SOCIOLOGICAL, HISTORICAL, PHILOSOPHICAL, AND TECHNOLOGICAL ANALYSIS OF WATER USE: AN EMPIRICAL STUDY ON AWARENESS AND SYSTEM DEVELOPMENT FOR SUSTAINABLE WATER RESOURCE MANAGEMENT

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Abstract

Water is one of the natural resources most essential to sustaining life, economic development, and environmental stability. Despite its importance, however, population growth, rapid urbanization, industrial expansion, and climate change are intensifying the challenges associated with the sustainable management of water resources. This article presents a scientific analysis based on empirical data obtained through an electronic questionnaire developed by a second-year high school class specializing in Systems Development at ETEC (Technical School of the Centro Paula Souza, São Paulo), Prof. Marinês Teodoro de Freitas Almeida School, Novo Horizonte, São Paulo, during the morning session of the 2026 academic year. Administered to forty-two participants, the questionnaire sought to understand how people in the city of Novo Horizonte, São Paulo, use water in their daily lives and their self-reported level of knowledge about this resource. The results reveal that all participants use water for domestic activities, whereas only 23.8% report using it for professional activities and 4.8% for scientific research. An average knowledge score of 3.69 on a five-point scale was also observed, indicating a moderately high level of awareness of the subject. The study interprets these results from sociological, historical, philosophical, environmental, and technological perspectives, establishing a dialogue with authors such as Émile

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Durkheim, Max Weber, Pierre Bourdieu, Hans Jonas, Edgar Morin, Enrique Leff, Ignacy Sachs, Leonardo Boff, and Paulo Freire. In addition, it discusses the growing importance of developing computer systems, intelligent software, and digital technologies for monitoring consumption, promoting environmental education, and formulating public policies aimed at the rational use of water. The study concludes that strengthening environmental awareness depends simultaneously on education, technological innovation, and collective responsibility.

Keywords: Environmental Education, Information Systems, Society, Sustainability, Technology, Water, Water Resources.

INTRODUCTION

The history of human civilization can be understood as the history of humanity's relationship with water. From the earliest organized communities along the banks of the Tigris, Euphrates, Nile, Indus, and Yellow Rivers, the development of societies has been conditioned by the availability of this natural resource. Water enabled the emergence of agriculture, cities, trade, the great maritime voyages, and, subsequently, the Industrial Revolution, becoming a structural element in the economic, political, and cultural organization of civilizations.

Contemporary society, however, is witnessing a historical paradox.

Never before has so much technology been available to manage natural resources, yet, at the same time, levels of waste, contamination, and inequality in access to drinking water have never been so high.

Disorderly urban growth, intensive industrialization, excessive consumption, and the effects of climate change are jeopardizing water security in various regions of the world.

According to the United Nations (UN), billions of people still face difficulties in accessing drinking water and basic sanitation, a situation that directly compromises public health, food security, and sustainable development.

Through Sustainable Development Goal 6, the 2030 Agenda establishes the need to ensure clean water and sanitation for all, recognizing this resource as a fundamental human right.

In the Brazilian context, although the country accounts for approximately 12% of the world's available surface freshwater, its geographical distribution is profoundly unequal.

Regions with high population concentrations frequently experience water-supply crises, while large volumes of water remain located in sparsely populated areas. This reveals that the problem is not limited to the physical availability of water but also involves planning, governance, and efficient management.

Given this situation, understanding how the population perceives water use is indispensable to the development of effective public policies.

Environmental education, combined with digital technologies, constitutes an important means of transforming individual habits into collective sustainable practices.

Within this context, the present study seeks to conduct an empirical analysis of the perceptions of forty-two participants who completed an online questionnaire concerning their use of water and their knowledge about this resource. It provides an interdisciplinary interpretation grounded in Sociology, Philosophy, History, Environmental Sciences, and Information Technology.

Beyond presenting statistical data, the study aims to understand how human behavior directly influences the sustainability of water resources and how intelligent systems can help transform this reality.

THEORETICAL FRAMEWORK

Water transcends its physicochemical condition to acquire social, political, economic, cultural, and philosophical dimensions.

Its use reveals specific forms of social organization, expressing inequalities, conflicts, cultural values, and power relations.

From a sociological perspective, Émile Durkheim understands social phenomena as possessing an existence of their own and exerting a coercive influence on individuals.

When this conception is applied to water management, it becomes evident that consumption habits are not exclusively individual choices but reflect culturally internalized collective patterns.

