Cultural adaptation and validation of the water attitude scale: Insights from Hungarian student responses

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Abstract

Education plays a crucial role in shaping future generations. This is also the case for the formation of environmental attitudes. Hungary is a country with abundant water resources; however, fostering students with a strong water attitude is especially important for the future, even in such nations. The objective of this study was to adapt and validate the Water Attitude Scale (WAS) questionnaire for use with primary school students in Hungary. A total of 964 students from grades 5–8, enrolled in twenty schools located in Southern Transdanubia, completed the questionnaire. The results of the confirmatory factor analysis indicated that the original factor structure was not an optimal fit for the data, prompting the development of a new four-factor model through exploratory factor analysis. The revised factors were: 1) The Value of Water and Responsibility, 2) Awareness and Education, 3) Water Usage at Home and in Society, and 4) Responsibility and Intervention. Analysis across grade levels revealed that fifth graders showed high initial awareness, which gradually declined in higher grades, while attitudes toward water use improved with age. Responsibility peaked in grade 6 but decreased slightly thereafter. The adapted questionnaire proved to be a reliable and valid tool for assessing water-related attitudes among Hungarian students, making it applicable for both diagnostic purposes in environmental education and as a foundation for longitudinal studies.

Keywords: water attitude, environmental education, diagnostic tool, questionnaire validation

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Introduction

Relevance of the research

Water is one of the most essential resources on Earth and plays a pivotal role in several life processes and in the functioning of diverse ecosystems. Water is indispensable for all living organisms, because it is involved in fundamental biochemical processes, including the transport of nutrients and the removal of metabolic waste. Furthermore, numerous human activities, including agriculture, industry, and energy production, are also significantly dependent on water. Freshwater resources are limited, making up only 2.5 percent of the Earth's water supply, with much of this – in a form not directly usable – stored in ice caps and glaciers. Climate change, population growth, and pollution are worsening the growing demand for freshwater and potentially leading to a global

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water crisis. Sustainable water management, including water conservation, pollution reduction, and recycling, is critical to ensuring water availability for future generations. On 28 July 2010, the United Nations General Assembly adopted Resolution 64/292, which declared access to safe and clean drinking water and sanitation facilities as a human right, essential for fully enjoying life and all other human rights (United Nations, 2010).

In recent decades, it has become clear that freshwater is a limited resource that is significantly impacted by human activity. The effects of population growth are not as immediately apparent on freshwater consumption, as the regions with the fastest-growing populations often have the lowest per capita water usage (United Nations, 2023). In lower-income countries, the primary cause of poor environmental water quality is inadequate wastewater treatment. In contrast, in higher-income countries, agricultural runoff represents the most significant environmental challenge (United Nations, 2024). As reported by Seelen, L.M.S. *et al.* (2019), Europeans use an average of 3,550 litres per person per day, a quantity that continues to rise with increasing incomes. Their findings showed that European respondents significantly underestimated their daily water usage, particularly regarding the indirect water use associated with the production of goods and services. Environmental awareness, societal attitudes, behaviour, and knowledge play a significant role in enabling sustainable socio-economic processes (Bodó, A. and Alpek, B.L. 2024).

In addition to the above, climate skepticism is also a critical issue that affects Hungarian society too (Jankó, F. *et al.* 2018). Therefore, the role of education is invaluable. The primary educational goals concerning water resource issues should be to foster long-term changes and nurture conscious citizens ready to act on water-related matters. This will require a shift in focus toward attitudes, knowledge, and behaviours (Hurlimann, A. *et al.* 2009; Gopinath, G. 2014; Amahmid, O. *et al.* 2019). It is crucial to acknowledge that young people can establish the fundamental elements for lifelong learning and awareness at an early stage of their education. This enables them to make more informed decisions about water-related concepts based on accurate knowledge (Rejeski, D.W. 1982; Dieser, O. and Bogner, F.X. 2016). The early educational stages thus present an opportunity to model public education on water conservation. The children of today will eventually make decisions about the future use of water resources. The most effective way to equip the next generation with the knowledge and attitudes that promote wise water use and proper behaviour is through school education (Schaap, W. and van Steenbergen, F. 2001; Global Water Partnership, 2003; Kovačević-Majkić, J. *et al.* 2022).

Water Attitude Scale

This study is based on a questionnaire package developed by Yeap, C.H. *et al.* (2007), known as the Water Attitude Scale (WAS), which was validated by the authors on a primary school-age sample. Yeap, C.H. *et al.* (2007) designed this questionnaire to assess four key components. The four components are: (1) Water and Environmentally Sustainable Development; (2) Water for Health, Hygiene, and Recreation; (3) Water, Social Equity, and Human Dignity; and (4) Cultural, Traditional, and Religious Practices Related to Water. The original objective of the questionnaire was twofold: firstly, to serve as a diagnostic tool for measuring changes resulting from water-related pedagogical interventions introduced by the research group, and secondly, to function as a formative assessment tool.

Despite undergoing multi-stage testing, the questionnaire was conducted with relatively small sample sizes. The initial pilot testing was conducted with 43 participants (across three groups of teachers), followed by a second round with 39 participants (science and mathematics teachers). Following these tests, the final version was established through confirmatory factor analysis. The original five-point Likert scale was reduced to a four-point scale, eliminating the neutral option. The starting 102 items were gradually refined to a final 29 items. The questionnaire was administered in a small-sample study comprising 24 participants in a science class and 27 in a mathematics class, both before and after the HVWSHE intervention (see subchapter "*The HVWSHE curriculum*"). Yeap, C.H. *et al.* (2007) grouped the questionnaire items as shown in *Table 1.*

Research objectives

At the outset of this research project, our objective was to develop a standardized questionnaire package that could be used to diagnose attitudes toward water among primary school-aged students. A review of the literature revealed the WAS questionnaire, as previously outlined. However, it became clear that the questionnaire, in its original form, could not be directly transferred as a diagnostic tool into Hungarian educational practice. This was due to its use of terms and expressions unfamiliar to students in this age group, who often lacked the background knowledge necessary for proper comprehension and evaluation of certain concepts. Consequently, we made preliminary adjustments to the original WAS questionnaire, clarifying terms like water meter, water theft, and sanitation by providing explanations in parentheses.

Literature review

Environmental education and its aspects in Hungary

The concept of environmental education has undergone significant evolution since its initial appearance, rendering a precise definition challenging due to its changing content (Neal, P. and Palmer, J. 1994). One of the most influential international interpretations emerged at the Tbilisi Conference 1978, defining environmental education's aim "to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic and cultural aspects, and acquire the knowledge, values, attitudes, and practical skills to participate responsibly and effectively in participating and solving environmental problems, and the management of the quality of the environment." (United Nations, 1978, 25).

In recent decades, the scope of environmental education has transformed. Initially, it was narrowly focused on environmental protection and primarily conveyed by biology teachers and conservationists. Over time, however, the concept expanded to include human and social dimensions. The principle of sustainability has also taken on an increasingly prominent role within environmental education over the past few decades. Consequently, this field of educa-

*Table 1. Cronbach's alpha coefficients and average inter-item correlation for the factors of the WAS**

Factor	Items	Cronbach alpha	Mean correlation
Water and Environmentally Sustainable Development	1, 2, 10, 11, 12, 18, 22, 26	0.99	0.45
Water for Health, Sanitation and Recreation	3, 13, 14, 17, 19, 25, 27	0.99	0.34
Water, Social Equity, Human Dignity	4, 5, 6, 16, 23, 28, 29	0.98	0.44
Water in Culture, Tradition and Religious Practice	7, 8, 9, 15, 20, 21, 24	0.99	0.43

*N = 51. *Source*: Yeap, C.H. *et al.* (2007) p. 7.

tion is now often designated as "education for sustainability", rendering it pertinent not only for biology instructors but for all educators (Kónya, G. 2019). One of the fundamental tenets of environmental education is the instruction of students through an interdisciplinary approach, with an emphasis on the development of skills across a range of contexts. Teachers and educational professionals need to develop curricula and programs that emphasize integrated skill areas, including practical applications (e.g., interpersonal collaboration, problem-solving, and analysis) (Vincent, S. and Focht, W. 2009).

The current Hungarian National Core Curriculum (NCC), which has been in effect since 2020, plays a foundational role in the Hungarian education system. In analysing the NCC 2020, Varjas, J. (2021, 2022) demonstrated its alignment with the 17 Sustainable Development Goals (SDGs), two of which are directly water related. Goal 6, Clean Water and Sanitation, addresses the provision of water, drinking water, and associated global challenges, while Goal 14, Life Below Water, focuses on the protection of oceans, seas, freshwater organisms, and water pollution. In his 2021 analysis, Varjas, J. observed that environmental education goals in the NCC 2020 are now presented more as a list, contrasting with the previous versions' detailed approach. This format affords teachers greater autonomy but provides less detailed guidance.

The NCC 2020 no longer identifies sustainable development as a principal objective. The concept of sustainability is referenced in social science disciplines, including history, civic education, and ethics, and is addressed in all natural science subjects. However, only in biology and ethics is sustainability designated as an independent learning outcome group, while in geography, this is not the case. In the primary school version, approximately 16.9 percent of the overall text is related to sustainable development, increasing to 20.5 percent in secondary school. In primary schools, this represents a decrease to approximately half the word count seen in previous versions.

