Using system dynamics to develop education for sustainable development in higher education with the emphasis on the sustainability competencies of students

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ABSTRACT

In response to growing concerns of the community about sustainability challenges and the intensification of the international calls to move towards a sustainable future, higher education should be involved in implementing the programs of education for sustainable development; because of this fact that University graduates are part of this solution as future leaders and inheritors of technology. In this study, the underlying research question is: What mechanisms are needed to develop education for sustainable development in higher education with the emphasis on the sustainability competencies of students? The research method was system dynamics. Therefore, we used a mix method research design. Tools of research included the literature review, questionnaire, interview, and observation. We developed a dynamic model to develop the education for sustainable development in higher education with the emphasis on the sustainability competencies of students. This model describes the research problem and predicts the behavior of model variables by simulating in the next 20 years. This model included 18 reinforcing and six balancing feedback loops. After ensuring the validity of the model, mechanisms were elicited from the model. Finally, we evaluated these mechanisms for finding the impacts on improving the problem.

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1. Introduction

A brief look at the status of the world in the recent decades reflects the challenges of sustainability. We know that sustainability index in human activities is not suitable; therefore, if the activities are increased with the unsustainable methods, sustainability challenges would be multiplied. On the other hand, sustainability issue is complex because of the overlap among economic, environmental, and social aspects. Then, there is a need to propose comprehensive and holistic solutions to sustainability challenges. Then, there is a need to propose comprehensive and holistic solutions to sustainability challenges.

In response to growing concerns in society about sustainability challenges as well as the intensification of the international calls to move towards a sustainable future, such as the declaration of decade of education for sustainable development by UNESCO, all educational sectors of society should implement the programs of education for sustainable development (ESD) or sustainability education (SE)

(UNESCO, 2009). Education for sustainable development and sustainability education have the same concept in this article.

The efforts to rethink and revise educational programs towards sustainability which are important for the present and future communities, are the target of education for sustainable development. This educational approach can occur from preschool to university to integrate the principles, knowledge, skills, perspectives, and values associated with sustainability. Accordingly, the role of higher education in social transformation towards sustainable development was determined as a scientific subject and the higher education institutions around the world started to change their educational mission and procedures for integrating sustainability into the educational system (Stephens and Graham, 2010; Holmberg et al., 2008).

Higher education has always responded to the social needs. The goals of the university directly affect the dynamics of technology and social systems (Bursztyn, 2008; Vorley, 2008). Universities can play a critical role in the process of social change that relies on educating new generations of leaders and citizens. Academic freedom of higher education is unique. It has a variety of skills for developing new ideas and meeting the challenges of society (Meadows, 1997).

In fact, higher education fosters many future managers, decision makers, planners, and educators (Bekessy et al., 2003; Fien, 2002). It has the potential to prepare students and increase information and knowledge in order to move towards a sustainable future.

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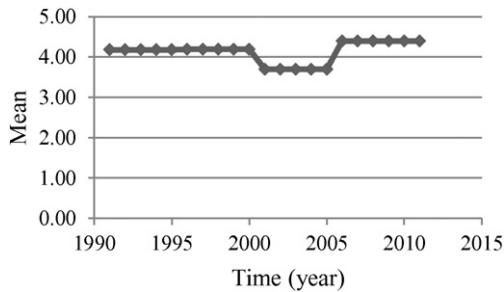
Chart 1. Mean and behavior pattern of sustainability competencies of graduates from 1991 to 2011.
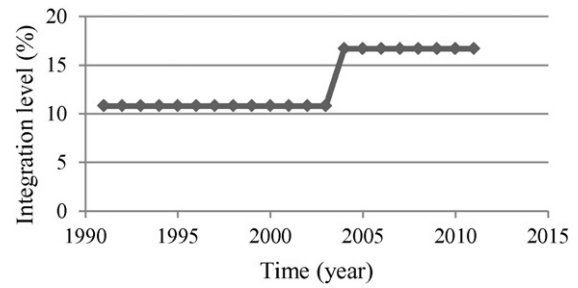
Chart 3. Mean and behavior pattern of integrating sustainability content into curricula of the agriculture and natural resources disciplines from 1991 to 2011.

University graduates as future leaders and inheritors of technology can be part of the solution of sustainability challenges (Woodruff, 2006). Correlations among humans, environment, technology, and politics for a sustainable future are interdependent issues in the community (Cortese, 2003). These issues pass the boundaries of all disciplines. All disciplines need to participate in preparing the community for a sustainable future.