Everyday waste, for example, often results from socially naturalized practices transmitted across generations without critical reflection.

In developing his theory of social action, Max Weber demonstrates that individuals attribute subjective meanings to their practices.

Thus, water consumption represents not only a biological necessity but also a symbolic construction associated with comfort, status, hygiene, and economic development.

The instrumental rationality characteristic of modernity frequently prioritizes productive efficiency at the expense of environmental preservation, thereby creating tensions between economic growth and sustainability.

From Pierre Bourdieu's perspective, the concept of **habitus** explains that the dispositions internalized by individuals guide their everyday practices. The conscious use of water therefore depends on the formation of an **ecological habitus**, developed through ongoing educational processes capable of transforming individual behavior into collective responsibility.

This discussion is significantly broadened in the work of Ulrich Beck, who describes contemporary society as a **"risk society."** According to Beck, the principal challenges of the present arise not only from the natural scarcity of resources but also from the risks produced by technological and industrial development itself.

The water crisis is an emblematic example of this reflexive modernity, in which economic progress begins to generate global environmental threats.

In the field of philosophy, Hans Jonas proposes a profound reassessment of traditional ethics. In *The Imperative of Responsibility*, he argues that technological development requires a new morality oriented toward preserving future generations.

Water use thus ceases to be an exclusively economic matter and becomes a universal ethical duty. For Jonas, acting responsibly means considering the environmental impacts of our present actions on those who have yet to be born.

This reflection directly engages with Edgar Morin, whose complexity theory demonstrates that environmental problems cannot be understood through fragmented analyses.

Water simultaneously involves biological, economic, political, cultural, technological, and educational aspects, requiring interdisciplinary approaches capable of integrating different fields of knowledge.

From an educational perspective, Paulo Freire maintains that conscientization is an indispensable condition for social transformation.

Environmental education should not be restricted to the transmission of technical information; rather, it should foster critical individuals capable of understanding the relationship among consumption, citizenship, and environmental preservation. Knowledge produces transformation only when it awakens ethical awareness and collective participation.

Similarly, Enrique Leff argues that the contemporary environmental crisis fundamentally results from a crisis of knowledge.

According to Leff, traditional models of development have ignored the planet's ecological limits, making it necessary to establish an environmental rationality based on sustainability and the integration of science, culture, and nature.

Within the context of **sustainable development**, Ignacy Sachs proposes a multidimensional conception that integrates economic growth, social inclusion, environmental preservation, and intergenerational justice.

For Sachs, effective public policies depend on harmonizing productive efficiency with the conservation of natural resources.

Complementing this perspective, Leonardo Boff emphasizes that water represents the common heritage of humanity and a sacred element for numerous cultures.

Its preservation requires **an ethics of care**, grounded in solidarity, shared responsibility, and recognition of the interdependence between human beings and nature.

From a technological perspective, a new paradigm is emerging based on the use of intelligent systems to monitor water consumption. Sensors connected to the Internet of Things (IoT), environmental management software, artificial intelligence, big data, and digital platforms make it possible to identify waste, predict consumption patterns, and assist public administrators in decision-making.

This transformation demonstrates that technology is no longer merely a productive instrument but assumes a strategic role in building sustainability.

In this regard, the development of computer systems for managing water resources constitutes an important scientific and social advancement.

Tools capable of integrating consumption data, real-time monitoring, and environmental education can significantly strengthen citizen participation, enhance the efficiency of public administration, and promote a lasting culture of conscious water use.

Based on these theoretical contributions, the empirical results of this study can be interpreted not merely as statistical indicators but as expressions of the relationships among culture, knowledge, technology, and socio-environmental responsibility, thereby providing a foundation for the critical analysis developed in the following sections.

METHODOLOGY

The present research is characterized as an applied study employing both quantitative and qualitative approaches, grounded in an interdisciplinary perspective that integrates contributions from Sociology, Philosophy, History, Environmental Sciences, and Information Technology.

The investigation sought to understand participants' perceptions of water use in their everyday activities and to assess their self-reported level of knowledge about this natural resource. It also sought to relate this information to contemporary challenges involving sustainability and the intelligent management of water resources.

In terms of its objectives, this is a descriptive and exploratory study.

According to Gil (2019), descriptive research seeks to identify, record, and interpret the characteristics of a given phenomenon, whereas exploratory research provides greater familiarity with the problem under investigation, making it possible to understand aspects that have received little attention in the context studied.

