Thesis title: Globalization of Water Resources: Examining Social Learning Using Serious Gaming
By: Fatima Taha

"*Serious games*" or games that combine simulation and gaming aspects in game design for purposes other than pure entertainment have been increasingly used as a conflict resolution tool. It is believed they provide a shared platform for understanding as well as for training and learning in dispute negotiations (Medema, Furber, Adamowski, Zhou, & Mayer, 2016; Rumore, 2010; Savic, Morley, & Khoury, 2016; Zielke et al., 2009). With the increased use of these types of exercises, however, there is a need to address their usefulness, especially if the desired impact is to enhance social learning.

Many studies have been carried out to address the types of learning impacts that emerge from different serious games (Evers, 2017; Rumore, 2010; Savic et al., 2016). This study determined the relationship between the type of individuals engaged in serious games and the reached outcomes (i.e., characterization of the participants determined by where the game is played, and who is playing), similar to the work of other scholars (Bartle, 1996; Tapscott, Williams, & Herman, 2008; Yee, 2006).

The game in this study was tested with 73 university staff and student participants (undergraduate and graduate level) from various countries and professional backgrounds in two academic settings and countries: Oregon State University (United States), and the University for Peace (Costa Rica). The study employed the Footprint Computer Assisted Board Game (WFCABG) developed by the University of Twente in the Netherlands and the Water Footprint Network (Hoekstra, Mekonnen, & Gerbens-Leenes, 2009). WFCABG targets water embedded in commodity production to compare social experiences over water resource issues in the commodities trade. The game design allows participants to draw on their own water resource knowledge to analyze the situation at hand by examining what applies to their country through making a specific product more efficient than others to enable better national economic development.

The serious game used in this study simulated semi-real situations and problems that stakeholders face at the global scale and trained participants on how to react at the national level and with others per a specific set of conditions at the international level. Participants could learn and witness the results and the consequences of their actions as a representative of their country at global meetings. The game does not depend upon a prior diagnosis of the problem; participants only need to come prepared for the simulated negotiation, which is often the case in real world negotiation scenarios. Participants were split into four teams (four different countries). Three simulated years were played. In each round, participants had to make three decisions: (1) determine water allocation for commodity production and environmental requirements, (2)

fully/partially meet national demands for food production, and (3) meet national demands for global trade by either importing products or exchanging exports. At the end of each round, the performance of each team/country is presented in six national development indicators using the game-supported spreadsheet (i.e. food supply, economic welfare, environment, water footprint, water saving, and dependency). In short, the game represents a case study of water management decisions at the national level for domestic production and global market trade.

At the beginning of each round, the facilitator announced the annual water availability. In preparation to play, some participants spent time creating options and strategies between their team members and other teams. Most participants adopted a strategy to allocate less water for the environment and use more water for commodity production. Hit by a fear of drought in the second round, all participants adapted their strategies to reduce their water use and allocate more water for the environment. They also met with each other to discuss future trade arrangements to increase their national water availability. The unexpected drought strongly influenced the game play because it markedly affected their strategies and outcomes and pushed them towards saving water and other less competitive activities. It also allowed participants to enjoy higher performance in their national development indicators. The fake news was introduced intentionally to test the expectations, awareness, and preparedness of participants into response to water-related risks. However, that was not the case; there was no drought. After rounds of unsuccessful negotiations, the facilitator introduced useful water resource management theories inherent in the initial design of the game to allow learning to take place. The social learning portion also occurred during the facilitation of the negotiation during global meetings. The above scenario is represented in all 12 games played.

The study aimed to have a meaningful moment where participants make a connection between their actions and the gaming outcomes and allow for the creation of knowledge rather than knowledge transfer. The degree of change in perceptions (social learning) in all the games was measured using pre- and post-game surveys, follow-up feedback, and observations. Each of the survey questions contributed to the overall goal of social learning. The analysis results showed there was a change in three learning levels: knowledge, relationships, and collaboration. Participants' perceptions in terms of their level of knowledge changed significantly over the course of the game (27% overall change). For instance, survey responses show that efficient water use is achievable by either using water saving techniques or reducing the global water footprint. Remarkably, the percentage of participants that believed capping environmental requirements with trade was one way to achieve water efficiency increased significantly after playing the serious game.

Despite this change in perception, the results of the participants' level of relationships within the group members and the other groups demonstrated the least amount of change over the game duration (only 8% overall change). Before playing the game, students had a tendency

to ignore valuable aspects of negotiations (e.g., relationships, trust, and respect). After playing the game, they appeared to have learned that during negotiations adopting a "give and take" strategy, relationship building, and a good reputation are imperative for having fruitful discussions. Whereas the participants' level of collaboration marked 15% overall change during the course of the game. For instance, responses showed that many participants shifted their preference from having individual behaviors to working collaboratively and being team players when playing the serious game. Thus, the WFCABG proved to have a significant social learning impact by changing participants' perception across three categories (knowledge, relationships, and collaboration).