The HVWSHE curriculum

The study by Yeap, C.H. *et al.* (2007) relates to the HVWSHE curriculum, which aims to impart knowledge and values associated with water use to foster environmentally conscious behaviours among students. The curriculum, developed for use in Southeast Asian schools through the SEAMEO–UN-HABITAT project, encompasses not only water and hygiene education but also places significant emphasis on the essential human values necessary for sustainability, including honesty, peace, truth, love, and non-violence. The HVWSHE curriculum is structured around four main thematic strands, which address key topics in a way that enables students to gain insight into the multifaceted role of water in society and nature. This approach fosters the development of valuable attitudes toward sustainable water use.

a) Water and Environmentally Sustainable Development

In the first module, students examine the importance of water and its limited availability, as well as strategies for contributing to its long-term preservation, which is vital for sustaining life and human well-being. This theme incorporates social, environmental, and economic perspectives that facilitate students' comprehension of the value of water and the concept of environmental sustainability. The educational objective is to instill in students a commitment to conserving water for future generations through the implementation of methods such as water conservation and recycling.

b) Water for Health, Sanitation, and Recreation

This theme posits that water is a foundation for a healthy life, essential for human functioning and meeting fundamental hygiene needs. The curriculum encompasses instruction in water-related hygiene practices and the use of appropriate facilities, as well as an examination of the role of water in recreational activities. The concept encourages students to recognize the health significance of clean water and to engage actively in water-related activities, such as sports or recreation, thereby enhancing their quality of life.

c) Water, Human Dignity, and Social Equity

In this theme, the proposition is advanced that equal access to water and sanitation facilities is a fundamental human right. Students are introduced to the concepts of social justice and human dignity, alongside the necessity for social equality regardless of gender, ethnicity, economic status, or geographic location. The objective of this theme is to cultivate a sense of justice and fairness in students and to equip them with the ability to critically examine and advocate for the equitable distribution of water resources, such as through the implementation of water metering and cost calculation.

d) Water in Culture, Tradition, and Religious Practice

In the last module, students will gain an understanding of how water is integrated into the practices of diverse cultures, traditions, and religions, and the impact this has on people's lives. The curriculum offers students the chance to gain a deeper comprehension of their own and others' cultural, traditional, and religious practices, thereby fostering social cohesion. Furthermore, students gain insight into the significance of water-related festivals and ceremonies, such as water festivals, and learn to express water-related human values, including respect and cooperation, through creative activities.

Each of these themes includes a variety of indicators that can be used to assess students' knowledge, cognitive abilities, and values. The experiences and attitudes that are cultivated through these themes encourage students to commit to the sustainable use and conservation of water, while also fostering an appreciation for water's role in their health and community well-being. Researchers have validated the WAS questionnaire, which is used to measure students' attitudes toward water, using indicators that have been developed based on these themes.

Comparison with related scales

Measuring environmental and water attitudes is cardinal to understanding and promoting sustainable behaviours, especially in educational and policy contexts. Validated questionnaires such as CHEAKS, EAI, the New Water Culture instrument, and Yeap, C.H. *et al*.'s (2007) values-based water education tool provide structured means to assess knowledge, attitudes, and behaviours related to environmental and water issues. Their comparative analysis reveals both methodological strengths and persistent gaps, particularly in cross-cultural applicability and the linkage between attitudes and real-world behaviours. To situate the development of the Modified Water Attitude Scale in context, this section reviews several existing instruments for assessing environmental and water-related attitudes. The focus is on three prominent scales – the Children's Environmental Attitudes and Knowledge Scale (CHEAKS), the Environmental Attitudes Inventory (EAI), and a recent New Water Culture questionnaire – and how they compare with the WAS. A summary of key characteristics is provided in *Table 2.*

The Children's Environmental Attitudes and Knowledge Scale (CHEAKS), developed by Leeming, F.C. *et al.* (1995), is a widely used instrument for assessing children's environmental orientations. It consists of 66 items divided into a 36-item Attitudes subscale – covering verbal commitment, actual commitment, and affect – and a 30-item Knowledge subscale, addressing domains such as animals, energy, pollution, recycling, water, and general environmental issues. Responses are measured on a 5-point Likert-type scale, with higher scores indicating stronger pro-environmental attitudes and greater knowledge. Originally validated on U.S. children aged 6–13, CHEAKS has demonstrated acceptable reliability ($\alpha \approx .68–.85$) and validity, though cross-cultural applications (e.g. in Ireland, Brazil, Spain) reveal differences in factor structures and item relevance, necessitating cultural adaptation (Walsh-Daneshmandi, A. and MacLachlan, M. 2006; Moreno, I. *et al*. 2016; Galli, F. *et al*. 2018). While robust for evaluating environmental education interventions among children and adolescents, CHEAKS is a general ecological instrument

Table 2. Comparison of environmental and water attitude scales: focus, structure, and cultural adaptation

Questionnaire (Source)	Target population	Focus / Main constructs	Structure (Items and scales)	Theoretical foundation	Cultural adaptation	Key limitations
CHEAKS (Leeming, F.C. *et al*. 1995)	Children, adolescents (6–13)	General environmental *attitudes* (affective, behavioural, cognitive) and *knowledge* (ecological topics: animals, energy, pollution, recycling, water, general issues)	66 items: *Attitudes* (36 items, 3 subscales: verbal commitment, actual commitment, affect) + *Knowledge* (30 items). 5-point Likert (attitudes), correct/incorrect (knowledge).	Socio-ecological and educational frameworks	Moderate – constituent elements and factor structures vary across contexts (e.g. US, Ireland, Brazil, Spain)	Limited to younger students; cross-cultural reliability varies; not designed for adults
Environmental Attitudes Inventory (EAI) (Milfont, T.L. and Duckitt, J. 2010)	General population, university students	Broad environmental attitudes (e.g. enjoyment of nature, support for conservation, ecocentrism, human dominance, personal behaviour, confidence in science)	120 items (12 scales, 10 items each); shorter 72- and 24-item forms available. 7-point Likert with balanced items. Yields 12 scale scores + 2 higher-order dimensions: *Preservation* vs. *Utilization*.	Multidimensional, hierarchical, deliberative attitudinal models	High – validated in multiple languages (e.g. Portuguese, Spanish, Brazilian, European samples)	Less sensitive to short-term educational effects; some subscales less relevant in certain cultural contexts
"New Water Culture" (NWC) Questionnaire (Benarroch, A. *et al*. 2021)	General public, students, trainee teachers (Spain)	*Water-specific* attitudes: scarcity, sustainability, governance, personal actions	27 items (final version, 4-point Likert without neutral option). Organized into 4 sections: (1) scarcity/quantity/distribution, (2) water's multiple dimensions, (3) management/governance, (4) personal water-saving behaviour.	Integrated water education paradigm (KAPP: knowledge, attitudes, perceptions, practices); sustainability and participatory governance frameworks	Low – validated only in Spain, culturally grounded in Iberian water policy	Limited explicit integration of broader cultural/educational dimensions; not adapted beyond Iberian context
Water Attitude Scale (WAS) (Yeap, C.H. *et al*. 2007)	University students, employees (Malaysia)	*Water-specific* values and attitudes; links cultural orientation (e.g. collectivism, power distance) to water conservation behaviour	29 Likert-type items; items reflect cultural values, personal responsibility, and conservation behaviours	Cultural/behavioural theories (Hofstede's cultural dimensions, theory of planned behaviour)	Low – limited cross-cultural validation outside Malaysia	Heterogeneity in cultural attitudes; limited psychometric validation; not widely adapted internationally
Modified Water Attitude Scale (mWAS) (Adapted in present study)	Students (Hungary, secondary level)	*Water-specific* values, attitudes, and behaviours (e.g. conservation)	25 Likert-type items, adapted from Yeap, C.H. *et al*. (2007). Items probe values, responsibility, and awareness regarding water conservation.	Educational and values-based water conservation framework	Current study provides *first Hungarian validation*	Novel instrument in Hungarian; further testing needed to confirm cross-cultural stability

Source: Compiled by the authors.

rather than domain-specific and is less suitable for adult populations.

The Environmental Attitudes Inventory (EAI), developed by Milfont, T.L. and Duckitt, J. (2010), is a multidimensional measure designed to assess the complexity of adult environmental attitudes. The full version consists of 120 items (12 subscales with 10 items each), capturing diverse dimensions such as Enjoyment of Nature, Ecocentric Concern, Support for Conservation Policies, Personal Conservation Behaviour, Human Dominance, and Confidence in Science and Technology. Responses are rated on a 7-point agreement scale, with balanced (half reverse-scored) items to minimize acquiescence bias. Psychometric analyses consistently support a hierarchical structure in which the 12 subscales load onto two higher-order dimensions: Preservation (reflecting pro-environmental orientations) and Utilization (reflecting anthropocentric and exploitative orientations). Shortened versions (e.g. 72- and 24-item forms) have been developed for practical use while maintaining acceptable reliability and validity (Sutton, S.G. and Gyuris, E. 2015). Originally validated with university students in New Zealand, the EAI has since been adapted and applied across numerous cultural contexts (e.g. Brazil, Spain, Australia, North America, Europe), though certain subscales (e.g. environmental movement activism) show variable cross-cultural relevance (Ajdukovic, I. *et al*. 2019; Andrade, E. *et al*. 2021). Despite its broad applicability and strong psychometric robustness, the EAI is not tailored to specific domains such as water-related issues, is less sensitive to short-term educational interventions, and to date lacks a validated Hungarian adaptation – highlighting a gap this study's WAS seeks to address.

The "New Water Culture" (NWC) Questionnaire, developed by Benarroch, A. *et al*. (2021), was designed to assess knowledge, attitudes, perceptions, and practices (KAPP) consistent with the NWC paradigm, which conceptualizes water as an eco-social resource requiring sustainable, participatory, and demand-oriented management in contrast to traditional supply-driven approaches (Ramírez-Segado, A. *et al*. 2023). The instrument was initially composed of 20 Likert-type items (1–4 scale, with no neutral option) generating 51 variables and was subsequently refined through expert panel review – including contributions from the New Water Culture Foundation – into a validated 27-item scale. These items are organized into four thematic areas: (1) perceptions of scarcity, quantity, and distribution; (2) recognition of water's multiple dimensions (environmental, social, cultural, economic); (3) preferences for participatory and sustainable management strategies; and (4) personal water-saving actions. The final version demonstrated high internal consistency (Cronbach's $\alpha \approx .91$) and strong content validity (Aiken's $V \approx .84$). Developed and validated in Spain, the NWC questionnaire has been primarily applied to the general public, students, and pre-service teachers in formal education contexts (Ramírez-Segado, A. *et al*. 2023). Unlike broader ecological instruments such as CHEAKS and EAI, the NWC questionnaire is explicitly water-specific and education-oriented, though its cultural grounding in Iberian water policy discourse means adaptation is required for other contexts, including Hungary.

