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Measuring Water Saving Awareness in Preschool Children

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Abstract: A comprehensive water conservation awareness scale was developed to assess the awareness levels of preschool children regarding water conservation. This scale encompasses four distinct dimensions: personal action awareness, daily activity awareness, outdoor water use awareness, and shared responsibility awareness. The study involved 471 children from four kindergartens located in Uşak Province. The four-factor structure of the scale was validated through both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), confirming its reliability and construct validity. The overall scale demonstrated a Cronbach's alpha coefficient of 0.79, indicating a high level of internal consistency. The developed scale is intended to serve as a critical tool for evaluating the effectiveness of educational programs aimed at fostering water conservation awareness among young children. Additionally, it provides valuable insights for the design and implementation of early childhood education initiatives focused on environmental sustainability. The findings are expected to contribute significantly to the promotion of water-saving behaviors from an early age.

Keywords: Water conservation awareness; Preschool children; Scale development; Environmental education

1. Introduction

Water is one of the most valuable resources on the earth and acts as a basic necessity for all living organisms. Oceans and seas occupy roughly 71% of the earth's surface, and only 1% of the total water is available for human consumption and ecosystems (United Nations, 2022). This scarcity, combined with the increase in global demand and effects of climate change, has led to a global water crisis that presents serious challenges to the development and welfare of mankind (Dankelman, 2010). The crisis is further compounded by water pollution, driven by unsustainable water usage practices, which jeopardizes the already scarce water resources (Worthington & Whittaker, 2006).

In order to overcome this challenge, it is crucial to enhance water conservation consciousness, particularly among the young. The study shows that the first-stage child development is significant because it is the foundation of further environmental attitudes and behaviors (Chawla & Cushing, 2007; Liefländer & Bogner, 2018). Such awareness is best fostered in preschool education institutions (Elliott & Davis, 2009; Davis & Elliott, 2023). It is critical to consider children's previous knowledge and beliefs about water in order to successfully modify their attitudes and behaviors.

According to cognitive development theories, including cognitive constructivism theory by Piaget (1964) and sociocultural theory by Vygotsky (1978), direct experiences and interactions with the environment in the early years of a child's development have a significant impact on the development of their environmental concepts and attitudes (Piaget, 1964; Vygotsky, 1978). However, a lack of adequate and accurate assessment tools makes it difficult to assess the level of water conservation awareness in young children and evaluate the effectiveness of such educational interventions (Fraenkel et al., 1993).

As of 2024, the goals in many countries of preschool education programs have become closer to water conservation, which indicates the increasing role of environmental education in the preschool age (Seacrest & Herpel, 1997). However, there still remain challenges in the measurement of these educational interventions or initiatives due to the absence of proper instruments.

This study aims to address this gap by developing a reliable and valid scale to assess water conservation

awareness among preschool children aged 60-72 months. Grounded in social learning theory and environmental education frameworks, the significance of early experiences in shaping long-term behaviors and attitudes was emphasized in this study (Bandura, 1977; Palmer, 2002). This study addresses the following research questions:

- What are the key dimensions of water conservation awareness in preschool children?
- Can a reliable and valid scale be developed to measure these dimensions?
- How effective is this scale in assessing water conservation awareness among children aged 60-72 months?

It is necessary to create this tool for several reasons. It allows educators and researchers to assess the impact of water conservation education for young children, helps to understand how children perceive water conservation and how they are willing to engage in it, thereby contributing to the development of more effective educational interventions (Wilson, 2007). This study is useful in the overall field of environmental education as it provides a methodological approach towards evaluating environmental consciousness in early childhood.

The study results are expected to have a great influence on the future design, execution and assessment of educational interventions in an attempt to enhance water conservation consciousness at an early age. This study thus offers a clear measurement tool that forms a basis for practice-based research on environmental education in early childhood facilities. The rest of this study is designed as follows: Section 2 reviews the relevant literature; the methodology is explained in Section 3; Section 4 presents the findings; and Section 5 presents the conclusion of this study.

