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STUDENTS' INTERACTION FOR ENHANCING LEARNING MOTIVATION AND LEARNING SUCCESS: FINDINGS FROM INTEGRATING A SIMULATION GAME INTO A UNIVERSITY

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Abstract

In recent decades, a vast amount of literature has been published discussing the educational use of simulation games in higher education. One reason simulation games are regarded as superior to traditional teaching is that they encourage students to learn through interaction and collaboration. Simulation games can therefore be subsumed under Kolb's learning model of experiential learning referring to learning through experience. Boosted students' interaction might be one key reason to explain the success of simulation games. The article critically examines whether, and if yes to what extent, the use of simulation games in higher education results in enhanced learning motivation and learning success. As a case study, the incorporation of a simulation game into a university course about climate change is presented. The results of the course evaluation reinforce the core argument that the increased interaction of the students played a vital role for the course success. To integrate various opportunities for students to interact and engage with each other can enhance the learning motivation and thereby enrich the learning experience

Keywords: simulation games, experiential learning, climate change, learning success, learning motivation, higher education.

1 INTRODUCTION

In recent decades, a vast amount of literature has been published discussing the educational use of simulation games in higher education. Since their emergence in the 1960s, simulation games have had a substantial effect on the way we think about teaching and learning in higher education [1,2]. One reason simulation games are regarded as superior to traditional teaching is that they encourage students to interact and collaborate [3]. Simulation games can therefore be subsumed under Kolb's learning model of experiential learning referring to learning through experience [4]. Experiential learning follows a recursive cycle of experiencing, reflecting, thinking and acting to increase students learning motivation and learning success.

In the broader field of education, the added value of gaming in general is incrementally becoming more evident [5]. A large number of articles from various fields have been published stating the benefits of simulation games in higher education [6–9]. In spite of the success of gaming as a tool to foster learning, the way it affects learning success and learning motivation of students needs further clarification [10]. With the following article, I want to contribute to the debate by critically examining whether, and if yes to what extent, the use of simulation games in higher education can lead to enhanced learning motivation and improved learning success. Based on the findings of existing literature, boosted students' interaction might be one key reason to explain the benefits of simulation games.

As a case study, I present findings from the incorporation of a simulation game into a university course about climate change. The course is part of a Master program on interdisciplinary environmental science. The course aims to teach students the basic knowledge about causes and effects of climate change with a special focus on the political understanding of the international negotiation process. The course is offered as blended learning course combining a virtual collaboration phase with a three-day attendance seminar. For several years, this attendance seminar was comprised of students' presentations, scientific lectures and joint discussions. In 2015, we tested whether the use of a simulation game in addition to classical teaching methods would affect the students' learning motivation and learning success. The simulation game acted out the upcoming climate change negotiations in Paris in December 2015. To evaluate the impact of the simulation games on learning motivation and learning success, we compared the previous evaluations of the course with the one in which we performed the simulation game. Our findings are intended to further promote the debate about the influence of simulation games on certain learning variables.

As for the structure of the article: In the first section, I discuss the potential benefits of simulation games for teaching in higher education. In the second section, I present how the simulation game was integrated and conducted during the course. In the third section, I present and critically examine the influence of the simulation game on the students' performance. To this end, I compare data from previous course evaluations with the recent course evaluation. To secure the reliability of the findings, an additional survey was conducted to gauge whether the simulation game was decisive for the variances in the regular evaluation. In the last section, I discuss the results in the wider context of simulation games in education.

2 SIMULATION GAMES AND STUDENTS' INTERACTION

A simulation game, briefly summarized, is a replication of a setting that has occurred or is expected to occur in reality. The simulation of a scenario is usually followed by a joint evaluation with the participants. It is worth noting that the use of the term "simulation games" in educational contexts is rather fuzzy [11,12]. As one central common characteristic, simulation games are based on certain rules and procedures the participants have to comply with. Facing a concrete challenge, participants assemble in groups taking the position of certain actors during the game. Round based, the groups endeavour to cooperate in solving a concrete problem by simultaneously striving to maximize their benefits. Simulation games can but do not necessarily have to be assisted by the use of computers.

