Work for Online Conference Program

Systems thinking and systems dynamics skills inquiry in an international master's program in Sustainable Resource Management.

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Current research showed that dynamic behaviour of even very simple systems are not well understood correctly by students of all domains of sciences, e. g. Booth Sweeney & Sterman (2000), Kapmeier & Zahn (2001), Ossimitz (2002), Fisher (2003), Quaden & Ticotsky (2003) , Langfelder et al. (2005), Kasperidus et al. (2006), Kapmeier et al. (2014, 2017) and others. Many studies identified surprisingly poor performance on different levels of education. This raises the question what are students' previous experiences and current expectations about systems thinking and system dynamics in higher education. Since its implementation in 2001, the international master's program in Sustainable Resource Management (SRM) of the Technical University of Munich attracts students from all over the world and it includes classes in systems theory, systems analysis and system dynamics. From 2006 to 2017, more than 600 SRM students participated in an inquiry at the beginning of their system theory class. It included a questionnaire and solving system dynamics tasks (bathtub tasks). The questionnaire asked about personal and educational backgrounds, previous experiences, opinions about own skills and the relevance of system thinking in their career. The bathtub tasks are slightly modified applications of the original bathtub tasks. For this presentation, we will show selected questionnaire results related to the department store task performance. From 2006 to 2010 the numbers of participating students per year were below 40, since 2011 the numbers increase above 50 with the highest number of 90 students in 2017. The gender distribution is 61 % female and 37 % male. The mean age of the entire group is about 26. About 41 % of the students came from Europe, 26 % from Asia, 15 % from Latin America, 9 % from North America, 3 % from Middle East and remaining students from other regions. The previous fields of study are more or less evenly distributed between natural science, engineering, social science, and business/management. The majority of the students hold a Bachelor of Science (55 %) or Bachelor of Arts (23 %). About two-thirds of SRM students said that they have no previous systems thinking experiences. Those, who have experiences, gained it from university studies.

About 44 % estimated their current level of system thinking skills as very low or low and about 48 % as medium. About 90 % think that systems thinking skills are of high or very high importance for their career. The results of the department store task performance are as following. Question 1 and Question 2 achieved 96 % respect. 93 % correct answers for total group vs. 94 % respect. 97 % for SRM group 2017. Question 3 and Question 4 achieved only 26 % respect. 19 % correct answers for total group vs. 23 % respect. 19 % for SRM group 2017. The SRM students also made the typical errors for this SF task. For question 3, 289 out of 653 (43 %) believed that in minute 8 the most people were in the store and 127 (21 %) believed that the question can't be determined. For question 4, 215 out of 653 (32 %) believe in minute 16 the fewest people were in the store and 158 (26 %) believed that the question can't be determined.

The mean of total performance is about 58 % (min = 55 % in 2008, max = 65 % in 2015). There is no significant trend that the students start the SRM program with improved systems thinking and systems analysis skills in current years. Students with Bachelor of Science degree performed better than with Bachelor of Arts. Students with higher degree like MSc or Diploma did not perform better. Students from the field of social sciences performed lowest, all other fields performed higher than 60 %. A small group of students from Middle East performed best with 65 %. Students from Europe and Asia performed higher than 60 %. Students from other regions performed below 60 %.

Poor performances of master students still persist and there are no changes over the years. In the field of social sciences is a lack in system thinking and system analysis skills related to stock-flow tasks. The majority of students estimated their current level of skills as medium and below. They think that system thinking skills are of high or very high importance for their career. In order to improve the

performance of the students we think that sufficient education in systems thinking and system analysis is the key to success! More teaching is needed to train the simple basics of systems thinking and modelling tasks in systems simulation. For the next steps we will perform more rigorous statistical analysis of the dataset and complete the current database with tests of other students from other study programs.

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