Water Literacy Evaluation in Urban Society (Case study: Isfahan City)

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Abstract

Water literacy is a new concept in the studies of water demand management that calculates the water knowledge, attitude and behavior of people in a society. This research used surveys and questionnaires to account the water literacy of citizens in Isfahan city and examined the roles of different variables, such as education, gender, income and employment by statistical analysis. For this purpose, the sampling society was selected citizens older than 20 years in which questionnaires were collected from 398 people. Results showed that the mean score of water literacy among citizens were 43.5 (out of 100). Here, only 1% of respondents could achieve a score above 66, while 10% were below 33. Water knowledge could receive the lowest score (34.1), while attitude had the highest score (47.6). Although the regression analysis indicated that the three pillars of water literacy were relatively independent, behavior and attitude had the highest correlation with water literacy. Comparative analysis also revealed that having college education, stable job, high income or higher age (>40) could significantly increase the water literacy. This index was higher for men than women as well. These outcomes show that water literacy and its components can be quantified in urban areas.

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Extended abstract

Introduction

In 1958, UNESCO announced the first definition of literacy. This definition evolved in 1978 and 2005, particularly when the "plurality of literacy" could expand its perspectives. Environmental literacy is an example in plural literacy. It is the main objective of environmental education based on sustainable development goals (SDGs). The objective of environmental education is to improve the awareness, incentives, commitment, and skills of citizens to rationally deal with environmental challenges. In a nutshell, environmental literacy is made of three main pillars of knowledge, attitude and behavior that should be learnt continuously and in long-term. Knowledge represents basic information learnt by education or experience. Attitude points to the sensitive or sensible perspectives about a subject. Hopes, frustrations and values can be included as attitude. Behavior is an index for rational actions carried out in specific conditions.

Water literacy can similarly include these three pillars (Figure 1). Water management and saving methods in urban societies should be educated for citizens, particularly in arid areas. Isfahan is a city with dramatic water scarcity. However, there is a lack of knowledge about the level of water literacy in this society. Therefore, this research calculates the water literacy of citizens living in Isfahan, with population more than 2 millions, based on field surveys and statistical analysis.
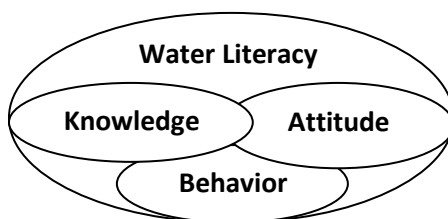

Figure 1. The three pillars of water literacy

Material and methods

This research used questionnaires and field surveys to collect the required data from citizens in Isfahan City. The population of the study consisted of all citizens of Isfahan having more than 20 years old. Therefore, the sample size based on Kukran formula was 384 citizens. Accordingly, the whole questionnaires were totally collected on 2020, in two forms of virtual (37%) and physical (63%). Here, a self-made questionnaire with 36 questions was used. These questions enquire about the knowledge, attitude, and behavior (each 12 questions) of citizens about water in urban areas. These questions consist of different topics in urban water management such as: water supplies, water scarcity, leakage and bursts, water cycle, water saving methods, water tariffs, virtual water, the treatment process, water quality and sanitation, personal hygiene or obsessions, actions during water switch-offs, dependability to tap water, their responses to water misuse, and etc.

It should be noted that questionnaires were developed by a two-step pre-test. The validity of the instrument was controlled by 4 experts of National Water and Wastewater Company (NWWC) and 3 professors in University of Isfahan. The reliability of questionnaire was measured by Cronbach's alpha as 0.73, 0.8 and 0.87 for water knowledge, attitude, and behavior, respectively.

Data analysis was carried out by the application of descriptive and inferential statistics by SPSS (version 23) and Minitab (version 19). Kolmogorov–Smirnov (KS) and Anderson-Darling (AD) were used to control the normality of results about water literacy. One-way analysis of variance (ANOVA) was used to compare water literacy in different variables. The impacts of gender, age, education, employment, living property, and income status of respondents on water literacy were examined. In this test, the reliability of 95% confidence interval (P-value < 0.05) was set as the criterion. In addition, Pearson test was used for correlation, while path analysis used partial least squares (PLS) regression with standardized coefficient.