The use of simulation games is attributed to hold several benefits for teaching in higher education [6]. In terms of methods, simulation games are a form of experiential learning and are based on the assumption that learning is best accomplished through experience [13,14]. Experiential learning defines learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" [14]. Empowering students to manage their own learning pathways is indispensable for them to best accumulate knowledge and develop desirable skills. Students' learning is based on a constant recursive cycle of experiencing, reflecting, thinking and acting. Thus, simulations games stimulate experiential learning in a manner a traditional course cannot accomplish.

One explanation for the success of simulation games in education is that they foster active learning by encouraging students to engage with each other. Petranek states that simulation games can have an icebreaking effect spurring open as well as group discussions and thereby dismantling the restraints of participants to interact [15]. Against the background in the literature, it is persuasive to argue that simulation games enhance learning motivation and therefore learning success [10,16]. Furthermore, the above mentioned arguments indicate that the interaction of students is a key feature for explaining the learning success with simulation games [6]. As Kolb and Kolb notice, „to improve learning in higher education, the primary focus should be on engaging students in a process that best enhances their learning"[13]. During the execution of a simulation game, students mutually complement and motivate each other. As a result, the successful implementation of a simulation game can trigger enhanced learning motivation and learning success.

3 CASE STUDY

While there is compelling theoretical indication for the influence of students' interaction on learning motivation and learning success, it requires further empirical verification. Hence, as a case study, I present findings from the integration of a simulation game into a university course about interdisciplinary perspectives on climate change. The course is offered in a master programme about interdisciplinary environmental science. Delivered in a blended learning format, the course combines a virtual learning phase with a three-day attendance seminar. Regarding the structure, the seminar is a mixture of lectures followed by open discussions and student presentations.

Albeit the course received positive feedback in the students' evaluations in the past, my colleagues and I observed that the course structure hampered the students' interaction. When interaction occurred, it was mostly restricted to discussions following the presentations or during break times. We identified simulation games as one key mechanism to enhance the students' interaction. Selecting this didactical method was based on the assumption that a simulation game is a promising educational tool to adequately address the problem of climate change [3].

Table 1. Structure of the courses.

Year	2012, 2013, 2014	2015
Course structure	Blended learning	Blended learning
Online Learning (2 months)	▪ Reading course material ▪ Prepare presentations for the weekend seminar alone	▪ Reading course material ▪ Prepare the simulation game: develop a negotiating position of a country in groups (4 persons) ▪ Develop an opening speech for the simulation game
Attendance Seminar	▪ Lectures (1st and 2nd day) ▪ Open discussions (following lectures) ▪ Student presentations followed by discussions (2nd and 3rd day)	▪ Lectures (1st day) ▪ Open discussions (following lectures) ▪ Simulation game: negotiating a new agreement against climate change (2nd and 3rd day)

Table 1 shows an overview of the conceptual changes we made to integrate the simulation game into the course. Predominantly, we implemented various units where the students could interact during the online learning phase and during the attendance seminar, for example when they had to develop a common negotiating position for their country.

What has affected our decision to test the use of a simulation game to increase learning success about climate change? While we can observe significant learning accomplishments with the use of simulation games in many thematic fields [8], sustainable development in particular is an area where simulation games can play a vital role to learn about a complex issue [9]. Climate change as a central challenge for sustainable development is especially suitable for a simulation game [3]. Often described as a super wicked problem, many different scientific disciplines are involved in developing an interdisciplinary response towards the problem of climate change [17,18]. A pivotal role has been attributed to the community of states to bargain an ample agreement to limit the rising greenhouse gas emissions. Hitherto, the 195 states involved have accomplished little progress in complying with the target of a maximum warming of 2° defined by the scientific community in the form of the Intergovernmental Panel on Climate Change (IPCC) [19]. For students and even for proven experts, it is challenging to understand and explain the dynamic of this bargaining process that has been ongoing for more than 25 years [20–22].

The simulation game ought to give students an insight perspective on the major hurdles and barriers to a common agreement. These new skills should lead to an improved assessment of the political negotiating process. Especially, the interaction of students through the simulation game was supposed to trigger mutual learning by complementing and motivating each other.

