



Secondary school teachers' knowledge, perceptions, and attitudes toward renewable energy in Jordan



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ABSTRACT

Successful energy planning requires substituting the standard economic model with a more transparent public participatory model because people play a fundamental role in climate change mitigation and renewable energy (RE) deployment. This approach requires improving communication with society and enabling smooth delivery of easy to digest information to citizens in both formal and informal educational settings. In this context, education and teachers, as the principal components, are recognized as one mechanism. We conducted a survey-based study, collecting 260 questionnaires from secondary school teachers in Jordan aiming to investigate their knowledge, perceptions, and attitudes toward RE development. The main findings of this study revealed that teachers have limited knowledge of RE and neutral perceptions regarding its use. However, teachers showed clear positive attitudes toward RE development. Overall, male teachers exhibited slightly higher knowledge of RE and female teachers held stronger positive attitudes. A number of socio-demographic and work related factors did not influence the teachers' knowledge and attitudes toward RE. It was also found that teachers require personal training regarding RE before it is introduced into school curricula.

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1. Introduction

Humans have unquestionably entered the unprecedented *Anthropocene* era [1,2]. The restless endeavor to utilize fossil resources to mainly please the growth-addicted culture and supply the accompanying unfettered menu of “must-haves” of the average modern lifestyle has caused myopia and numbness toward serious ecological crises such as climate change [1]. The axis of climate change mitigation consists of a series of international treaties that have been ratified (e.g. The Kyoto protocol), proposed global energy governance [3], and recommended community-based adaptation measures [4]. However, these actions have been proven to be a remarkably insufficient and inefficient means to tackle the problem of accumulating CO₂ emissions in the atmosphere [5,6]. From the shadows of this formidable global challenge, the idea of availing ourselves of renewable energy (RE) resources came to light and witnessed a noteworthy growth, standing at 16.7% in 2011 [7]. It has however been widely acknowledged that RE alone will not withstand the overwhelming and ever increasing demand for energy in the near future [8]. Furthermore, a recently concluded evaluative

study of several existing smart grid projects revealed that consumer acceptance and awareness is an indispensable pre-requisite of smart grid success [9]. A growing wealth of scholarly research therefore proposes reducing energy consumption through changing people's behavior as an alternative to the standard economic model that only embraces financial incentives [10–12]. In this context, increasing public awareness in energy consumption often results in lower energy (mainly electricity) use [9]. For instance, a Dutch study concluded that “the more respondents thought they were capable of saving energy, the more energy they tended to save” [13]. Moreover, it was found that a 7.4% reduction in the national carbon emissions of the U.S. seems achievable through household actions without jeopardizing well-being [14]. In a recently published report by the European Energy Agency (EEA), the potential energy savings due to measures targeting behavior may reach up to 20% if certain interventions such as feedback and energy audits are deployed [15]. The aforementioned trends in energy consumption place greater emphasis on the role of education as a pre-requisite to successful energy policy through knowledge dissemination, community participation, and understanding the relationship between technology and human behavior [12,16,17]. In this regard, the importance of Environmental Education (EE) is gaining prominence around the world. It is regarded as an imperative tool with which to galvanize RE development [18,19]

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and cultivate public awareness of contemporary environmental issues. Environmental Education is a 50-year old discipline. It seeks to contribute to environmental sustainability through a diversity of practices from information dissemination to capacity building [20]. It targets young people and adults in formal and informal educational settings and strives to engage people in new ways of thinking and acting that ultimately create environmentally literate citizens [21,22]. Advancing education for sustainable development to empower people was a key recommendation of a high level panel report addressed to the UN Secretary-General on Global Sustainability [23].

Teachers are the principal component at the heart of education and the pedagogical process, and are thus the keystone of knowledge dissemination and enhancing societal acceptance of newly developed technologies. Teachers who are receptive and knowledgeable as regards RE will in turn assist young students to acquire proper knowledge and values regarding RE and its benefits to society and the environment [16,24].

In Academia, teachers' attitudes toward a mosaic of environmental issues have received ample research emphasis. However, in the light of the global ecological challenges, teachers have become the subject of new research arenas concerning sustainable development (SD) [25,26] and, more recently, RE issues [16]. Findings from such research studies have accentuated some teacher's misconceptions of SD and RE, despite them having a high level of interest in such issues [25–27]. Nevertheless, in spite of academic propensity, there is a paucity of research into the attitudes of teachers toward RE and the factors that influence these attitudes, such as socio-economics, bio-demographics, and the teacher's personal teaching profile.