Conceptual distinctions and measurement of knowledge, beliefs, and attitudes

In the literature on environmental and water education, knowledge, beliefs, and attitudes are commonly conceptualized as distinct yet interrelated constructs. Knowledge is treated as factual or conceptual understanding of environmental and water-related issues and is typically assessed with objective instruments such as factual quizzes, structured tests, or knowledge subscales (Walsh-Daneshmandi, A. and MacLachlan, M. 2006; Rosa, C.D. *et al*. 2022; Mostacedo-Marasovic, S.-J. *et al*. 2023). Beliefs refer to convictions and symbolic or cultural meanings attached to environmental and water phenomena; these are examined with belief subscales, the New Ecological Paradigm (NEP) and its child version, and – critically – qualitative or ethnographic approaches that surface culturally embedded meanings (Kopnina, H. 2011; Rosa, C.D. *et al*. 2022; Mostacedo-Marasovic, S.-J. *et al*. 2023; Berze, I.Z. *et al*. 2024). Attitudes capture affective evaluations and predispositions, often including behavioural intentions, and are measured with well-established scales such as CHEAKS, the EAI, and the Two-Major Environmental Values (2-MEV) instrument (Musser, L.M. and Malkus, A.J. 1994; Wilfong, M. *et al*. 2023; Vucetich, J.A. *et al*. 2024).

Validated tools like CHEAKS, EAI, and 2-MEV rely on factor-analytic procedures and, increasingly, Rasch modelling and Item Response Theory (IRT) to sharpen construct separation and improve item performance (Musser, L.M. and Malkus, A.J. 1994; Walsh-Daneshmandi, A. and MacLachlan, M. 2006; Milfont, T.L. and Duckitt, J. 2010; Mamat, M.N. and Mokhtar, F. 2012; Liefländer, A.K. and Bogner, F.X. 2018; Vucetich, J.A. *et al*. 2024; Ngan, S.F. and Li, C.S. 2025). Disciplinary emphases, however, differ: pedagogy and curriculum studies stress experiential and transdisciplinary integration (Palozzi, J.E. *et al*. 2025), educational psychology advances identity-based explanations (Freed, A. 2018; Pagano, L.P. *et al*. 2025), sociology situates orientations within social-demographic contexts (Newman, T.P. and Fernandes, R. 2016), and anthropology foregrounds symbolic beliefs, local knowledge, and inequities related to water (Jackson, S. 2011; Lahiri-Dutt, K. 2020; Wilfong, M. *et al*. 2023). Despite these advances, several challenges persist – most notably the conceptual ambiguity of "beliefs", the limitations of NEP with children, cross-cultural validity concerns for "Western"-developed scales, and the enduring gap between self-reported attitudes and behaviour (Moore, S. *et al*. 1994; Grob, A. 1995; Zhu, Z. *et al*. 2019; Yu, J.-H. *et al*. 2021; Hundemer, S. *et al*. 2022; Rosa, C.D. *et al*. 2022).

In water-specific contexts, water knowledge centres on objective understanding of cycles, conservation, and management and is increasingly anchored in standards and water-literacy frameworks (Yu, J.-H. *et al*. 2021; Mostacedo-Marasovic, S.-J. *et al*. 2023). Water beliefs encompass both factual beliefs and symbolic meanings – such as sacredness or identity value – often documented in indigenous or traditional settings and associated with preservation behaviours (Sindik, J. and Araya, Y.N. 2013; Freed, A. 2018; Lahiri-Dutt, K. 2020). Water attitudes cover evaluative tendencies and willingness to engage in water-saving practices, with recent child/adolescent instruments and composite water-literacy measures extending the toolkit (Aysu, B. *et al*. 2025). In addition, the Water Attitude Scale (WAS) has been specifically developed to capture students' perceptions and values in water education, further broadening the range of validated instruments available for water-related research (Yeap, C.H. *et al*. 2007). Demographic heterogeneity is common: gender, age, education, place, and broader contextual factors systematically shape knowledge, attitudes, acceptance, and behaviour (Braun, T. *et al*. 2018).

Identity-based pathways frequently outperform attitude-only models in explaining behaviour: structural models show environmental knowledge acting as a distal driver via attitudes and intentions, while values and emotions exert comparatively strong direct effects. Classroom-embedded, dialogical approaches and theory-based formative assessment broaden the lens beyond knowledge–attitude–behaviour by capturing relevance, responsibility, and identity exploration (Ligorio, M.B. 2010; Granit-Dgani, D. *et al*. 2017).

Materials and methods

Sampling

The primary area for questionnaire sampling was the South Transdanubia region in SW Hungary *(Figure 1)*. This region is characterized by a high number of small schools with few students, which have undergone continuous transformations: "Over the past seven decades, education policy measures have left a profound impact on the school network, including institutional restructuring, closures, and occasionally the establishment of new schools" (Andl, H. 2023, 259). In many small settlements, these educational facilities have been shut down, necessitating that students commute to other locations. A total of seventy-two primary schools were contacted for this survey. Of these, twenty granted permissions to administer the questionnaire. The schools are situated in fifteen different towns within the region. The institutions encompass rural primary schools (notably small schools) in the villages of Látrány and Szőlősgyörök, as well as institutions in cities like Nagykanizsa and the regional centre, Pécs.

The statistical representativeness of the population is evident in the region, as demonstrated by the chi-square tests, which indicate a statistically significant relationship between the legal status of the settlements, the response rates, and the number of respondents relative to the total number of primary school students in each grade level *(Table 3).*

The total number of participating students was 964. Of these, 20 percent were in fifth grade (197 students), 25 percent in sixth grade (237 students), 26 percent in seventh grade (253 students), and 29 percent in eighth grade (277 students). The grade distribution by municipality demonstrates that certain grades are more homogeneous in certain municipalities, as only a limited number of schools agreed to administer the survey across all upper grades. Full grade-level data collection was only conducted in Látrány, Nagykanizsa, and Pécs *(Figure 2).*

Questionnaire adaptation

As previously noted in the introduction, the original WAS questionnaire included a multitude of terms and expressions that were either unfamiliar to the target age group or beyond the scope of their background knowl-

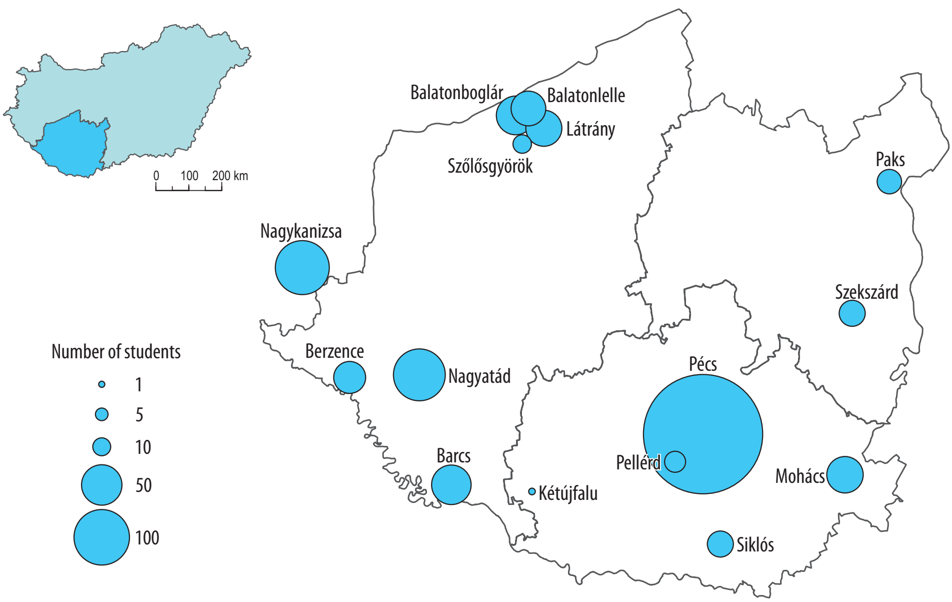

Fig. 1. Spatial dimensions of the population by settlements of school. *Source:* Authors' own elaboration.

*Table 3. Statistical representativeness of the participants based on Chi-square test of independence**

Attribute 1	Attribute 2		Df	χ^2 value
Legal status of settlement	All respondents		30	607.43
	Non-respondents		472	1,314.00
Legal status of settlement	Fifth grade	Respondents	122	424.86
		Non-respondents	14	138.66
	Sixth grade	Respondents	120	419.32
		Non-respondents	20	199.55
	Seventh grade	Respondents	116	406.48
		Non-respondents	18	140.96
	Eight grade	Respondents	120	420.04
		Non-respondents	14	133.88

*p-value <0.001, Fisher exact <0.001. *Source:* Authors' own elaboration.