3.1 A brief note on methods

Each year between 15 and 25 students are participating in the course. We requested all participants (n80) to take part in the course evaluation. In total, from 2012 until 2015, 63 students participated in the course evaluation. The empirical basis for the analysis of the influence of the simulation game on learning motivation and learning success were the participatory observation of the tutors during the seminar and the evaluation at the end of each course. As an additional source for assessing the impact of the simulation game on the students' perception of learning, we conducted a supplementary survey for the course in 2015. Statistical Package for the Social Sciences (SPSS) was used to analyse the evaluations and the survey.

The standard evaluation conducted after each course contains over 30 queried items ranging from the quality of the discussions to the productiveness of the learning atmosphere. To assess the learning impact of the simulation game and against the background of the theoretical discussions, we isolated items, which we define as possible indicators for learning motivation and learning success.

Table 2. Identified variables from the standard course evaluation.

Identified variables from standard evaluation	Evaluation criteria
1. Achievement of learning objectives	1 (very low) – 5 (very high)
2. Assessment of personal learning success	1 (very low) – 5 (very high)
3. Quality and helpfulness of the discussions	1 (very low) – 5 (very high)
4. Role of tutors during the course	1 (very low) – 5 (very high)
5. Arouse of interest for the topic	1 (very low) – 5 (very high)
6. Satisfaction with the seminar	1 (very low) – 5 (very high)
7. Hours of preparation for the course	Number of hours
8. How would you grade the course?	1 (excellent) – 6 (insufficient)

In the standard course evaluation, for most of the items students are supposed to assess to what extent they agree with certain statements. The scale of agreement ranges from 1 (very low) to 5 (very high). To carve out whether significant variations exist in the course evaluation with and without the simulation game, we compared the results from the standard course evaluation without the simulation game (2012-2014) with the results from 2015 including the simulation game. We used the aggregated data from the courses without the simulation game to secure a high statistical significance and to reduce dispersion because of outliners in the students' answers.

In search of dependent variables, we recognised 8 items from the standard course evaluation (Table 2). However, these comparisons are indicators, but do not necessarily prove that the alternation can be traced back exclusively to the use of the simulation game. Therefore, in an additional survey we sent out to the students after the course in 2015, we asked them in particular about their experiences with the simulation game.

4 RESULTS

To verify the existence of an influence of the simulation game on the students learning, I first investigated the results of the additional survey sent to the students after the course in 2015. This survey was designed to directly query the students' experience with the simulation game. The results of the survey reinforce the core argument that the interaction of the students plays a vital role for learning motivation and perceived learning success. The simulation game was fun and the learning success received a mean of 4.38 (Table 3). The highest means in the survey were achieved when the students were asked whether interaction with other students has enhanced their learning motivation (4.63) and learning success (4.69). Noteworthy, little standard deviation existed for all items as students either fully agreed or rather agreed. In terms of knowledge growth, the evaluation shows that the students believe that the course has enhanced their understanding of climate change negotiations and their ability to argue about the topic of climate change with others. All students would recommend the course to others.

Table 3. Additional survey.

Item	N	Mean	Standard Deviation
The simulation game was fun	16	4.38	,500
My knowledge about climate negotiations has enhanced	16	4.38	,619
Helped me to better argue about climate negotiations	16	4.06	,680
I would recommend the simulation game	16	4.63	,500
Interaction with other students contributed to my learning success	16	4.69	,479
Interaction with other students contributed to my learning motivation	16	4.63	,500

When the students were asked in the survey what they enjoyed most during the simulation games, beside the playing element with 81.25 percent, 75 percent mentioned the interaction with other

students (Table 4). This further supports the assumption that the interaction was perceived as a key element for the success of the course.

Table 4. Open question from the additional survey.

What did you like the most about the simulation game? (n16)

	Frequency	Percent of n16 students
Role change (act out the role of a country)	13	81.25
Interaction with other students during the simulation game	12	75.00
Open discussions with other students	6	37.50
Developing the negotiating strategy of a country	6	37.50
Chance to be creative	7	43.75
Total	44	100

In the next step, I compare the standard evaluation results with that of the standard evaluations of the previous courses to collect further evidence for a positive effect of the simulation game. This comparison was supposed to unveil whether the simulation game has affected certain variables in the evaluation. The results first of all demonstrate that the students overall grading of the course with the simulation game is higher in average than the aggregated course evaluations without the simulation game (Table 5). The courses without the simulation games moreover show a higher standard deviation.