In the present study, the two approaches complement each other by describing participants' behavior and interpreting its meanings in light of the scientific literature.

Data were collected using the **Google Forms platform**, an instrument widely employed in academic research because of its ease of administration and its capacity to store and automatically systematize information.

The questionnaire consisted of objective questions concerning the everyday use of water and participants' level of knowledge about this resource, including multiple-choice questions and rating scales.

A total of 42 respondents took part in the study, constituting a nonprobability convenience sample.

Although this sample does not allow for statistical generalizations to the entire Brazilian population, it provides important indicators of social perceptions related to water use, enabling qualitative interpretations grounded in established scientific frameworks.

The data were automatically organized by Google Forms, generating statistical charts that served as the basis for the analyses presented in this article.

Data analysis was performed using descriptive statistics, based on the absolute and relative frequencies provided by the Google Forms system itself.

This study, however, is not limited to the numerical presentation of the results.

The charts were interpreted from sociological, historical, philosophical, environmental, and technological perspectives, with the aim of understanding how individual behavior reflects broader cultural structures and directly influences the sustainability of water resources.

Issues related to culture, education, economics, technological development, and public policy constitute inseparable dimensions of sustainable water resource management.

Finally, the study sought to establish a relationship between the empirical results obtained and the potential of computer systems, intelligent software, the Internet of Things (IoT), Big Data, and Artificial Intelligence as instruments capable of enhancing the efficiency of water monitoring, promoting environmental education, and supporting public policies aimed at the rational use of water.

PRESENTATION AND ANALYSIS OF THE RESULTS

WATER AS A UNIVERSAL ELEMENT OF EVERYDAY LIFE

The first chart analyzed sought to identify the contexts in which participants use water in their daily activities.

The results revealed that all 42 respondents (100%) reported using water for domestic activities, while 10 participants (23.8%) stated that they also used it for professional activities. Only 2 participants (4.8%) indicated that they used water in scientific research.

The data demonstrate an apparently obvious yet sociologically significant reality: water remains strongly associated with the basic necessities of human existence.

The universality of domestic use demonstrates that this resource is indispensable to nutrition, hygiene, cleaning, food preparation, and health maintenance.

From the perspective of Émile Durkheim (2014), these results represent a genuine **"social fact."** Domestic water consumption does not arise exclusively from individual choices but constitutes a collective social practice internalized across different cultures.

From childhood onward, individuals learn patterns of hygiene, eating, and cleaning that directly depend on water use, thereby transforming this behavior into an almost universal social norm.

Max Weber (2004) would add that these actions are guided by subjective meanings. Water use transcends its biological function and comes to represent comfort, dignity, quality of life, and social well-being.

Thus, the behavior observed in this study reflects cultural values historically constructed and reproduced by social institutions.

Historically, this dependence has accompanied the entire course of human development. The earliest civilizations flourished along the banks of major rivers because they understood that access to water determined collective survival.

Egyptian, Mesopotamian, Chinese, and Indus Valley civilizations structured their economies around water availability, demonstrating that the history of humanity is inseparable from the history of water itself.

Nevertheless, the low percentage of water use in scientific activities (4.8%) is noteworthy. Although this result was expected because of the sample's profile, it reveals a gap between the population and scientific knowledge production related to water resources.

Enrique Leff (2015) argues that the contemporary environmental crisis also results from the difficulty of democratizing scientific knowledge and bringing it closer to everyday social practices.

From an environmental perspective, this result reinforces the need to expand scientific and environmental education programs capable of demonstrating that water preservation depends not only on researchers but also on the active participation of society.

LEVEL OF KNOWLEDGE ABOUT THE IMPORTANCE OF WATER

The second chart assessed participants' self-reported level of knowledge about the importance of water, using a scale ranging from one to five points.

The results presented the following distribution:

Score 1: 4.8%;

Score 2: 9.5%;

Score 3: 31%;

Score 4: 21.4%;

Score 5: 33.3%.

The overall average score was 3.69, indicating a relatively high level of awareness of the subject. These data, however, must be analyzed with caution.

Although approximately one-third of participants assigned the highest score to their own knowledge, nearly another third classified their knowledge as merely intermediate.

This demonstrates that some awareness exists regarding the importance of water, but significant gaps remain in the understanding of issues related to water management, waste, climate change, and technologies designed to monitor consumption.