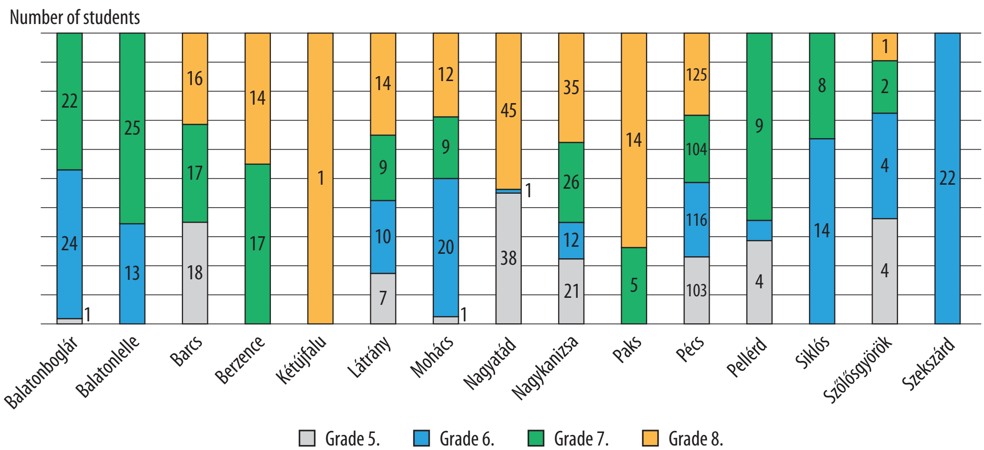

Fig. 2. Distribution of age groups in the population by settlement of school. *Source:* Authors' own elaboration.

edge for assessment purposes. Accordingly, the initial version of the WAS questionnaire was modified to provide clarification regarding certain terms. For example, regarding the phenomenon of water theft, we provided an illustrative example, stating, "e.g. someone uses a neighbour's water without paying for it". Concerning the objective of a water conservation campaign, we offered a clarification, stating, "The purpose of this would be to encourage people to save water". In the context of sanitary items, we offered a definition, stating, "sanitary = faucets, showers, bathtubs". For instance, the term "water meters" was clarified as "a water meter measures water consumption in a house/apartment". Additionally, the concept of the water cycle was elucidated as "without the water cycle, the ecosystem would be harmed". Furthermore, the term "erosion" was defined as "erosion = the degradation of land surfaces". Following these initial modifications, a large-scale survey was conducted.

However, additional issues emerged with certain statements, as most students encountered difficulty in understanding questions 2, 14, 21, and 28. Regarding question 2, a considerable number of students encountered difficulties in interpreting the term "drinking water at the garden faucet". Question 14 did not resonate with the age group in question, as students frequently reacted with excessive humour. Questions 21 and 28 presented interpretation challenges, as students lacked sufficient background knowledge to grasp government responsibilities or the phenomenon of water theft, despite the added explanations. These concepts were largely unfamiliar, especially for this age group.

Data processing

Confirmatory factor analysis: Purpose and application in the research

The concept of reliability concerns the consistency of measurement outcomes. It encompasses test-retest reliability, internal consistency, and inter-rater reliability, which are essential for identifying random and systematic errors in measurements (Streiner, D.L. *et al.* 2015; Mohajan, H.K. 2017). Although reliability pertains to the precision of test scores in representing an attribute, it does not confirm the attribute measured or the test's effectiveness. This is the realm of validity (Slaney, K. 2017). Validity pertains to the accuracy of measurement tools in capturing the intended construct (Buckingham, B.R. *et al.* 1921). The link between factor analysis and construct validity has been recognized since Thompson, B. and Daniel, L.G. (1996). The mid-twentieth century saw a shift in focus towards the assessment of validity through the structural configuration of test variables, often employing factor analysis. This shift was observed by Goodwin, L.D. and Leech, N.L. (2003) and represented a departure from the previous emphasis on correlating test scores with external criteria.

Confirmatory factor analysis (CFA) is a statistical technique employed to confirm the factor structure hypothesized by researchers. It is widely employed to bolster construct validity in measurement tools (DiStefano, C. and Hess, B. 2005). Researchers utilize CFA to furnish evidence of validity for a measurement instrument, drawing on its factor structure and the item-to-factor relationship patterns (Rios, J. and Wells, C. 2014). Typically, researchers provide evidence in support of this in the subsequent formats. For data analysis, we used JASP[4] and RStudio[5] software.

Fit indices: Use and significance in CFA

This study utilizes CFA to validate a modified version of the WAS. The key model fit indices – including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Residual (SRMR) – are employed to evaluate the congruence between the revised model and observed data. These indices facilitate a comprehensive understanding of the model's suitability and ensure that the scale's constructs are appropriately measured within the new demographic.

Both the CFI and the TLI are indices that range from 0 to 1. A CFI value above 0.90 is indicative of an acceptable fit, whereby the proposed model is evaluated in comparison to a null model. The TLI is analogous to the CFI, yet it also considers model complexity. Values exceeding 0.95 indicate an appropriate fit. Additionally, the RMSEA and SRMR are important. An RMSEA value below 0.06 suggests a good fit, although it should be noted that caution is advised in models with limited degrees of freedom, as this value may be misleading in such cases. SRMR is less sensitive to model complexity, with values under 0.08 considered acceptable (Shi, D. *et al.* 2019; Khademi, A. *et al.* 2023). This approach allows the study to assess model fit while addressing the challenges and nuances in cross-cultural adaptation of attitudinal measures, thereby contributing to more accurate and generalizable findings in educational and environmental research.

[4] JASP Team (2024). JASP (Version 0.18.3) [Software]. JASP Team (Revelle, W. 2018).
[5] RStudio Team (2023). RStudio: Integrated Development for R, Version 2023.06.1 (Software). Posit, PBC.

Exploratory factor analysis

Empirical methods such as exploratory factor analysis (EFA) reveal patterns within the correlations of items in a measurement tool and their unknown domains (factors) (Tavakol, M. and Wetzel, A. 2020). EFA clarifies the relationship patterns among assorted items and constructs (Knekta, E. *et al.* 2019). Furthermore, it identifies items that do not align with the anticipated construct, suggesting their exclusion from the assessment (Knekta, E. *et al.* 2019). The EFA provides evidence to support the validity of a construct, which in turn informs decisions regarding its factor structure. In particular, the factor solution derived from the EFA demonstrates the relationships between the constructs of interest and indicators such as behaviours and attitudes. This offers a basis for validating the construct's measurement and for supporting theoretical frameworks (Brown, T.A. 2015), As a result, the empirical and theoretical understanding of the measure is enhanced (Knekta, E. *et al.* 2019).

In EFA, we used Promax rotation to facilitate the identification of underlying factor structures within the scale. Promax rotation, a type of oblique rotation, allows factors to be correlated, which is often more representative of real-world data where constructs may not be fully independent. This approach allowed us to achieve a clearer and more interpretable factor solution by maximizing the variance of the factor loadings and providing insight into the relationships between the identified factors (Finch, H. 2006).

Results

Modification of the questionnaire

To assess the reliability of the research data, a confirmatory factor analysis was conducted to ascertain the validity of the original factor structure proposed by Yeap, C.H. *et al.* (2007) within the context of the current sample. The structure developed by Yeap, C.H. *et al.* (2007) exhibited at least one negative eigenvalue in the covariance matrix, indicating deficiencies in the model specification. The data structure became interpretable when the condition for the program to search for correlations between factors was removed. However, even with this adjustment, the resulting model lacked statistical reliability, even at the component level *(Table 4).*

Utilizing our dataset with a larger sample size, we developed a novel model based on the original WAS questionnaire (*Appendix A*). After exploratory factor analysis, we removed questions 2, 14, 21, and 28 due to their low factor loadings and issues observed during completion (see subchapter "*Questionnaire adaptation*"). This resulted in a more coherent model *(Table 5, Appendix B).* The original number of factors was retained, but their content composition changed *(Table 6).*

The content of the four new factors has been modified, necessitating adjustments to their grouped labels. The correlations between the factors are displayed in *Figure 3*.

The first factor, designated as Fc1, is entitled "The Value of Water and Responsibility".

Table 4. Reliability analysis of the original WAS factor structure

Reliability model	Factor 1	Factor 2	Factor 3	Factor 4
McDonald's Omega (ω)	0.569	0.708	0.445	0.240
Cronbach's Alpha (α)	0.522	0.669	0.412	0.234

Source: Authors' own elaboration.

Table 5. Reliability analysis of the modified WAS

Reliability model	Factor 1	Factor 2	Factor 3	Factor 4
McDonald's Omega (ω)	0.880	0.790	0.664	0.670
Cronbach's Alpha (α)	0.876	0.786	0.646	0.658

Source: Authors' own elaboration.

Table 6. Model fit and test summary of the modified WAS

Test	Results
Chi-Square Test	Baseline Model: χ^2 = 7769.331; Df = 300; p < 0.001 Factor Model: χ^2 = 868.393; Df = 269; p < 0.001
Bartlett's Test	χ^2 = 7687.393; Df = 300; p < 0.001
Fit indices	CFI = 0.920 TLI = 0.911 RMSEA = 0.048 SRMR = 0.044

Source: Authors' own elaboration.

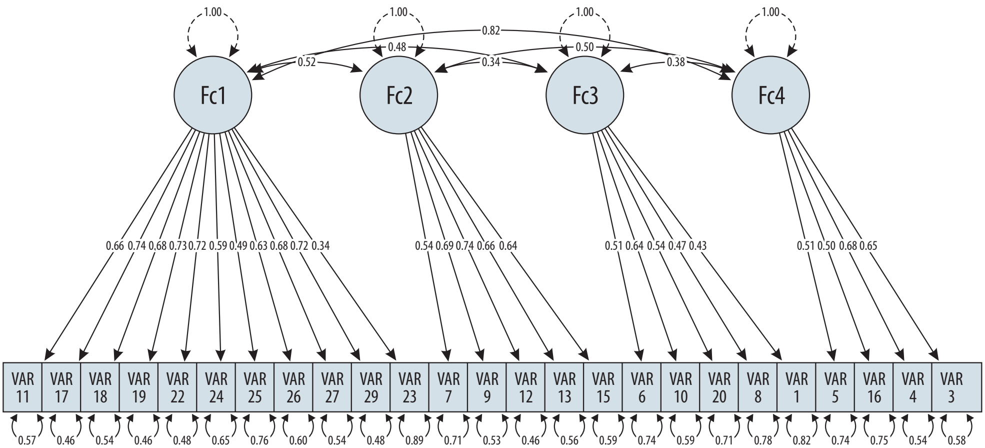

Fig. 3. Structure of the modified WAS. *Source:* Authors' own elaboration.