Professionals should be prepared to confront challenges (Mihelcic et al., 2007). They should establish safety, health, and welfare of the community in the best way and attempt to agree with the principles of sustainable development in both the professional and personal life (Woodruff, 2006). This issue occurs under the umbrella of education for sustainable development in higher education. Education for sustainable development affects all components of higher education, such as policy, curriculum, teaching and learning strategies, competencies, assessment, finance, and extra-curricular activities.

Some studies have pointed out the necessity of integrating the programs of education for sustainable development into the higher education (e.g. Figueiro and Raufflet, 2015; Verhulst and Lambrechts, 2015; Lambrechts et al., 2013; Lozano et al., 2013; Barth and Rieckmann, 2012; Brundiers et al., 2010; Chhokar, 2010; Sibble, 2009; Barth et al., 2007; Velazquez et al., 2005; Bryce et al., 2004). The studies showed that higher education should lead to create the knowledge and skills for dealing with global issues such as food security, climate change, water management, non-renewable energy management, biodiversity, health, and social inequality.

The higher education of agriculture and natural resources include these issues. Due to this fact that the inputs in agriculture and natural resources are non-renewable ones, integrating education for sustainable development into this educational system is necessary. Applying unsustainable technologies and policies in managing these resources limits the accessibility of the present and future generation to consumption. According to this, higher education in agriculture and natural resources can train managers, professionals,
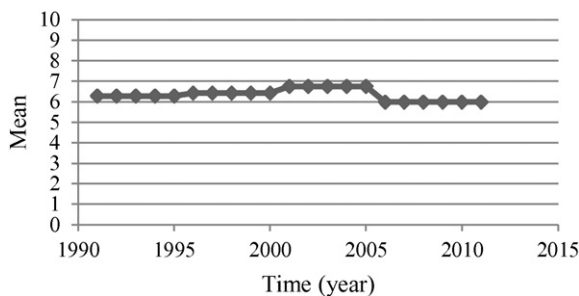
researchers and future leaders who have a mental model based on the sustainability principles, and capability in their practical actions.

Iran's rank in the 2012 Environmental Performance Index report was 118 (Emerson et al., 2012). In Iran, like other countries, the integration of sustainability into higher education was understood, but not seriously and profoundly.

Today's managers are past students; therefore, the mental model of these actors has not formed based on the sustainability principles. In fact, this issue is especially tangible in a way that the progress of the sustainability challenges in the fields of agriculture and natural resources in Iran could be the consequence of paying less attention to the higher education system for integrating education for sustainable development and reinforcing sustainability competencies of students.

We implemented this research in order to show this problem and present solutions to integrate education for sustainable development into higher education with the emphasis on the sustainability competencies in Iran. We selected University College of Agriculture & Natural Resources, University of Tehran, as a case for studying. This case has been implementing a few programs of education for sustainable development, but not with a specific approach.

It is necessary to explain sustainability competencies which provide a framework for developing knowledge and skill of today's students, who are future problem solvers (Willard et al., 2010; Wiek et al., 2011). Sustainability competencies are a combination of knowledge, skills, and attitudes that enable to solve real-world sustainability challenges (Rieckmann, 2012; Wiek et al., 2011; Barth et al., 2007).

Taxonomy of sustainability competencies was presented in the studies such as Wiek et al. (2011), Brundiers et al. (2010), Segalas (2009), Sipos et al. (2008), De Haan (2006), Sterling and Thomas (2006). Based on the literature and viewpoints of subjective experts, sustainability competencies included three classes in this article:

a. Understanding of the sustainability;
b. Skills: critical thinking in the sustainability, creative thinking in the sustainability, systemic thinking, empathy, and interdisciplinary collaboration;
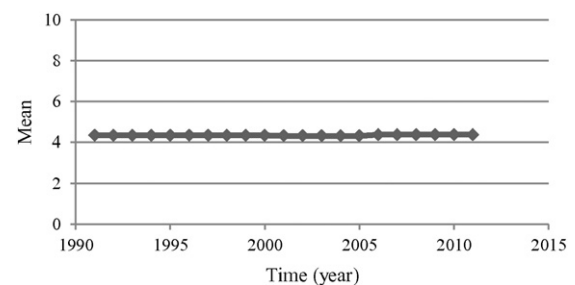
Chart 2. Mean and behavior pattern of science members' competencies for education for sustainable development from 1991 to 2011.

Chart 4. Mean and behavior pattern of applying appropriate teaching and learning strategies for education for sustainable development from 1991 to 2011.