Pierre Bourdieu (1983) explains that environmental knowledge constitutes a form of cultural capital. Individuals exposed to broader educational processes tend to develop greater ecological awareness and, consequently, more sustainable practices.

The results therefore suggest that education continues to be the principal mechanism for transforming habits related to water use.

Paulo Freire (1996) reinforces this interpretation by asserting that knowing does not mean merely accumulating information but developing a critical consciousness capable of transforming reality.

Simply recognizing the importance of water does not guarantee sustainable behavior. Genuine awareness is manifested when individuals change their everyday habits for the benefit of the common good.

In formulating *The Imperative of Responsibility*, Hans Jonas (2006) broadens this discussion by stating that contemporary ethics must be guided by the future consequences of human actions.

Knowledge about water should generate intergenerational responsibility; that is, it should commit each individual to preserving this resource for future generations.

From the perspective of the Risk Society proposed by Ulrich Beck (2011), these results reveal a typical characteristic of modernity: a large proportion of the population recognizes the existence of environmental problems but has not yet fully adopted practices capable of addressing them.

There is awareness of the risk, yet this perception does not always result in effective behavioral change.

INTEGRATED INTERPRETATION OF THE RESULTS

A combined analysis of the two charts makes it possible to identify a relevant social phenomenon.

Although domestic water use is entirely universal among the participants, knowledge about its management remains at intermediate levels.

This difference reveals a paradox characteristic of contemporary society: an essential natural resource is used intensively without its environmental, economic, and technological complexity necessarily being understood.

Edgar Morin (2005) argues that this type of fragmentation constitutes one of the principal limitations of modern thought. Individuals know water only as an element of everyday life but

rarely understand its place within complex ecological systems, production chains, public policies, and technological processes.

This situation reinforces the importance of continuing environmental education and incorporating digital technologies into the educational process.

Computer systems, consumption-monitoring platforms, mobile applications, intelligent sensors, and Artificial Intelligence tools can transform data into accessible knowledge, bringing the population closer to the conscious management of water resources.

Within this context, Information Technology ceases to perform merely administrative functions and assumes a pedagogical, social, and environmental role.

Software capable of monitoring consumption in real time, identifying waste, issuing automatic alerts, and providing sustainability indicators can help change individual behavior and strengthen public policies for water conservation.

Although the results of this study were obtained from a specific sample, they demonstrate that building a sustainable water culture depends on the integration of education, science, technological innovation, and citizen participation.

The development of intelligent systems for water resource management therefore represents not merely a technological advancement but an indispensable strategy for ensuring the responsible use of water in the face of the challenges posed by climate change, urban growth, and the increasing demand for natural resources.

REFERENCES

Agência Nacional de Águas e Saneamento Básico (ANA). *Conjuntura dos recursos hídricos no Brasil 2024* [Overview of water resources in Brazil 2024]. Brasília: ANA, 2024. Available at: Portal da ANA. Accessed on: 07 Jul. 2026.

Boff, Leonardo. *Sustentabilidade*: o que é, o que não é [Sustainability: what it is and what it is not]. 5. ed. Petrópolis: Vozes, 2017.

Bourdieu, Pierre. *Escritos de educação* [Writings on education]. 16. ed. Petrópolis: Vozes, 2015.

Durkheim, Émile. *As regras do método sociológico* [The rules of sociological method]. 3. ed. São Paulo: Martins Fontes, 2007.

Freire, Paulo. *Pedagogia da autonomia*: saberes necessários à prática educativa [Pedagogy of autonomy: knowledge necessary for educational practice]. 57. ed. Rio de Janeiro: Paz e Terra, 2019.

Gil, Antonio Carlos. *Métodos e técnicas de pesquisa social* [Methods and techniques of social research]. 7. ed. São Paulo: Atlas, 2019.

Google. *Google Forms*: formulários eletrônicos para coleta de dados [Google Forms: electronic forms for data collection]. Available at: Google Forms. Accessed on: 07 Jul. 2026.

Google Forms. *Questionário*: conscientização sobre o uso da água e o desenvolvimento de sistemas inteligentes para a gestão dos recursos hídricos [Questionnaire: awareness of water use and the development of intelligent systems for water resource management]. Data collected through an electronic form, 42 respondents, 2026. (Research database).

IBGE – Instituto Brasileiro de Geografia e Estatística. *Indicadores de desenvolvimento sustentável* [Sustainable development indicators]. Rio de Janeiro: IBGE, 2024. Available at: Portal do IBGE. Accessed on: 07 Jul. 2026.

