

Transdisciplinary Water Education: A View Across Standards for Teaching and Learning to Foster Water Literacy



Authors

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Purpose of the studies

- To examine K-12 water-related standards for teaching and learning about water and natural (NS) and human systems (HS) to develop a comprehensive and transdisciplinary perspective on water education.
- Overarching question:** "What do disciplinary standards specify as outcomes for students' learning about water and humans?"
- RQ1:** "To what extent do these water-related standards address recognized domains of learning?"
- RQ2:** "What thematic outcomes for students' learning are apparent across grades in these water-related standards?"

Theoretical framework

- Water Literacy (WL)** is a **key outcome for learners of all ages**, who should understand how water interacts with both natural and human systems to participate in informed-decision-making that supports effective water management.
- Learning Domains (LD) and components:**
 - Cognitive:** Declarative: Factual or conceptual knowledge; Procedural: Knowing how to do something
 - Affective:** Social: Collaboration, negotiation, and communication; Emotional: Interests, attitudes, motivations, self-reflection, and values.
 - Behaviors:** Observable actions. Part of cognitive and affective domains.

Data sources

- 12 education-oriented governmental and non-governmental organizations based in the United States. 11 for NS & 12 for HS
- $N=477$ standards: $n=196$: NS & $n=341$ HS

RQ

Natural systems (NS)

- Standards emphasize the cognitive domain, including declarative and procedural knowledge, for water-related concepts and skills (Figure 4 & 5). The affective domain and its social component are less prevalent.

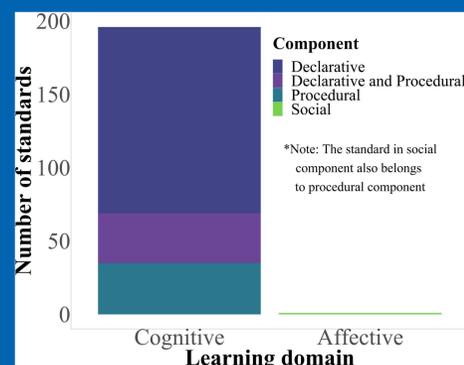


Figure 4. Learning domains - NS

Human systems (HS)

The affective domain and its social and emotional components are less prevalent.

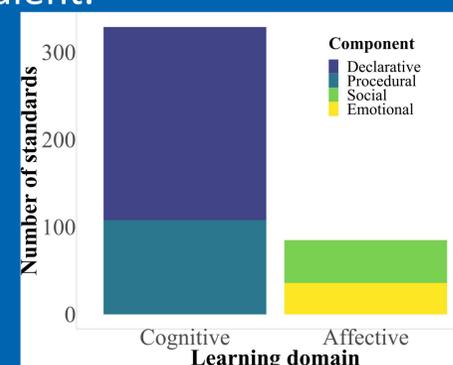


Figure 5. Learning domains - HS

Most standards are relatively equally distributed among grade bands (Figure 6 & 7).

Fewer standards for higher grade bands.

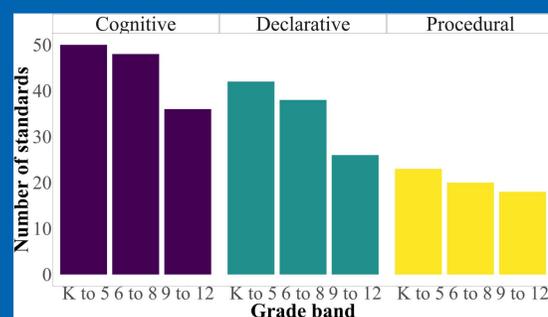


Figure 6. Representation of standards across grade bands - NS

Emotional: $K-5 < 6-8 < 9-12$ ($p < .05$)
Declarative $>$ Emotional ($p < .05$)

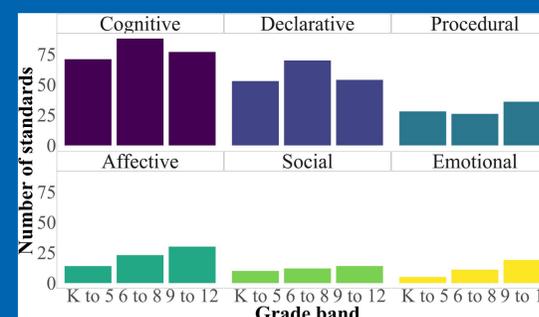


Figure 7. Representation of standards across grade bands - HS

2 Thematic outcomes:

- 1) Abundance, distribution, and movement of water on Earth;
- 2) Water and the Geosphere;
- 3) Water and climate; and
- 4) Water and life.

- 1) Human settlements;
- 2) Water, food, and energy nexus;
- 3) Public health;
- 4) Impacts of human activities on water quality and quantity; and
- 5) Water resources management

Methodology

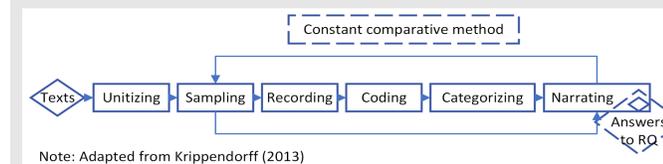


Figure 1: Components of the research process

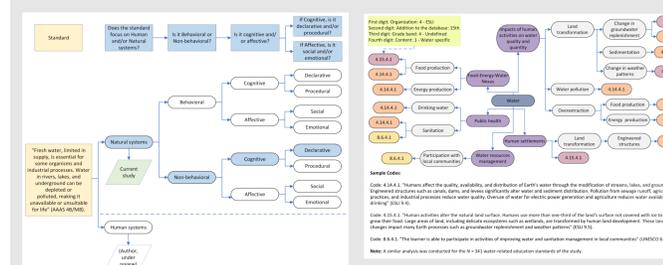


Figure 2 & 3: Learning domains (2) and thematic (3) coding processes

RQ1: Chi-square statistics & **RQ2:** Content analysis and grounded theory

Discussion

- Students need to develop understanding of the components and processes of socio-hydrologic systems to properly understand challenges and make evidence-based decisions about water resources, both locally and globally.
- The cognitive domain plays a role in helping develop the fundamentals upon which students can understand problems related with water resources.
- Water education should foreground how ethics, morals, emotions, and context play a differential and contextual role when evaluating and making decisions about SHIs.
- Water-related curriculum, instruction, and assessment must support this interdisciplinary understanding of the interactions between and within human and natural dimensions of water systems.
- Results of these studies can be used as a guide for the design and implementation of instructional practices, assessments, and materials, which can take advantage of constructivist approaches.

Resources

- References: <https://bit.ly/ReferencesWS>