2. Literature Review

It is important to develop water conservation awareness in preschools because it helps to form habits that will continue into the future (Elliott & Davis, 2009; Davis & Elliott, 2023). Research highlights the need for effective educational interventions and reliable measurements that can assess and improve young children's water conservation awareness, knowledge and behaviors. Water awareness in early childhood lays the foundation for future ecological attitudes and behaviors. Recent research has emphasized the cognitive developmental aspects of environmental awareness in young children. For example, Collado et al. (2017) showed that preschool children developed basic ideas about the environment, such as water conservation, through age-appropriate presentations. Similarly, Samaltani & Christidou (2013) found that through focused interventions, preschool children demonstrated an adequate understanding of simple water concepts.

Recent studies on environmental awareness scales designed for young children have demonstrated methodological advances in this field. For example, Larson et al. (2011) developed an age-appropriate environmental perception scale for children. This study pioneered new methodologies in scale development for children's environmental education.

Global perspectives on water conservation education at the early childhood level have also gained importance in recent years. Ärlemalm-Hagsér & Elliott (2017) examined the integration of sustainability into early childhood curricula in five different countries, highlighting the importance of a uniform policy approach to environmental education in preschools. This study offers important insights into how water conservation education is addressed in a global context. Somerville & Williams (2015) summarized recent developments in ecological teaching targeting young children and emphasized the importance of environmental education in early childhood. This study supports the importance of starting environmental education, including water conservation, at an early age.

In a more recent study, Green et al. (2016) developed a new scale to measure environmental awareness in preschool children, with a specific focus on water conservation awareness. This scale is particularly relevant as it underscores the significance of this research and aligns with contemporary trends in the field. The importance of water conservation education in early childhood and the gaps in measurement tools were revealed by this literature review. Different educational programs are available, but there is still a need for a valid and reliable scale to assess preschool children's water conservation awareness. In particular, there is no specific tool to measure water awareness among children aged 60-72 months (Ursavaş & Aytar, 2018). Finally, a meta-analysis study by Cheng & Monroe (2012) examined the long-term effects of environmental education in early childhood and emphasized the importance of developing water conservation awareness. This study shows that environmental awareness gained at an early age can lead to lifelong behavioral changes.

This literature review clearly demonstrates the need for a valid and reliable scale to measure water conservation awareness in preschool children. Therefore, the aim of this study is to develop a scale to fill this gap in the literature and contribute to the field.

3. Methodology

This study aims to develop a scale to measure preschool children's water conservation awareness. The scale development process was carried out in four stages: creating an item pool, obtaining expert opinions, pilot

implementation, and actual implementation.

Stage 1: Creating the item pool

The literature review reveals that water conservation awareness consists of four dimensions: personal action awareness, daily activity awareness, outdoor water use awareness, and shared responsibility awareness (Hollweg et al., 2011; Miller et al., 2014, Roth, 1992). To reflect these dimensions, 20 items were developed, each specifically designed to align with one of the four dimensions. For example:

- Personal action awareness (*K-E*): Items such as "Is it right to use more soap and shampoo when bathing?" were created to assess personal water-saving behaviors.
- Daily activity awareness (*G-F*): Items such as "It is bad to flush the toilet multiple times after using it?" were included to measure awareness of daily routines.
- Outdoor water use awareness (*D-M*): Items such as "Should we water the lawn every day?" were developed to measure awareness of outdoor activities.
- Shared responsibility awareness (*P-S*): Items such as "Water is only important for people?" aim to assess children's understanding of shared responsibility for water use.

The items were prepared on a three-point Likert scale (yes, no, and no opinion) to be suitable for young children (Borgers et al., 2000).

Stage 2: Expert opinions

The draft scale was then presented to five experts in the fields of preschool education, measurement and evaluation, and water education for content validity. These experts provided feedback on the comprehensibility, appropriateness and relevance of the items. In line with their suggestions, five items were revised and the other five items were removed to form a 15-item trial form. This process ensured that the items accurately represented the four dimensions of water conservation awareness (Haynes et al., 1995).

Stage 3: Pilot implementation

The pilot version of the scale was administered to 100 children from four kindergartens in Uşak Province. Item analysis was conducted, including item-total correlations (Worthington & Whittaker, 2006). Items with low correlations were removed, leaving a final scale of ten items. This stage allowed the scale to be developed based on empirical data.