Table 5. Overall grade for the course.

Overall grading of the course (1= excellent till 6= insufficient)

Simulation Game	Average	N	Standard Deviation
Yes	1.579	19	,5073
No	1.736	36	,5792
Overall	1.682	55	,5558

In the next step, I contrast the most important variables in terms of the students' learning, the achievement of the learning objectives, the perceived personal learning success and learning atmosphere. The biggest variance in the average occurred for the achievement of the learning objectives with 0.37 points difference. Combined with a small difference of 0.21 for the perceived learning success, this allows concluding that the simulation game has contributed to a higher perceived learning success of the students. Equally important, the course with the simulation games received a higher score concerning the learning atmosphere. The low standard deviation shows the high approval rate of the students.

Table 6. Learning variables.

Simulation Game		learning achievement	learning atmosphere	learning success
Yes	Average	4.21	4.63	4.32
	N	19	19	19
	Standard deviation	,713	,496	,582
No	Average	3,84	4,30	4,11
	N	37	43	44
	Standard deviation	,646	,638	,655
Overall	Average	3.96	4.40	4.17
	N	56	62	63
	Standard deviation	,687	,613	,636

To support the argument that using a simulation game has a significant influence, using Cramer´s V test we observe a significant correlation for the learning achievement (,279) and the learning atmosphere (,251). However, for learning success (,159) only a week correlation can be stated.

Table 7. Cramer V test.

Simulation Game	learning achievement	learning atmosphere	learning success
Cramer V	,279	,251	,159
N	63	62	56

In the next step, I investigate which of the surveyed variables might have been influenced by the use of the simulation game. Against the background of the literature, we assume that the positive learning outcomes of simulation games are a result of an increased interaction among the students combined with a successful involvement of the tutors which have to coordinate the simulation game and be supportive when necessary [23,24]. This should be observable when we asked the students about whether the discussion during the course were helpful, whether the course has increased their interest in the topic, whether the tutors were supportive and last but not least their overall satisfaction with the seminar (Table 8).

Table 8. Course variables of the evaluations.

Simulation Game		helpful discussions	role of tutors	interest in topic	satisfaction
Yes	Average	4.63	4.63	4.71	4.53
	N	19	19	17	19
	Standard deviation	,496	,496	,470	,513
No	Average	4.16	4.36	4.23	4.27
	N	44	44	43	44
	Standard deviation	,805	,718	,649	,544
Overall	Average	4.30	4.44	4.37	4.35
	N	63	63	60	63
	Standard deviation	,754	,667	,637	,544

The results display a higher score for the course with the simulation games in all of the categories. Especially the high ratings for helpful discussions and supportive role of the tutors can be understood as a result of the increased students' interaction during the simulation game and the corresponding necessity for the tutors to support when problems arise. Furthermore, the low standard deviation points to the high approval rate among the students who acted out the simulation game. Performing the simulation game likewise led to a higher satisfaction with the seminar and a significantly higher interest in the topic.

Again, using the Cramer V test reveals an influence of the simulation game on all items:

Table 9. Cramer V test.

Simulation Game	helpful discussions	role of tutors	interest in topic	satisfaction
Cramer V	,299	,219	,340	,217
N	63	63	60	63