This factor emphasizes students' acknowledgment and assumption of accountability for the significance and preservation of water. It includes items addressing themes such as the responsibility associated with water conservation, the appreciation of water's aesthetic qualities, the stabilizing effects of the water cycle, and the significance of water for human health.

The second factor (Fc2), "Awareness and Education", is centred on educational initiatives and awareness-building, encouraging students to disseminate information regarding the importance of water conservation to others. The items included in this factor are organized around three primary areas: personal development regarding water-related issues, intention to participate in water-saving campaigns, and sharing of knowledge about water conservation.

The third factor (Fc3), "Water Usage at Home and in Society", encompasses questions related to personal and societal water-use habits and attitudes. This encompasses the willingness to conserve water, the individual's responsibility in its usage, and the social equity of access to and the maintenance of hygiene through its use.

The fourth factor (Fc4), "Responsibility and Intervention", addresses individual responsibility, intervention intentions, and ethical concerns. It examines students' attitudes toward avoiding water pollution, reporting leaks and water theft, and the ethical perception of water meter tampering. The number of items within each factor is provided in *Table 7*.

Table 7. Items of the modified WAS factors

No.	Factor	Items of scale
1	The Value of Water and Responsibility	11, 17, 18, 19, 22, 23,24, 25, 26, 27, 29
2	Awareness and Education	7, 9, 12, 13, 15
3	Water Usage at Home and in Society	1, 6, 8, 10, 20
4	Responsibility and Intervention	3, 4, 5, 16

Note: In the modified version of the WAS, the following items were categorized: *Knowledge* – 7, 18, 19, 26; *Beliefs* – 6, 8, 10, 20, 22, 23, 24, 29; *Attitudes* – 1, 3, 4, 5, 9, 11, 12, 13, 15, 16, 17, 25, 27. This classification reflects the different pedagogical implications of the items: knowledge relates to factual understanding, beliefs reflect normative or value-based assumptions, while attitudes capture emotional and behavioural orientations toward water. *Source*: Authors' own elaboration.

Development of Water Attitudes by grade

In the following phase of the research, an investigation was conducted to ascertain whether the grouped factors of the questionnaire, calculated for each student, demonstrated any correlations when analysed by grade. Based on the Welch-ANOVA test (*Table 8* and *9*), the second and third factors exhibited significant correlations, while the fourth factor, though above the significance threshold, was close to it.

With regard to the "Awareness and Education" (Fc2), the observed decline in the mean value indicates a potential reduction in students' awareness and commitment to education as they progress through the grade levels. The fluctuation in standard deviation indicates changes in the differences of opinion among students, though no significant discrepancies are evident. The minimum value remains constant, except for a slight increase observed in one grade level. The maximum value remains constant, indicating that the highest level of commitment remains unaltered.

The slight increase in the mean value for "Water Usage at Home and in Society" (Fc3) indicates a positive trend, suggesting that students' water-use habits and attitudes tend to improve with grade level. The observed fluctuation in standard deviation indicates an in-

Table 8. Welch's ANOVA Test – Correlations between grade levels and water attitudes

Attitude	Df	Sum Sq	Mean Sq	F value	p-value
The Value of Water and Responsibility	3	68.0	22.5300	1.3681	0.250
Awareness and Education	3	208.7	69.5570	16.1970	0.000
Water Usage at Home and in Society	3	21.0	7.0026	4.1846	0.000
Responsibility and Intervention	3	13.5	4.5090	2.5086	0.051

Source: Authors' own elaboration.

Table 9. Descriptive statistics for factors 2–4

Factors	Factor 2				Factor 3				Factor 4			
Grade	5	6	7	8	5	6	7	8	5	6	7	8
Number of students	197	237	253	277	197	237	253	277	197	237	253	277
Mode	9.81	9.81	9.81	9.81	2.59	2.59	2.59	2.59	9.36	9.36	9.36	8.35
Mean	9.13	8.23	8.29	7.79	4.02	4.30	4.16	4.42	7.55	7.75	7.44	7.48
SD	1.97	2.13	2.00	2.15	1.22	1.34	1.24	1.35	1.35	1.08	1.52	1.36
Min	3.27	3.27	3.81	3.27	2.59	2.59	2.59	2.59	2.34	3.67	2.34	2.34
Max	13.08	13.08	13.08	13.08	8.41	10.36	8.16	10.36	9.36	9.36	9.36	9.36

Source:Authors' own elaboration.

crease in the diversity of opinions among students. The minimum value remains constant, indicating that the lowest level of commitment remains unaltered. The fluctuations in the maximum value indicate that the highest level of commitment varies between grade levels.

Finally, regarding "Responsibility and Intervention" (Fc4), the fluctuations in the mean indicate that students' sense of responsibility and intention to intervene vary across grade levels, without a clear trend. The changes in standard deviation suggest that differences in opinions do not follow a distinct pattern. Variations in the minimum value show that the lowest level of commitment differs across grades. The maximum value remains constant, indicating that the highest level of commitment is stable.

In general, it can be stated that the values of the factors in question undergo a change as students' progress through the various grade levels. Regarding the factor "Awareness and Education" (Fc2), fifth-grade students demonstrate the greatest commitment, although this commitment then declines gradually in subsequent grades. The data indicate that responses from fifth graders exhibit less variability, whereas variability in responses increases in later grades. As indicated by the "Water Usage at Home and in Society" (Fc3) factor, students demonstrate enhanced awareness and commitment across grade levels, particularly in eighth grade. The distribution data demonstrates a notable positive skewness and a pronounced peak, indicating that a subset of students attain higher scores than the remainder. Regarding the "Responsibility and Intervention" (Fc4) factor, fifth and sixth graders evince a heightened sense of responsibility and intention to intervene. However, this declines slightly in seventh and eighth grades. The distribution data indicate a reduction in dispersion, with a few notably high values.

These changes reflect developmental processes associated with age, which influence students' water-related attitudes and commitment within and across grade levels. Significant differences are evident in students' water-related attitudes and commitment when comparing academic levels. Fifth graders typically demonstrate a less developed awareness of water conservation and management practices. At this age, the primary objective of education should be the establishment of awareness and the imparting of fundamental knowledge. By the eighth grade, students typically demonstrate a heightened level of awareness and a more nuanced understanding of the personal and societal implications of water use. Consequently, their sensitivity to water management issues increases, enabling them to view water consumption habits and their societal impact with greater criticality.

The capacity for assuming responsibility and engaging in intervention also undergoes a transformation as students progress through the academic grades. Fifth and sixth graders typically demonstrate a heightened sense of responsibility and more active involvement in environmental matters. However, this attitude may exhibit a slight decline among seventh and eighth graders, potentially influenced by social norms, age-specific traits (such as adolescence) and evolving interests.

Beyond these developmental patterns, we also examined whether settlement type was associated with differences across the four extracted factors. Four one-way analyses of variance (ANOVAs) were conducted, with the assumption of homogeneity of variances met in each case, as indicated by non-significant Levene's tests (all $p > .31$). The omnibus ANOVAs revealed no statistically significant differences between settlement types on any of the factors (Factor1: $F(2, 961) = 0.350$, $p = .705$; Factor2: $F(2, 961) = 1.986$, $p = .138$; Factor3: $F(2, 961) = 0.654$, $p = .520$; Factor4: $F(2, 961) = 0.680$, $p = .507$). Robust Welch tests yielded the same pattern of non-significant results. Effect sizes were consistently trivial ($\eta^2 < .01$), suggesting that settlement type did not account for meaningful variation in students' responses on the four factors. These findings indicate that while developmental differences across age groups are apparent, the influence of settlement context is negligible in shaping students' water-related attitudes.

In sum, the analyses indicate that age-related patterns exert a more consistent influence on students' water-related attitudes than settlement context, a finding that sets the stage for the subsequent discussion of educational implications.

Discussion and conclusions

The study findings provide insight into how Hungarian students' attitudes toward water and environmental sensitivity evolve with grade level, shedding light on age-related shifts in both awareness and engagement. In terms of "Awareness and Education" (Fc2), fifth-grade students displayed the highest awareness and commitment to water-related issues, but this commitment appeared to decrease slightly in higher grades. This trend suggests a potential need for sustained or enhanced engagement strategies as students' progress to maintain and deepen their understanding of water conservation. The variability in responses also increased, indicating a growing diversity of perspectives with age. For "Water Usage at Home and in Society" (Fc3), there was a gradual increase in positive attitudes and practices, particularly noticeable by eighth grade. This trend suggests an overall improvement in students' water-conscious behaviour over time. The distribution of responses, showing a skew towards higher scores, points to a subset of students who display notably elevated levels of commitment. With the "Responsibility and Intervention" (Fc4) factor, fifth and sixth graders showed a stronger sense of responsibility and intervention in water issues. However, this commitment slightly decreased in seventh and eighth grades, possibly due to adolescent developmental factors, shifting interests, and peer influence. This observation highlights the importance of reinforcing responsibility as students grow older, countering potential declines in environmental engagement during adolescence.

The observed decline in awareness from grade 5 onwards resonates with international findings that environmental sensitivity often diminishes during early adolescence, when cognitive demands increase and peer influences strengthen (Liefländer, A.K. and Bogner, F.X. 2018; Otto, S. *et al*. 2019; Grønhøj, A. and Hubert, M. 2022). This highlights the importance of sustained educational reinforcement: early gains in awareness need to be consolidated through age-appropriate activities that connect abstract knowledge with practical action. At the same time, the increase in positive attitudes toward daily water use by grade 8 suggests that older students can translate abstract principles into personal habits, provided that curricula emphasize experiential and participatory approaches. The temporary peak in responsibility observed in grade 6, followed by a slight decline, points to a window of opportunity for interventions that foster civic responsibility and ethical reflection before adolescence reshapes motivational orientations.