Stage 4: Actual implementation

In the final stage, the ten-item scale was administered to a sample of 371 children selected by simple random sampling from four kindergartens in Uşak. Data were collected through one-on-one interviews conducted by the teachers (Ravanis & Bagakis, 1998). The interview process involved reading each statement to the children and recording their responses. Teachers were specially trained to administer the scale. This training included the following topics:

- The purpose and theoretical basis of the scale
- Standard operating procedures
- Strategies to avoid potential biases

In this framework, the following steps were taken to minimize biases during data collection:

- All interviews were conducted in a calm and child-friendly environment.
- Teachers avoided giving verbal or non-verbal cues that could influence children's responses.
- Each child was given the same standardized instructions.
- Answers were recorded immediately and impartially.

Teachers trained in standardized interview techniques conducted one-on-one interviews with children. Each statement was read aloud to the children, who indicated their responses by choosing one of three options: "yes", "no" or "no opinion". Teachers recorded the first option that came to the children's minds. It took approximately seven minutes to complete the entire scale, which is appropriate for young children's attention span (Borgers et al., 2000).

4. Analysis and Findings

4.1 Suitability of the Data for Factor Analysis

In the data analysis process, EFA and CFA were used to test the construct validity of the scale. RStudio was

used for EFA. Principal component analysis (PCA) and varimax rotation were applied. For the CFA, the "lavaan" package in the R program was utilised, with the maximum likelihood estimation method applied.

Before starting the data analysis, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were applied to assess whether the data were suitable for factor analysis. The KMO value was calculated as 0.76 and Bartlett's test of sphericity yielded significant results ($\chi^2(190) = 1067.53$, $p < 0.001$), as shown in Table 1. These findings indicate that the sample size is sufficient and that there are relationships between the items suitable for factor analysis.

Table 1. Results of KMO and Bartlett's test of sphericity

Tests	Values
KMO	0.76
Bartlett's test of sphericity	$\chi^2(190) = 1067.53$, $p < 0.001$

4.2 Exploratory Factor Analysis

To explore the underlying factor structure of the scale, an EFA was conducted using PCA with varimax rotation. The analysis revealed a four-factor structure, explaining 53% of the total variance. The factors explain 20%, 18%, 12%, and 3% of the variance, respectively.

The factor loadings for each item are presented in Table 2. Items that loaded strongly on each factor were retained, with factor loadings ranging from 0.542 to 0.72, indicating that the items well align with the relevant factors.

Table 2. EFA results and factor loadings

Items	Factor 1: Personal Action Awareness	Factor 2: Daily Activity Awareness	Factor 3: Outdoor Water Use Awareness	Factor 4: Shared Responsibility Awareness
Item 1	0.573			
Item 2	0.577			
Item 3	0.633			
Item 4		0.61		
Item 5		0.59		
Item 6		0.6		
Item 7			0.691	
Item 8			0.667	
Item 9				0.542
Item 10				0.72

Note: Items 1, 2, 3, 8, 9 and 10 are reverse items.

These results show that the scale has a clear and interpretable structure with items grouped according to the four dimensions of water conservation awareness.

4.3 Confirmatory Factor Analysis

To confirm the factor structure identified in the EFA, a CFA was conducted using the maximum likelihood estimation method. The CFA results support the four-factor model and the model fit indices show excellent fit to the data.

As shown in Table 3, the model fit indices confirm the adequacy of the model by showing that the Chi-Square value is not significant and the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) values are within acceptable ranges.

Table 3. CFA model fit indices

Fit Indices	Values
Chi-Square (χ^2)	31.543, df = 29, p-value = 0.340
CFI	0.995
TLI	0.992
RMSEA	0.015 (90% confidence interval: 0.000 - 0.044)
SRMR	0.032

As seen in Figure 1, the factor loadings of the items are high and significant. This indicates that each item

represents the relevant factor well and the construct validity of the scale is strong. These factor loadings support the overall fit of the model and the validity of the scale.

