork skills	**21st Century Skills**: collaboration **Actions: Cooperation/Collaboration**: Motivation to collaborate more with others	**Social development**: Connectedness (e.g., teamwork)	Social skills, Leadership, Group work, Participatory capacities	
	Reminiscing with other participants					Social Norms
	Sharing with nonparticipants					Social Norms
Self developme nt	**Self-efficacy**		**Self-Efficacy**: Belief in one's own ability to achieve one's goals and influence their environment	**Psychological and emotional development**: Mental health including positive self-regard (e.g., self-confidence); confidence in personal efficacy (e.g., how to enact change)	Locus of control, Environmental studies self-efficacy, Group locus of control, Self-confidence to act, Self-efficacy, Confidence in action skills, Empowerment, Perceptions of control for managing risks to the environment, Science self-efficacy	Efficacy
	Self-esteem		**Meaning/Identity**: A heightened sense of self-awareness, critical reflection, and purpose		Self-esteem	
	Traits			**Psychological and emotional development**: Mental health including positive self-regard (e.g., self-confidence, open-mindedness); emotional self-regulation (e.g., patience, persistence, paying attention); coping skills (e.g., adaptability); mastery and achievement motivation (e.g., initiative, intrinsic reward); confidence in personal efficacy (e.g., how to enact change); 'planfulness' (e.g., vision, thinking ahead); sense of personal autonomy and responsibility; optimism coupled with realism; good use of time (e.g., balancing work load)	Disposition toward critical thinking, Ecological mindset, Intrinsic motivation, Autonomy, Character development, Maturity, Poise	
	Hobbies					
	Visions					