All of the findings are further confirmed by looking at a comparison of the evaluation results over the years. The seminar including the simulation game achieved the highest score in all identified categories over the years.
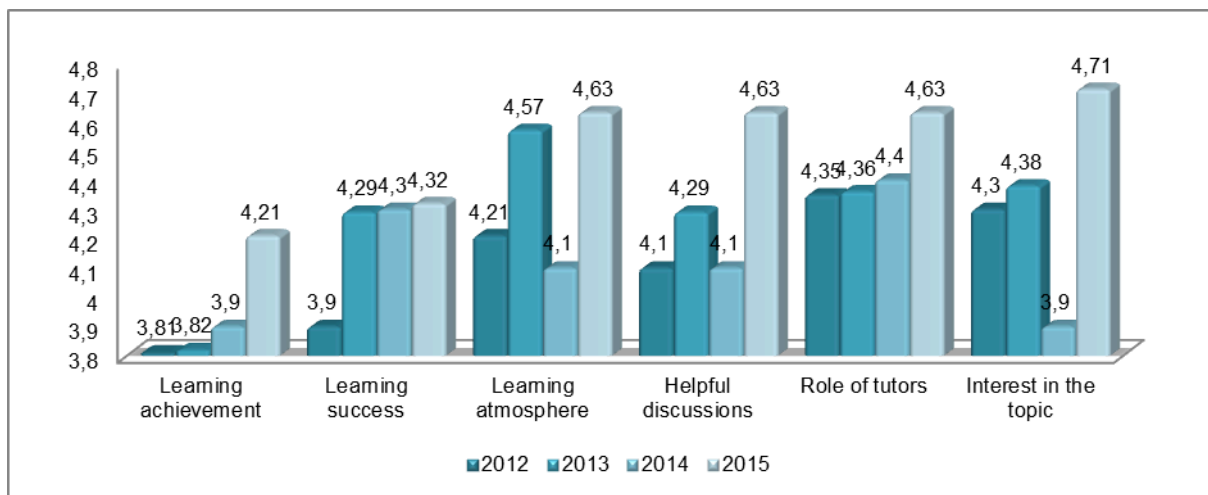
Figure 1. Comparison of the evaluations from the different years.

Noteworthy, the evaluation reveals significant differences in terms of the preparation time for the seminar. While the average before was 17.75 hours, the course with the simulation game required 31.83 hours of preparation. An active role during the simulation may require more planning time than preparing a short presentation. Furthermore, acting out the role of a country in the climate change negotiations entails comprehensive research to adequately reproduce the position of the delegation from the respective country.

Table 10. Preparation time for the course.

Simulation Game	Average	N	Standard deviation
Yes	31.83	15	22,638
No	17.75	36	18,949
Overall	21.89	51	20,901

To put it concisely, the findings of the standard evaluations further reinforce the assumption that simulation games spur students' interaction and lead to increased learning success and motivation among students. Students especially cherish the active role of the tutors and the helpful discussion during the seminar with others. Furthermore, interest in the topic of the course can be enhanced.

5 DISCUSSION

The benefits of simulation games in higher education have been acknowledged for a long time. Their use can stimulate experiential learning and potentially lead to better learning outcomes. In this article, I argued that boosted students' interaction is a key element for this enhanced learning experience. The case study of refining an existing course by implementing a simulation game offered evidence for this argument as it revealed the pivotal role of students' interaction for the learning motivation and learning success. Course comparison, with and without the simulation game, demonstrated a correlation with the learning achievement and learning atmosphere of the course. Furthermore, the comparison disclosed significant differences concerning the rating of the role of discussions, the supportive role of the tutors and the increased interest in the topic. However, it is important to note that a simulation game cannot be conducted without extensive preparation time for both students and tutors. The additional online survey undertaken after the course strengthened the relevance of students' interaction for learning motivation. It also provided evidence of the students' perceived learning success through the simulation game.

In a nutshell, my findings are in accordance with other studies pointing to the accomplishment of simulation games in numerous thematic fields and contexts. My results in particular stress the need to integrate various opportunities for students to interact and engage with each other, in groups or in a plenum. Doing so can enhance students learning motivation and thereby enrich the learning experience.

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REFERENCES

[1]   B.D. Ruben, *Simulations, Games, and Experience-Based Learning: The Quest for a New Paradigm for Teaching and Learning*, Simulation & Gaming 30 (1999), pp. 498–505.

[2]   D. Crookall and W. Thorngate, *Acting, Knowing, Learning, Simulating, Gaming*, Simulation & Gaming 40 (2009), pp. 8–26.

[3]   H. Breitmeier and D. Otto, *Understanding Political Processes in Climate Change Negotiations by means of an Interdisciplinary Curriculum in Higher Education*, International Journal on Innovation and Sustainable Development 6 (2012), pp. 20–30.