Jonas, Hans. *O princípio responsabilidade*: ensaio de uma ética para a civilização tecnológica [The imperative of responsibility: in search of an ethics for the technological age]. Rio de Janeiro: Contraponto, 2006.

Leff, Enrique. *Saber ambiental*: sustentabilidade, racionalidade, complexidade e poder [Environmental knowledge: sustainability, rationality, complexity, and power]. 11. ed. Petrópolis: Vozes, 2015.

Morin, Edgar. *Introdução ao pensamento complexo* [Introduction to complex thought]. Porto Alegre: Sulina, 2005.

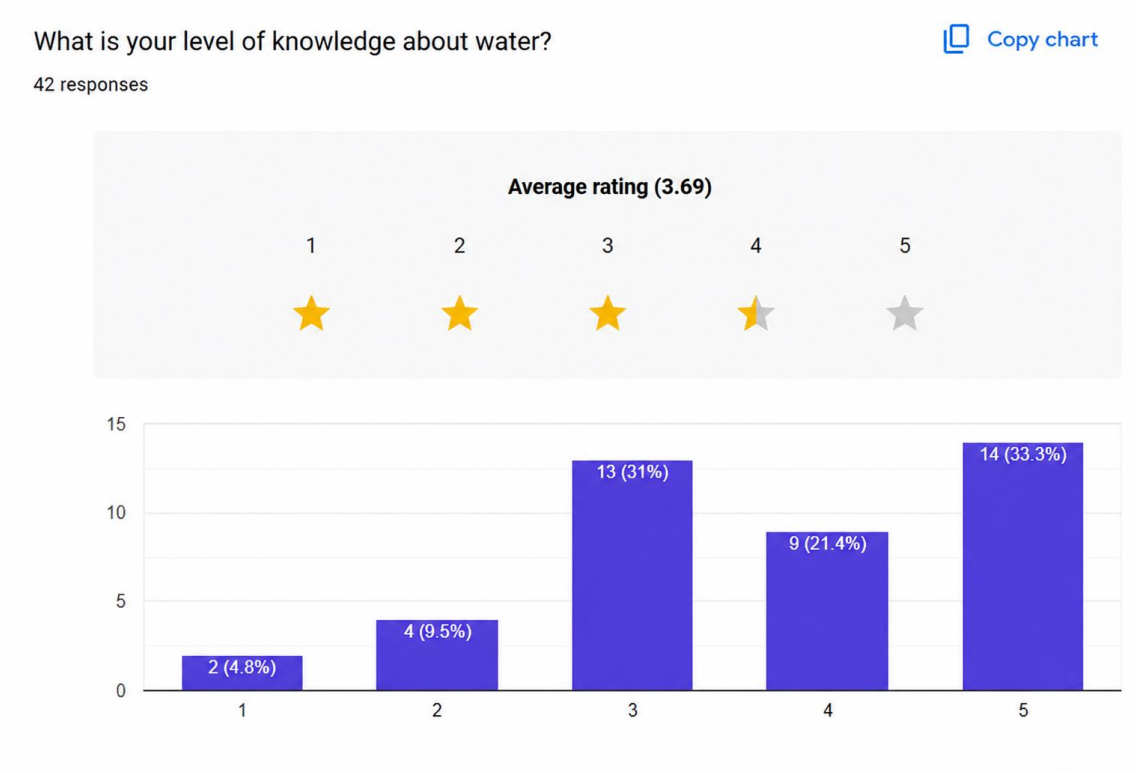
Sachs, Ignacy. *Desenvolvimento*: includente, sustentável e sustentado [Development: inclusive, sustainable, and sustained]. Rio de Janeiro: Garamond, 2008.