Yeap, C.H. *et al.* (2007) identified a positive shift in perceptions among lower secondary students following the integration of the HVWSHE curriculum. In comparison, the present study reveals notable variations in attitudes among Hungarian students as they progress through their educational trajectories. This observation lends support to the conclusion of Yeap, C.H. *et al.* (2007) that targeted educational strategies can effectively foster improved water-related perceptions among specific age groups. Moreover, the findings of Yeap, C.H. *et al.* (2007) emphasize the importance of continuous educational initiatives to maintain students' engagement and awareness about water-related issues. The present study corroborates this notion, as it reveals a decline in students' sense of responsibility and willingness to intervene in environmental matters during the seventh and eighth grades. This trend underscores the necessity for sustained educational programs that aim to reinforce positive attitudes toward water conservation as students mature. However, it is crucial to underscore that the findings of Varjas, J. (2021, 2022) point to a decline in the level of expectations regarding environmental education within the National Core Curriculum 2020. This decline presents a challenge in the context of Hungary, potentially impeding the efficacy of environmental education initiatives aimed at fostering positive attitudes and awareness about water among students.

The value of the revised and validated questionnaire lies primarily in its potential to advance research on environmental and water-related attitudes in Hungary and other European contexts. As a robust instrument, it enables systematic assessment of students' attitudes toward water and environmental issues, offering reliable data for academic inquiry. The scale also supports longitudinal investigations, allowing researchers to track developmental changes across age cohorts and to evaluate the long-term impact of specific educational interventions. Furthermore, its adaptability to diverse European contexts ensures that it can be modified to reflect regional environmental challenges and cultural specificities, thereby contributing to comparative studies and cross-national educational research.

Beyond its research value, the revised Water Attitude Scale provides direct pedagogical benefits. It can function as a formative tool, offering feedback that supports curriculum development and instructional design aimed at strengthening environmental education. Teachers may use the instrument to better understand students' perceptions, to identify opportunities for integrating water-related issues into everyday teaching, and to foster critical awareness of sustainability. In teacher training, the questionnaire can help future educators develop strategies for meaningful student engagement, while in practice it may encourage reflective pedagogy and evidence-based decision-making. By enabling comparative insights across different school contexts, the scale not only informs classroom practice but also contributes to broader educational policy discussions.

One important omission concerns the dimension of indirect water use, which refers to the hidden water footprint of energy production, food consumption, and material goods. This construct was not included in the original WAS developed by Yeap, C.H. *et al*. (2007), and therefore it was not part of the Hungarian adaptation either. While pedagogically relevant, its assessment poses challenges with students aged 10–14, as the concept requires abstract reasoning about production and consumption chains that exceed their everyday experience. Nevertheless, introducing indirect water use through project-based or experiential learning may represent an important future direction in environmental education, and future questionnaire adaptations might incorporate simplified items targeting this dimension.

Some items, such as reporting leaks, tampering with meters, or questions of social equity, may appear to exceed the immediate experience of 10–14-year-old students. We acknowledge this potential limitation. At the same time, our findings suggest that students were able to provide consistent responses, indicating that they can engage with such issues at an attitudinal level even if not all of them encounter these situations in practice. As with many attitude measures, responses may be influenced by socially desirable norms, which is itself relevant in understanding how civic and environmental expectations are internalized during adolescence.

In order to further contextualize the Hungarian findings, it is useful to draw on related research from Central and Eastern Europe. Although these studies typically relied on different instruments rather than the Water Attitude Scale, they nonetheless reveal comparable regional dynamics. In Serbia, for instance, validation work identified a three-factor structure that emphasized the rejection of anthropocentrism and the salience of ecological crisis perceptions (Vdović, M. *et al*. 2024). A Czech study likewise confirmed that pro-environmental orientations among young people were present, but their internal consistency varied depending on the applied measurement tool, underscoring the challenges of transferring scales across contexts (Laníková, S. and Zíka, V. 2025). In Greece, the internal consistency of the NEP scale proved unsatisfactory, raising questions about its applicability in this cultural setting (Matsiori, S.K. 2020). Polish findings, by contrast, suggested a two-factor solution reflecting an ambivalence between economic development priorities and environmental responsibility (Dyr, W. and Prusik, M. 2020). Taken together, these results highlight that environmental attitudes in the region are strongly conditioned by socio-cultural and economic contexts, which not only reinforces the relevance of the Hungarian findings but also underscores the necessity of context-sensitive approaches in cross-cultural attitude research. Consequently, given that Hungarian public education traditionally places strong emphasis on lexical knowledge (i.e. the transmission of factual content), it is likely that students are relatively well equipped to understand even those items that may initially appear remote from their everyday experience—such as questions about water meters.

It should be noted that the findings of this research are subject to certain limitations that may affect their generalizability. Primarily, the study was conducted exclusively in the Southern Transdanubia region of Hungary, which may limit the applicability of the results to other geographic areas with differing environmental education contexts. In addition, the lack of responses from certain grades in some schools may introduce some bias and limit the robustness of the data. Another limitation is that socioeconomic variables (e.g. parental education, household resources) and finer-grained urban–rural distinctions were not available. These factors could have provided additional explanatory power and should be incorporated in future research.

Further research could be conducted in the form of longitudinal studies, tracking students' attitudes and awareness regarding water conservation throughout their educational trajectories. Such investigations would provide deeper insights into the evolution of these attitudes over time and the effectiveness of educational interventions. Additionally, expanding the study to encompass multiple regions across Hungary would enhance the generalizability of the findings and allow for comparative analyses of environmental attitudes in diverse educational settings. This approach could yield valuable data on regional differences in environmental awareness and inform the development of targeted educational strategies to address specific community needs.

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REFERENCES

Ajdukovic, I., Gilibert, D. and Fointiat, V. 2019. Structural confirmation of the 24-item Environmental Attitude Inventory. *PsyEcology: Bilingual Journal of Environmental Psychology* 10. (2): 184–216. https://doi.org/10.1080/21711976.2019.1586140

Amahmid, O., El Guamri, Y., Yazidi, M., Razoki, B., Kaid Rassou, K., Rakibi, Y., Knini, G. and El Ouardi, T. 2019. Water education in school curricula: impact on children knowledge, attitudes and behaviours towards water use. *International Research in Geographical and Environmental Education* 28. (3): 178–193. https://doi.org/10.1080/10382046.2018.1513446

Andl, H. 2023. „A sorsunk közös." Falvak és iskolák ("We share a common destiny." Villages and schools). *Educatio* 32. (2): 257–273. https://doi.org/10.1556/2063.32.2023.2.6

Andrade, E., Seoane, G., Velay, L. and Sabucedo, J.-M. 2021. Multidimensional model of environmental attitudes: Evidence supporting an abbreviated measure in Spanish. *International Journal of Environmental Research and Public Health* 18. (9): 4438. https://doi.org/10.3390/ijerph18094438

Aysu, B., Aral, N., Aydoğdu, F. and Gürsoy, F. 2025. Children's attitudes towards water: A scale development study. *Frontiers in Education* 10. Online publication. https://doi.org/10.3389/feduc.2025.1552082

Benarroch, A., Rodríguez-Serrano, M. and Ramírez-Segado, A. 2021. New water culture versus the traditional design and validation of a questionnaire to discriminate between both. *Sustainability* 13. (4): 2174. https://doi.org/10.3390/su13042174

Berze, I.Z., Varga, A., Mónus, F. and Dúll, A. 2024. Measuring the environmental worldview of Hungarian students. A confirmatory study on the dimensionality and validity of the Hungarian version of the NEP scale for children. *Magyar Pszichológiai Szemle / Hungarian Review of Psychology* 78. (4): 647–673. https://doi.org/10.1556/0016.2023.00068

Bodó, A. and Alpek, B.L. 2024. A környezettudatos gondolkodás és magatartás vizsgálata a Pécsi járásban (Examination of the environmentally conscious thinking and behaviour in the district of Pécs). *Modern Geográfia* 19. (3): 13–24. https://doi.org/10.15170/MG.2024.19.03.02

Braun, T., Cottrell, R. and Dierkes, P. 2018. Fostering changes in attitude, knowledge and behaviour: Demographic variation in environmental education effects. *Environmental Education Research* 24. (6): 899–920. https://doi.org/10.1080/13504622.2017.1343279

Brown, T. A. 2015. *Confirmatory Factor Analysis for Applied Research*. New York, Guilford Press.

Buckingham, B.R., McCall, W.A., Otis, A.S., Rugg, H.O., Trabue, M.R. and Courtis, S.A. 1921. Report of the Standardization Committee. *Journal of Educational Research* 4. (1): 78–80.

Dieser, O. and Bogner, F.X. 2016. Young people's cognitive achievement as fostered by hands-on-centred environmental education. *Environmental Education Research* 22. (7): 943–957. https://doi.org/10.1080/13504622.2015.1054265

DiStefano, C. and Hess, B. 2005. Using confirmatory factor analysis for construct validation: An empirical review. *Journal of Psychoeducational Assessment* 23. (3): 225–241. https://doi.org/10.1177/073428290502300303

Dyr, W. and Prusik, M. 2020. Measurement of pro-ecological attitudes within new ecological paradigm in Polish current settings. *Social Psychological Bulletin* 15. (3): https://doi.org/10.32872/spb.3697

Finch, H. 2006. Comparison of the performance of varimax and promax rotations: Factor structure recovery for dichotomous items. *Journal of Educational Measurement* 43. (1): 39–52. https://doi.org/10.1111/j.1745-3984.2006.00003.x

Freed, A. 2018. The relationship between university students' environmental identity, decision-making process, and behaviour. *Environmental Education Research* 24. (3): 474–475. https://doi.org/10.1080/13504622.2017.1320705

Galli, F., Bedin, L.M., Strelhow, M.R.W. and Sarriera, J.C. 2018. Propriedades psicométricas da escala de atitudes ambientais para crianças e da escala infantil de satisfação com o ambiente (Psychometric properties of the scale of environmental attitudes for children and the children's scale of satisfaction with the environment). *Psicologia: Teoria e Pesquisa* 34. e3454. https://doi.org/10.1590/0102.3772e3454

Global Water Partnership 2003. *Integrated Water Resources Management Toolbox: Sharing Knowledge for Equitable, Efficient and Sustainable Water Resources Management*. Stockholm, GWP.