Results and discussion

The normality tests verified that water literacy follows a normal probability distribution function. The skewness and kurtosis of these data were 0.18 and 0.27, respectively and KS and AD were 0.074 ($P<0.05$) and 1.5 ($P<0.05$), respectively. The mean of water literacy was calculated as 43.5 (out of 100) with standard deviation of 9.5. Here, the first and third quartiles were 37.1 and 50, respectively. It verified that the majority of citizens (about 89%) in Isfahan had moderate water literacy having score between 33 and 66.

Among the three pillars of water literacy, surveys revealed that water knowledge could gain the lowest score (34.1), while attitude received the highest (47.6). Here the average score of behavior calculated as 43.9. It means that the citizens have little information about the basics of water but they have better understanding about its value and risks. This conclusion contradicts the results of previous studies in which knowledge was claimed as a prerequisite for good attitude or behavior in environmental literacy. It can be due to the fact that the life of people living in arid or semi arid area, like Isfahan, is very reliant on water. Therefore, the value, risks, and water saving methods may not necessarily dependent on the basic water knowledge. Path analysis with regression modeling also revealed that water literacy is mostly dependant on water behavior ($\beta= 0.77$) and attitude ($\beta= 0.66$) than basic knowledge ($\beta= 0.57$) as illustrated in Figure 2.

The comparative statistical analysis also demonstrated that variables such as gender, age, education, employment and income were effective on water literacy in the study area. Table 1 outlines the mean, standard deviation, and P-value of water literacy for each variable based on one-way T-test. It can be concluded that having a college education, a stable job, higher income, or age more than 40 may give citizens some personality or a character that presents responsibility to the citizens for water and can be reflected in attitude or behavior. In a traditional masculine society of Isfahan, being a man may also bring this kind of responsibility. Therefore, the intrinsic motivation for life and the responsibility of water saving can improve water literacy in a society. However, higher education seems to be the most influential variable according to the path analysis. In addition, it is realized that higher water literacy may reduce the satisfaction of citizens about the performance of water supply companies. It roots in higher education and consequently increases the expectations from water companies.
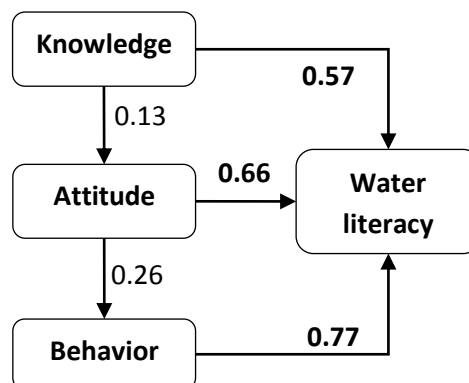

Figure 2: path analysis of water literacy and its variables

Conclusion

This research accounts the water literacy of citizens in a mega city in Iran based on basic knowledge, attitude and behavior. According to the results, it can be concluded that:

- Water literacy is moderate for the majority of citizens in Isfahan.
- Basic knowledge, attitude and behavior can independently enhance water literacy in which behavior and attitude are mostly influential.
- Having higher education, a stable job, higher income as well as being in the middle age (> 40 years old) can provide an opportunity for citizens to enhance their water literacy.

- People with higher water literacy showed less satisfaction about the performance of water companies. It implies that water literacy can be introduced as 1) an index for public water education programs, and 2) a motivation for upgrading the performance of water companies.

Table 1: comparative statistical analysis of water literacy in different variables

Variable	Group	Count	Mean	Std. deviation	P-value (T-test)
Gender	Man	204	44.72	8.98	0.004
	Woman	194	41.91	9.45	
Age	< 40	286	42.82	9.52	0.042
	> 40	112	45.19	8.30	
Education	College	222	42.56	9.89	0.000
	School	176	39.99	7.16	
Employment	Employed	236	44.62	9.29	0.000
	Unemployed	162	41.09	8.92	
Income	High	179	45.15	10.05	0.002
	Low	219	42.13	8.57	
Living property	Owner	209	43.51	9.69	0.716
	On rent	189	43.15	8.79	