[4]   D.A. Kolb, *Experiential Learning: Experience as the Source of Learning and Development*, Prentice Hall, Englewood Cliffs, NJ, 1984.

[5]   W.L. Bedwell, D. Pavlas, K. Heyne, E.H. Lazzara and E. Salas, *Toward a Taxonomy Linking Game Attributes to Learning: An Empirical Study*, Simulation & Gaming 43 (2012), pp. 729–760.

[6]   B. Herz and W. Merz, *Experiential Learning and the Effectiveness of Economic Simulation Games*, Simulation & Gaming 29 (1998), pp. 238–250.

[7]   R. Lozano, K. Ceulemans, M. Alonso-Almeida, D. Huisingh, F.J. Lozano, T. Waas et al., *A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey*, Journal of Cleaner Production (2014).

[8]   P. Dieckmann, S.M. Friis, A. Lippert and D. Østergaard, *Goals, Success Factors, and Barriers for Simulation-Based Learning: A Qualitative Interview Study in Health Care*, Simulation & Gaming 43 (2012), pp. 627–647.

[9]   O. Blanchard and A. Buchs, *Clarifying Sustainable Development Concepts Through Role-Play*, Simulation & Gaming 46 (2015), pp. 697–712.

[10]   F.F. Robison, *It's a Game! Evaluation of a Classroom Game to Enhance Learning in an Introductory Counseling Course*, Comprehensive Psychology 3 (2014).

[11]   D. Otto, *Let's Play! Using simulation games as a sustainable way to enhance students' motivation and collaboration in Open and Distance Learning*, in *E-Learning and Education for Sustainability*, U.M. Azeiteiro, W. Leal Filho and S. Caeiro, eds., Peter Lang, Frankfurt a. M. [u.a.], 2014, pp. 73–82.

[12]   A.H. Feinstein, S. Mann and D.L. Corsun, *Charting the experiential territory: Clarifying definitions and uses of computer simulation, games, and role play*, Journal of Management Development 21 (2002), pp. 732–744.

[13]   A.Y. Kolb and D.A. Kolb, *Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education*, Academy of Management Learning & Education 4 (2005), pp. 193–212.

[14]   D.A. Kolb, *Experiential Learning as the Science of Learning and Development*, Prentice Hall, Englewood Cliffs, NJ, 1984.

[15]   C. Petranek, *A Maturation in Experiential Learning: Principles of Simulation and Gaming*, Simulation & Gaming 25 (1994), pp. 513–523.

[16]   S.C. Snow, F.L. Gehlen and J.C. Green, *Different Ways to Introduce a Business Simulation: The Effect on Student Performance*, Simulation & Gaming 33 (2002), pp. 526–532.

[17]   R.J. Lazarus, *Super wicked problems and climate change: Restraining the present to liberate the future*, Cornell Law Review 94 (2009), pp. 1153–1233.

[18]   M. Hulme, *Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity*, Cambridge University Press, Cambridge, 2009.

[19] D. Otto, *Potenziale Und Grenzen Von 'epistemic Communities'. Eine Analyse Des Weltklimarates Und Der Klimarahmenkonvention*, LIT-Verlag, Münster [u.a.], 2015.

[20] D. Otto, *Understanding climate change negotiations: An International Relations perspective*, in „The heat is up!" – Cross-disciplinary perspectives on climate change, S. Caeiro, P. Bacelar-Nicolau, B. Sara and D. Otto, eds., Universidade Aberta, Lisbon, PT, 2016, pp. 9.

[21] C. Downie, *The Politics of Climate Change Negotiations Strategies and Variables in Prolonged International Negotiations*, Edward Elgar Publishing, Inc., Cheltenham, UK, 2014.

[22] C. Downie, *Three Ways to Understand State Actors in International Negotiations: Climate Change in the Clinton Years (1993–2000)*, Global Environmental Politics 13 (2013), pp. 22–40.

[23] N. Whitton, *Game Engagement Theory and Adult Learning*, Simulation & Gaming 42 (2010), pp. 596–609.

[24] D. Crookall, *Serious Games, Debriefing, and Simulation/Gaming as a Discipline*, Simulation & Gaming 41 (2010), pp. 898–920.