Goodwin, L.D. and Leech, N.L. 2003. The meaning of validity in the new standards for educational and psychological testing: *Measurement and Evaluation in Counseling and Development* 36. (3): 181–191. https://doi.org/10.1080/07481756.2003.11909741

Gopinath, G. 2014. A study on environmental awareness among secondary school students in a district of Kerala State. *International Journal of Education and Psychological Research* 3. (2): 54–57.

Granit-Dgani, D., Kaplan, A. and Flum, H. 2017. Theory-based assessment in environmental education: A tool for formative evaluation. *Environmental Education Research* 23. (2): 269–299. https://doi.org/10.1080/13504622.2016.1144172

Grob, A. 1995. A structural model of environmental attitudes and behaviour. *Journal of Environmental Psychology* 15. (3): 209–220. https://doi.org/10.1016/0272-4944(95)90004-7

Grønhøj, A. and Hubert, M. 2022. Are we a growing a green generation? Exploring young people's pro-environmental orientation over time. *Journal of Marketing Management* 38. (9–10): 844–865. https://doi.org/10.1080/0267257X.2021.2005664

Hundemer, S., Monroe, M.C. and Kaplan, D. 2022. The water science communication problem: Water knowledge and the acceptance or rejection of water science. *Journal of Hydrology* 604. 127230. https://doi.org/10.1016/j.jhydrol.2021.127230

Hurlimann, A., Dolnicar, S. and Meyer, P. 2009. Understanding behaviour to inform water supply management in developed nations – A review of literature, conceptual model and research agenda. *Journal of Environmental Management* 91. (1): 47–56. https://doi.org/10.1016/j.jenvman.2009.07.014

Jackson, S. 2011. Aboriginal access to water in Australia: Opportunities and constraints. In *Water Resources Planning and Management*. Eds.: Quentin Grafron, R. and Hussey, K., Cambridge, Cambridge University Press, 601–628. https://doi.org/10.1017/CBO9780511974304.031

Jankó, F., Bertalan, L., Hoschek, M., Komornoki, K., Németh, N. and Papp-Vancsó, J. 2018. Perception, understanding and action: Attitudes of climate change in the Hungarian population. *Hungarian Geographical Bulletin* 67. (2): 159–171. https://doi.org/10.15201/hungeobull.67.2.4

Khademi, A., Wells, C.S., Oliveri, M.E. and Villalonga-Olives, E. 2023. Examining appropriacy of CFI and TLI cutoff value in multiple-group CFA test of measurement invariance to enhance accuracy of test score interpretation. *Sage Open* 13. (4): 1–11. https://doi.org/10.1177/21582440231205354

Knekta, E., Runyon, C. and Eddy, S. 2019. One size doesn't fit all: Using factor analysis to gather validity evidence when using surveys in your research. *CBE – Life Sciences Education* 18. (1): 1–17. https://doi.org/10.1187/cbe.18-04-0064

Kónya, G. 2019. Középiskolások környezeti attitűdjét meghatározó tényezők vizsgálata (Investigation of factors influencing environmental attitudes among high school students). Doctoral thesis, Sopron, University of Sopron.

Kopnina, H. 2011. Qualitative revision of the new ecological paradigm (NEP) scale for children. *International Journal of Environmental Research* 5. (4): 1025–1034. https://www.researchgate.net/publication/267153409

Kovačević-Majkić, J., Ćalić, J., Micić, J., Brankov, J., Milanović, R. and Telbisz, T. 2022. Public knowledge on karst and protected areas: A case study of Tara National Park, Serbia. *Hungarian Geographical Bulletin* 71. (2): 163–179. https://doi.org/10.15201/hungeobull.71.2.5

Lahiri-Dutt, K. 2020. Knowledge others, others' knowledge. *Ecology, Economy and Society – the INSEE Journal* 3. (2): 113–123. https://doi.org/10.37773/ees.v3i2.226

Laníková, S. and Zíka, V. 2025. Validation of environmental scales on a Czech sample. *PsyArXiv*. Article in review. https://doi.org/10.31234/osf.io/qf8kv_v1

Leeming, F.C., Dwyer, W.O. and Bracken, B.A. 1995. Children's environmental attitude and knowledge scale: Construction and validation. *The Journal of Environmental Education* 26. (3): 22–31. https://doi.org/10.1080/00958964.1995.9941442

Liefländer, A.K. and Bogner, F.X. 2018. Educational impact on the relationship of environmental knowledge and attitudes. *Environmental Education Research* 24. (4): 611–624. https://doi.org/10.1080/13504622.2016.1188265

Ligorio, M.B. 2010. Dialogical relationship between identity and learning. *Culture and Psychology* 16. (1): 93–107. https://doi.org/10.1177/1354067X09353206

Mamat, M.N. and Mokhtar, F. 2012. Reliable assessment model for affective environmental education: Rasch model made simple. In *Proceedings, 2012 International Conference on E-Learning and E-Technologies in Education (ICEEE).* Piscataway, NJ, IEEE, 171–174. https://doi.org/10.1109/ICeLeTE.2012.6333387

Matsiori, S.K. 2020. Application of the new environmental paradigm to Greece: A critical case study. *Economic Analysis and Policy* 66. 335–344. https://doi.org/10.1016/j.eap.2020.02.010

Milfont, T.L. and Duckitt, J. 2010. The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes. *Journal of Environmental Psychology* 30. (1): 80–94. https://doi.org/10.1016/j.jenvp.2009.09.001

Mohajan, H.K. 2017. Two criteria for good measurements in research: Validity and reliability. *Annals of Spiru Haret University. Economic Series* 17. (4): 59–82. https://doi.org/10.26458/1746

Moore, S., Murphy, M. and Watson, R. 1994. A longitudinal study of domestic water conservation behaviour. *Population and Environment* 16. (2): 175–189. https://doi.org/10.1007/BF02208782

Moreno, I., Amérigo, M. and García, J.A. 2016. Design and application of an environmental attitudes scale in primary education. *PsyEcology: Bilingual Journal of Environmental Psychology* 7. (1): 64–88. https://doi.org/10.1080/21711976.2015.1114217

Mostacedo-Marasovic, S.-J., Mott, B.C., White, H. and Forbes, C.T. 2023. Towards water literacy: Analysis of standards for teaching and learning about water on Earth. *Journal of Geoscience Education* 71. (2): 192–207. https://doi.org/10.1080/10899995.2022.2112490

Musser, L.M. and Malkus, A.J. 1994. The children's attitudes toward the environment scale. *The Journal of Environmental Education* 25. (3): 22–26. https://doi.org/10.1080/00958964.1994.9941954

Neal, P. and Palmer, J. 1994. *The Handbook of Environmental Education*. London, Routledge. https://doi.org/10.4324/9780203422021

Newman, T.P. and Fernandes, R. 2016. A re-assessment of factors associated with environmental concern and behaviour using the 2010 General Social Survey. *Environmental Education Research* 22. (2): 153–175. https://doi.org/10.1080/13504622.2014.999227

Ngan, S.F. and Li, C.S. 2025. Applying environmental attitudes of pre-service preschool teacher scale and its subscales to investigate the environmental attitudes of pre-service preschool teachers using the Rasch psychometric approach. *Social Sciences and Humanities Open* 12. 101768. https://doi.org/10.1016/j.ssaho.2025.101768

Otto, S., Evans, G.W., Moon, M.J. and Kaiser, F.G. 2019. The development of children's environmental attitude and behaviour. *Global Environmental Change* 58. 101947. https://doi.org/10.1016/j.gloenvcha.2019.101947

Pagano, L.P., Garofalo, C., Mazzeschi, C., De Caro, E.F. and Delvecchio, E. 2025. A systematic review of environmental identity: Definitions, measurement tools, and future directions. *Journal of Environmental Psychology* 105. 102657. https://doi.org/10.1016/j.jenvp.2025.102657

Palozzi, J.E., Harper, N.J. and Shackelford, N. 2025. From plants to pedagogies: reviewing environmental education pedagogies with a systems thinking approach to aid curricula development. *Environmental Education Research* 31. (7): 1509–1531. https://doi.org/10.1080/13504622.2024.2437694

Ramírez-Segado, A., Rodríguez-Serrano, M., Castro-Velásquez, F.E. and Benarroch, A.B. 2023. Knowledge of trainee teachers about the new water culture: A comparative study between two Spanish cities. *Sustainability* 15. (18): 13672. https://doi.org/10.3390/su151813672

Rejeski, D.W. 1982. Children look at nature: Environmental perception and education. *The Journal of Environmental Education* 13. (4): 27–40. https://doi.org/10.1080/00958964.1982.9942653

Revelle, W. 2018. *Psych: Procedures for Psychological, Psychometric, and Personality Research.* Evanstone, IL,