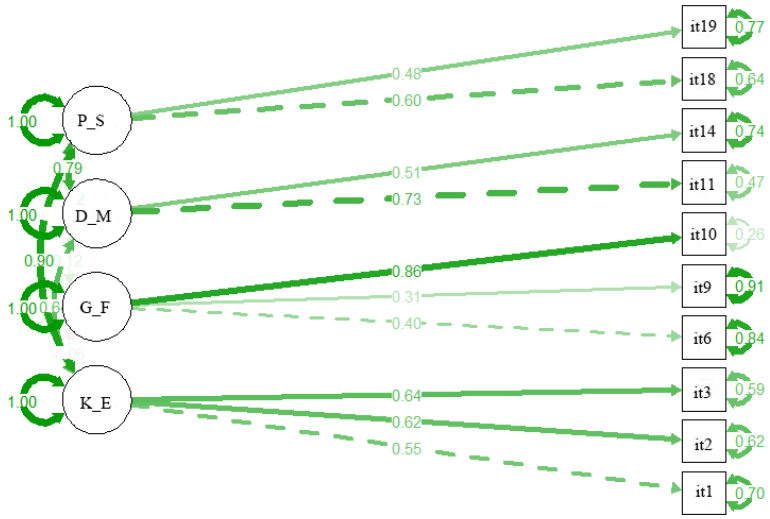

Figure 1. Path diagram and factor loadings of the model
Note: This figure was prepared by the authors.

4.4 Reliability Analysis

The internal consistency of the scale was assessed using Cronbach's alpha. The overall Cronbach's alpha value of the scale is 0.79, which indicates satisfactory reliability. The internal consistency coefficients for each factor are as follows:

- Factor 1: personal action awareness, $\alpha = 0.79$
- Factor 2: daily activity awareness, $\alpha = 0.78$
- Factor 3: outdoor water use awareness, $\alpha = 0.72$
- Factor 4: shared responsibility awareness, $\alpha = 0.75$

These values indicate that each subscale of the scale is reliable. Furthermore, the effect on Cronbach's alpha was analyzed when any item was removed. The reliability coefficients range from 0.76 to 0.79. This analysis confirms that the removal of any item cannot significantly affect the overall reliability of the scale.

5. Conclusions

A valid and reliable scale was developed in this study to measure water conservation awareness in preschool children aged 60-72 months. The four-factor structure of the scale, i.e., personal action awareness, daily activity awareness, outdoor water use awareness, and shared responsibility awareness, provides a comprehensive framework for understanding the various dimensions of water conservation awareness in young children.

The scale's robust psychometric properties, as demonstrated by the results of EFA and CFA, support its construct validity and reliability. The KMO value was 0.76; Bartlett's test of sphericity was significant; and the four-factor structure was confirmed by EFA and CFA. All of these indicate the structural integrity of the scale. Furthermore, the overall Cronbach's alpha coefficient was 0.79, and the inter-factor internal consistency coefficients range from 0.72 to 0.79, indicating high reliability.

The development of this scale represents an important step in evaluating the effectiveness of water conservation education and contributes to the broader field of environmental education research. The developed scale provides a tool for assessing the impact of the curriculum on water conservation and adapting teaching approaches accordingly. It can also be used for the development of early childhood environmental education policies. The four-factor structure of the scale can be used to create more targeted and effective water conservation programs for young children.

However, this study has some limitations. First, the scale was validated for a specific age group (60-72 months), which may limit its applicability to other age groups. Second, the sample was selected from a specific geographical region, which may limit the generalizability of the results. Third, it should be considered that there may be a social desirability effect on children's responses. Finally, the cultural sensitivity of the scale has not yet been tested and its use in different cultural contexts may require additional studies.

Several recommendations for future research can be made. First, the applicability of the scale to different age groups and cross-cultural settings could be explored. Second, longitudinal studies using this scale may provide valuable insights into the long-term impact of early water conservation awareness on later behaviors and attitudes. Third, future research could examine the relationship between scores on this scale and water-saving behaviors in both children and their families. Fourth, researchers could also examine how different educational interventions affect the scale scores over time. Furthermore, administering the scale to children from different socioeconomic groups could provide insights into how water conservation awareness is related to socioeconomic factors. In addition, the development of a digital-version scale may facilitate reaching larger samples and speed up the data collection process.

In conclusion, the scale developed in this study provides a valuable tool for assessing water conservation awareness in preschool children. This scale fills an important gap in the field of early childhood environmental education and provides a solid foundation for future research. The use of the scale can help educators and policymakers to design and implement more effective strategies to improve water conservation awareness in young children. In the long run, this can help to improve the overall water-saving behavior of society and contribute to a sustainable future.

By using and developing this scale, future research can contribute to improving the effectiveness of early childhood environmental education and efforts to conserve global water resources. It is expected that this study can inspire research and practice on developing environmental awareness at an early age, which is critical for a sustainable future.

Author Contributions

The authors have contributed equally to this work. All authors read and approved the final manuscript.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

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