Many of the Middle Eastern countries suffer between the hammer of asymmetric climate change (emitting the least but suffering the most) and the anvil of physical scarcity of potable water and horrendous energy prices [28,29]. The wind of change, resulting in the so called *Arab Spring*, unveiled some of the most formidable socio-economic and political challenges confronting the region. It also underscores the urgent need for a transparent and participatory approach to elevate public awareness of the adverse effects of climate change, and to change public attitudes toward old-fashioned energy and water consumption. Education in these countries has explicitly reduced illiteracy and the teacher remobilization program (e.g. from Jordan to the Gulf States) has contributed to the economies of both sides. However, in the *Anthropocene* era new pedagogical approaches to education, targeting adults and young people, are undoubtedly necessary to engage the public in the process of climate change mitigation, and to create new energy and water conscious citizens.

1.1. Jordan as a case study

Jordan is small country located at the heart of the Middle East, in an area also called *the Levant*. Due mainly to high fossil fuel subsidies and energy dependence, Jordan suffers a mosaic of socio-economic and political challenges. For instance, 96% of Jordan's primary energy is in the form of imported fossil fuels, coming mainly from Iraq and Saudi Arabia [29]. Natural gas fuels 65–80% of the electricity generation, and it arrives in Jordan through a pipeline extending from the Egyptian *Sinai* desert. This supply has been halted 15 times due to bombing attacks after the ousting of the former Egyptian regime. The ultimate consequence for Jordan has been the exacerbation of internal and external debt to a threatening level. While political instability in the region continues, climate change, the energy crisis, and water shortage will place overwhelming pressure on the government to meet the future demands of the steadily growing population. However, in the light of

resource scarcity, the current policies may fail and societal opposition will thus pervade. This is of crucial significance to many relevant policies, such as those which aim at cutting the fossil fuel subsidies and encouraging public energy saving measures.

More fortunately, on the other hand, Jordan is a very young country: about 33.8 percent of its population (7 million inhabitants) is aged 0–14 years, 62.4 percent are 15–64, while only 3.8 percent of the population is 65 years or older. At the time of writing, there are 6007 public and private schools, approximately 2.1 million students (including refugees), and almost 103 thousand teachers, with a ratio of 1 teacher to 16 students [30]. The education process has achieved a remarkable success in terms of annual number of graduates and reducing the illiteracy rate, however, teachers' monthly wages are still one of the lowest when compared to other service sectors, and the education still does not encompass broader environmental issues. A study by Zyadin et al. [19] found that school students in Jordan have limited capability to distinguish between RE sources and non-renewable ones. The study also found that students have positive attitudes and propensity to adopt RE, although the students had some misperceptions of energy issues, e.g. regarding nuclear power. It is therefore vital to investigate the teachers' knowledge and attitudes toward RE in order to develop a clearer understanding of the role of education, and to possibly identify disconnects between teachers and students.

The aims of this study are: (1) to investigate the general RE knowledge of teachers and their capability to distinguish between renewable and non-renewable energy sources. (2) To investigate the teachers' perceptions of RE implementation at the local level including any constraints. (3) To investigate the personal attitudes of teachers toward RE. (4) To investigate what teachers might need to ensure the integration of RE aspects in the school curricula or other relevant educational programs.

The outcomes of this study will assist the education authorities in finding suitable means to integrate RE education into the schooling process. This study will provide policy makers in Jordan with insights and recommendations for future planning. This study is the first to address this issue in Jordan. Due to some socio-economic, cultural, and demographic similarities, the research tool of this study can assist researchers in the surrounding countries to conduct similar studies.

2. Methodological approach

During January to March 2012, the research group conducted a series of meetings to develop a survey tool for exploring the knowledge, perceptions, and attitudes of secondary school teachers toward RE in Jordan. A preliminary questionnaire, consisting of six subscales, was first developed in English and then translated into Arabic, with careful consideration given to the use of terms related to RE. After acquiring the necessary arrangements, twenty five hard copies were prepared and mailed to a high school for boys in Amman, with a letter addressed to the school principal requesting that only teachers of secondary grades fill in the questionnaire, and to also provide feedback on the overall structure of the questions presented in the questionnaire. The pre-test questionnaires were later received by post and checked for suitability. The pre-test questionnaires unveiled several complicated and misunderstood questions, related mainly to knowledge of RE. Accordingly, these questions were rephrased and the teachers who participated in the pre-test and their school were excluded from the population sample. By April 2012 the questionnaire was ready to be disseminated.

Prior to questionnaire distribution, a formal letter was handed to the Ministry of Education in Amman requesting permission to access public and private schools in Jordan. The Ministry of

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