Northwestern University. https://CRAN.R-project.org/package=psych
Rios, J. and Wells, C. 2014. Validity evidence based on internal structure. *Psicothema* 26. (1): 108–116. https://doi.org/10.7334/psicothema2013.260
Rosa, C.D., Collado, S. and Larson, L.R. 2022. The utility and limitations of the new ecological paradigm scale for children. *The Journal of Environmental Education* 53. (2): 87–98. https://doi.org/10.1080/00958964.2022.2044281
Schaap, W. and van Steenbergen, F. 2001. *Ideas for Water Awareness Campaigns*. Stockholm, GWP.
Seelen, L.M.S., Flaim, G., Jennings, E. and De Senerpont Domis, L.N. 2019. Saving water for the future: Public awareness of water usage and water quality. *Journal of Environmental Management* 242. 246–257. https://doi.org/10.1016/j.jenvman.2019.04.047
Shi, D., Lee, T. and Maydeu-Olivares, A. 2019. Understanding the model size effect on SEM fit indices. *Educational and Psychological Measurement* 79. (2): 310–334. https://doi.org/10.1177/0013164418783530
Sindik, J. and Araya, Y.N. 2013. Raising awareness about water issues: The role of water symbolism and proverbs. *Journal of Water Resource and Protection* 5. (4): 34–39. https://doi.org/10.4236/jwarp.2013.54A006
Slaney, K. 2017. *Validating Psychological Constructs*. Cham, Palgrave Macmillan. https://doi.org/10.1057/978-1-137-38523-9
Streiner, D.L., Norman, G.R. and Cairney, J. 2015. *Health Measurement Scales*. Oxford, Oxford Medicine Online. https://doi.org/10.1093/med/9780199685219.001.0001
Sutton, S.G. and Gyuris, E. 2015. Optimizing the environmental attitudes inventory. *International Journal of Sustainability in Higher Education* 16. (1): 16–33. https://doi.org/10.1108/IJSHE-03-2013-0027
Tavakol, M. and Wetzel, A. 2020. Factor analysis: A means for theory and instrument development in support of construct validity. *International Journal of Medical Education* 11. 245–247. https://doi.org/10.5116/ijme.5f96.0f4a
Thompson, B. and Daniel, L.G. 1996. Factor analytic evidence for the construct validity of scores: A historical overview and some guidelines. *Educational and Psychological Measurement* 56. (2): 197–208. https://doi.org/10.1177/0013164496056002001
United Nations 1978. Intergovernmental Conference on Environmental Education, Tbilisi, USSR, 14-26 October 1977. Final report. United Nations.
United Nations 2010. Resolution adopted by the General Assembly on 28 July 2010. Resolution A/RES/64/292. United Nations.
United Nations 2023. The United Nations World Water Development Report 2023: Partnerships and Cooperation for Water. United Nations.
United Nations 2024. The United Nations World Water Development Report 2024: Water for Prosperity and Peace. United Nations.
Varjas, J. 2021. A fenntartható fejlődés megjelenése Magyarország és Anglia földrajztanterveiben (Sustainable development in the geography curricula of Hungary and England). *Modern Geográfia* 16. (2): 21–41. https://doi.org/10.15170/MG.2021.16.02.02
Varjas, J. 2022. The presence of sustainability in Hungarian geography textbooks. *European Journal of Geography* 13. (1): 22–46. https://doi.org/10.48088/EJG.J.VAR.13.1.22.46
Vdović, M., Hagen, M., Simonović, A., Avramović, N. and Milošević-Đorđević, J. 2024. Psychometric properties of the new ecological paradigm scale (NEP). *Psiholoska Istrazivanja* 27. (2): 267–295. https://doi.org/10.5937/PSISTRA0-47664
Vincent, S. and Focht, W. 2009. US higher education environmental program managers' perspectives on curriculum design and core competencies. *International Journal of Sustainability in Higher Education* 10. (2): 164–183. https://doi.org/10.1108/14676370910945963
Vucetich, J.A., Bruskotter, J.T., Ghasemi, B., Rapp, C.E., Nelson, M.P. and Slagle, K.M. 2024. A flexible inventory of survey items for environmental concepts generated via special attention to content validity and item response theory. *Sustainability* 16. (5): 1916. https://doi.org/10.3390/su16051916
Walsh-Daneshmandi, A. and MacLachlan, M. 2006. Toward effective evaluation of environmental education: Validity of the children's environmental attitudes and knowledge scale using data from a sample of Irish adolescents. *The Journal of Environmental Education* 37. (2): 13–23. https://doi.org/10.3200/JOEE.37.2.13-23
Wilfong, M., Paolisso, M. and Trombley, J. 2023. Introduction: Applying anthropology to water. *Human Organization* 82. (3): 197–208. https://doi.org/10.17730/1938-3525-82.3.197
Yeap, C.H., Ng Khar, T., Wahyudi, Y., Cheah, U.H. and Devadson, R.P. 2007. Development of a questionnaire to assess student's perceptions in values-based water education. Paper to the International Conference on Science and Maths Education (COSMED), Penang, Malaysia, 13–16 November 2007. https://www.researchgate.net/publication/228640245
Yu, J.-H., Lin, H.-H., Lo, Y.-C., Tseng, K.-C. and Hsu, C.-H. 2021. Measures to cope with the impact of climate change and drought in the Island Region: A study of the water literacy awareness, attitude, and behaviour of the Taiwanese public. *Water* 13. (13): 1799. https://doi.org/10.3390/w13131799
Zhu, Z., Wang, H. and Li, A. 2019. On the factors influencing public knowledge and acceptance of reclaimed water from a survey of three cities in northern China. *Journal of Water Reuse and Desalination* 9. (2): 193–202. https://doi.org/10.2166/wrd.2018.049

Appendix A

The modified WAS scale. (Questions to be deleted by CFA are marked in red)

Grade: ______________________ **Gender**:________________________(boy/girl)

Circle where you live!
a.) Municipality
b.) Village
c.) City

Circle what type of living environment you live in!
a.) Single-family house
b.) Apartment building (panel)
Other:

Decide whether you agree or disagree with the following statements! Mark the box with an X!

Strongly Disagree	Disagree	Agree	Strongly Agree

	Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
1	It is alright to keep tap water running when brushing teeth.				
2	Using high quality water or safe water for gardening is wasteful.				
3	It is important not to dirty drains, rivers, lakes, sea, or catchment area.				
4	I should report cases of water pipe leakage, water pump or any sanitation facility defects to my teachers or parents.				
5	I would report water theft if I saw it. (e.g., someone uses a neighbor's water without paying for it)				
6	Only people who cannot afford to pay water bill should try to save water.				
7	I read books or follow news about water issues.				
8	It is not necessary to discuss the values of water in school.				
9	I like to share my knowledge about how to save water.				
10	Water is cheap, we do not have to try hard to save it.				
11	I have the responsibility to save water even there is enough for use.				
12	I would like to participate in a water-saving campaign. (The purpose of this would be to encourage people to save water)				
13	I would like to work together with others to clean wells, sinks or other sanitation facilities. (sanitary – faucets, showers, bathtubs etc.)				
14	Maintaining the cleanliness of the toilet is too difficult. I can leave it to my parents or family to do that.				
15	I would persuade others to save water even though I must try very hard.				
16	Tempering with water meter is wrong. (a water meter measures water consumption in a house/apartment)				
17	I appreciate the beauty of lakes, rivers and sea.				
18	The water cycle stabilizes our environment. (without the water cycle, the ecosystem would be harmed)				
19	Water is important to health.				
20	Since there is no shortage of water in my school or home, I do not have to take much care about saving water.				
21	Supplying water to homes is the responsibility of the government only.				
22	Even there is enough water now, we should save water for future use.				
23	Rich and poor people should be charged the same water tariff.				
24	It is important for girls to have proper water supply and sanitation facilities as for boys.				
25	I often make facilities clean for the next users.				
26	Cutting down too many trees causes more erosion. (erosion = the degradation of land surfaces)				
27	I like to walk along streams, rivers or beaches.				
28	It is better not to report cases of water theft. One theft case does not cost much to the authority concerned.				
29	It is as important for the poor to have proper water supply and sanitation facilities as for the rich.				

Thank you very much for filling this out! If you have any additional comments, you can share them with us below:

Appendix B

The modified WAS scale (Final version)

1	It is all right to keep tap water running when brushing teeth.	14	Tampering with a water meter, or manipulating it, is wrong (a water meter measures household water use).
2	It is important not to dirty drains, rivers, lakes, sea, or catchment area.	15	I appreciate the beauty of lakes, rivers, and the sea.
3	If I see leakage in water pipes or at the toilet, I should tell my parents or teachers.	16	The water cycle stabilizes our environment (without the water cycle, ecosystems would be harmed).
4	I would report water theft if I see it (e.g. someone uses a neighbour's water without paying).	17	Water is important to health.
5	Only people who cannot afford to pay water bill should try to save water.	18	Since there is no water shortage in my school or home, I do not have to care much about saving water.
6	I read books or follow news about water issues.	19	Even if there is enough water now, we should still save water for future use.
7	It is not necessary to discuss the values of water in school.	20	Rich and poor people should be charged the same water tariff.
8	I like to share my knowledge about how to save water.	21	It is important for girls to have proper water supply and sanitation facilities just like boys.
9	Water is cheap, we do not have to try hard to save it.	22	I usually clean the sanitary facilities after use for the next user (sanitary facilities: taps, bathtubs, showerheads, etc.).
10	I have the responsibility to save water even when there is enough for use.	23	Cutting down too many trees causes more erosion (erosion: the degradation of soil/land).
11	I would like to participate in a water-saving campaign (whose goal is to encourage people to save water).	24	I like to walk along streams and rivers, and along lake shores.
12	I would like to work together with others to clean drinking fountains, sinks, or other sanitary fixtures (e.g. taps, showerheads, soap dispensers, etc.).	25	It is just as important for the poor to have proper water supply and sanitation facilities as for the rich.
13	I would persuade others to save water even though I have to try very hard.		

Note: The original Hungarian version of the validated questionnaire (mWAS) is available in *University of Pécs Institutional Repository* under http://doi.org/10.15170/modifiedwasscale-2025