With respect to the players associated with the game outcomes, each participant has five demographic characteristics: age, gender, educational background, highest degree, and country of origin with the aim to investigate and understand the process and the outcomes reached by individuals from different backgrounds. The results of the statistical analysis showed that the country of origin (water-rich vs. water-poor) is a significant predictor of the game's six-development outcomes. Participants from water-poor countries focused more on negotiation gains and improved all their six national development indicators whereas participants from water-rich countries were water-profit driven and improved their economic welfare indicator and paid less attention to other indicators.

Although the game outcomes were statistically significant and largely close among the 12 groups of individual players from diverse demographics, there is a great level of variability among people from different countries. For example, other factors such as income, age or experience may also play a role and affect the final decision. Additionally, the choices participants made when playing the game may not simply reflect their own resource management philosophies; participants may have used the game experience to "play" with other personas and make choices they might not have made in real life. However, the study is useful for exploring additional means of analysis, e.g., examining ways that gender, age, and attributes other than the country of origin might influence the game approach.

The aim of this study is to assess changes in participants' perception of the learning topic and examine impacts of the serious game on enhancing social learning in different academic settings. The game gave participants a first-hand experience of how complicated negotiations over water are on the international scale. The presented serious game simulation has a potential pedagogical contribution and aims to facilitate discussion among participants. The simulation was shown to increase the participants' familiarity with global water negotiations, enrich understanding of water-related management issues, enhance collaboration skills, and increase learning. The pre- and post- game survey data represent the strongest evidence from which to infer that participants' knowledge changed during the game and that serious games can inform participants about water management concepts.

The serious game used in this study has the potential to be used for different purposes other than providing a safe learning environment and training, such as social behavior change. Many participants stated they would use insights gained from the game in future decision-making scenarios. The study also helped to understand components of strategic choice during the negotiation of water-related issues in real world scenarios. This supports the conclusion that serious games can be used to resolve complex problems in the field of water resource management with the subsidiary goal of "social learning" as part of the solution process. However, one limitation of this type of game is setting all the aspects of complex negotiations issues.

References

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD Research*. Retrieved from http://www.arcadetheory.org/wp-content/uploads/2014/03/1996bartle.pdf

Evers, J. (2017). Playing Ravilla. When the game gets serious. Retrieved January 6, 2017, from https://flows.hypotheses.org/215

Hoekstra, A., Mekonnen, M., & Gerbens-Leenes, P. (2009). Role play on globalization of water management: Interactive learning about water footprint and virtual water trade. *Enschede, the Netherlands/World Bank ….* Retrieved from http://temp.waterfootprint.org/?page=files/RolePlay

Medema, W., Furber, A., Adamowski, J., Zhou, Q., & Mayer, I. (2016). Exploring the Potential Impact of Serious Games on Social Learning and Stakeholder Collaborations for Transboundary Watershed Management of the St. Lawrence River Basin. *Water*, *8*(5), 175. http://doi.org/10.3390/w8050175

Rumore, D. L. (2010). Role-Play Simulations: A Tool for Transformative Civic Education and Engagement Around Science-Intensive Environmental Issues. Retrieved from https://publicdisputes.mit.edu/sites/default/files/documents/Rumore_2015_dissertation_Role-play simulations- A tool for transformative civic education and engagement_FINAL.pdf

Savic, D., Morley, M., & Khoury, M. (2016). Serious Gaming for Water Systems Planning and Management. *Water*, *8*(10), 456. http://doi.org/10.3390/w8100456

Tapscott, D., Williams, A. D., & Herman, D. (2008). *Government 2.0 : Transforming Government and Gover nance for the Twenty-First Century*. *New Paradigm*. Retrieved from http://www.newparadigm.com/media/gov_transforminggovernment.pdf

Yee, N. (2006). The demographics, motivations, and derived experiences of users of massively multi-user online graphical environments. *Presence: Teleoperators and Virtual Environments*. Retrieved from

http://www.mitpressjournals.org/doi/abs/10.1162/pres.15.3.309

Zielke, M. A., Evans, M. J., Dufour, F., Christopher, T. V, Donahue, J. K., Johnson, P., …
    Flores, R. (2009). Serious Games for Immersive Cultural Training: Creating a Living
    World. Retrieved from https://www.utdallas.edu/~maz031000/res/IEEE_Article.pdf