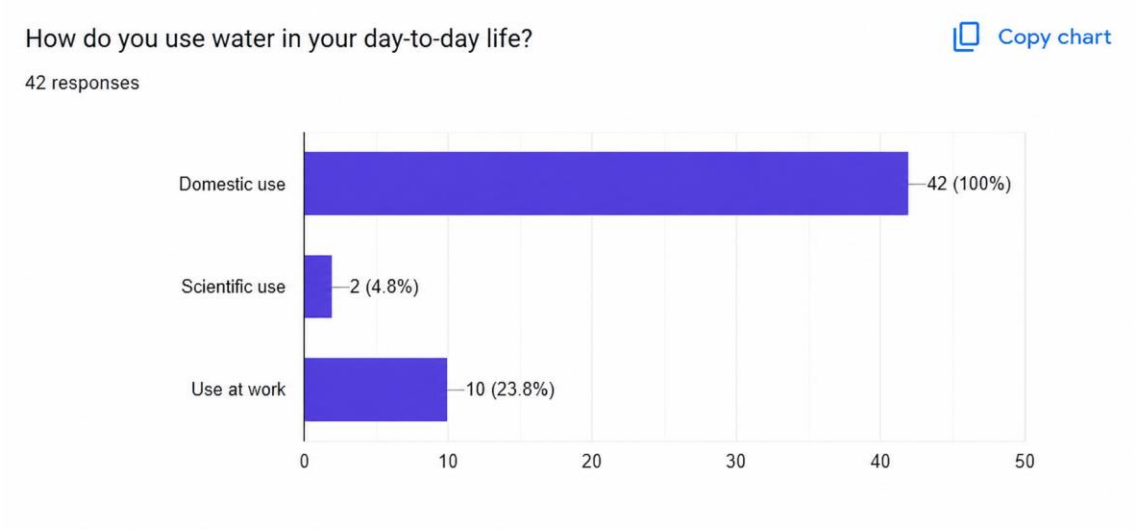
UNESCO. *United Nations World Water Development Report*. Paris: UNESCO, 2024. Available at: UNESCO Water Report. Accessed on: 07 Jul. 2026.

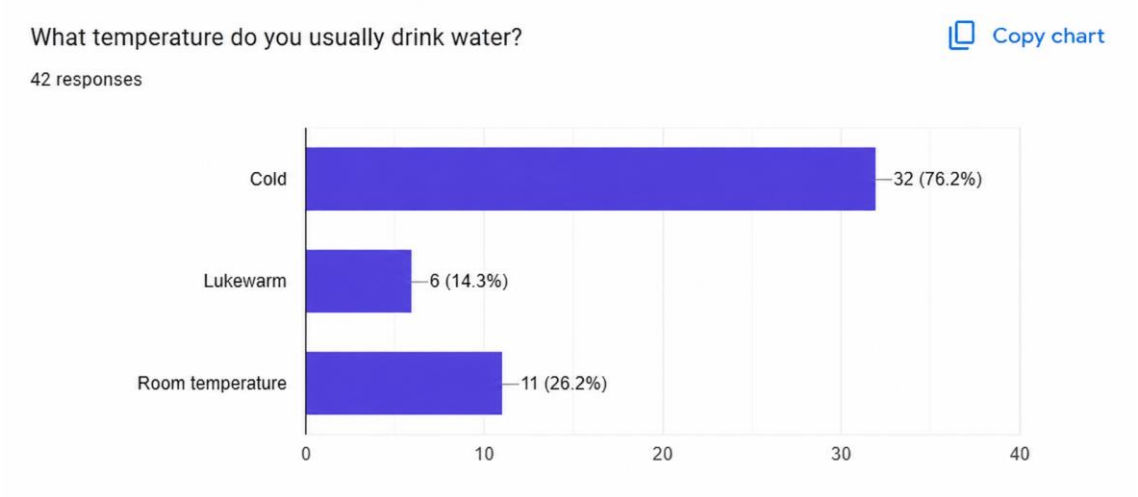
United Nations (UN). *Transforming our world*: the 2030 Agenda for Sustainable Development. New York: United Nations, 2015. Available at: Agenda 2030 – SDG 6. Accessed on: 07 Jul. 2026.

Weber, Max. *Economia e sociedade*: fundamentos da sociologia compreensiva [Economy and society: foundations of interpretive sociology]. v. 1. 4. ed. Brasília: Editora Universidade de Brasília, 2004.

APPENDICES


What is your level of knowledge about water?
Copy chart
42 responses
Average rating (3.69)
1
2
3
4
5
15
10
5
0
2 (4.8%)
4 (9.5%)
13 (31%)
9 (21.4%)
14 (33.3%)
1
2
3
4
5


How do you use water in your day-to-day life?
Copy chart
42 responses
Domestic use
Scientific use
Use at work
42 (100%)
2 (4.8%)
10 (23.8%)
0
10
20
30
40
50


What temperature do you usually drink water?
Copy chart
42 responses
Cold
32 (76.2%)
Lukewarm
6 (14.3%)
Room temperature
11 (26.2%)
0
10
20
30
40