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Article

Assessment of the Development of Professional Skills in University Students: Sustainability and Serious Games

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Abstract: This study assesses the development of professional skills in university students using serious games (SG), from a sustainability perspective. The Sustainable Development Goals (SDGs) were set by the United Nations' 2030 Agenda for Sustainable Development. Universities are strategic agents in the transformation process towards sustainability. This way, they should be committed to promoting such sustainable values in the students through curricular sustainability, implementing active methodologies and SG for that purpose. Transversal skills are essential for the development of future graduates. The objective of this study was to assess which professional skills should be developed through the SG called The Island, to improve the degree of student satisfaction with the incorporation of a sustainable curriculum. The data were obtained using a questionnaire and then analysed using linear regression models, with their inference estimated through the goodness of fit and ANOVA. The first results indicated that the implementation of the SG promoted a strengthening of the students' sustainable curriculum through the development of those skills. It was concluded that the key to success in education for sustainable development is improving the development of strategic thinking, collaborative thinking, and self-awareness, in addition to encouraging systemic, critical, and problem-solving thinking.

Keywords: active learning; professional skills; civic education; higher education; e-learning; serious games; critical thinking; sustainability

1. Introduction and State of play

1.1. Introduction

The 2030 Agenda for Sustainable Development elaborated prepared by the General Assembly of the United Nations set the Sustainable Development Goals (SDGs), in which they indicate the most important development challenges for humanity, in order to ensure a sustainable, peaceful, prosperous, and equitable life for all individuals, not only in the present but in the future. These objectives consider a series of social needs, which include education, health, social protection, and job opportunities, in addition to climate change and environmental protection. To achieve a more sustainable world and meet all the goals set in the SDGs, individuals should become agents of change, acquiring knowledge, skills, values, and being engaged in behaviours that empower them to contribute to sustainable development (Chung & Park, 2016).

Universities, understood as essential agents in the transformation process towards sustainability, are committed to promoting these sustainable values in the students. Therefore, the inclusion of the promotion of sustainable development (sustainable curriculum) in the university curricula, the implementation of active methodologies in the classrooms together with the use of new information and communication technologies (ICTs)—such as business simulators or 'serious games' (SG)—are mechanisms targeted at training the students on transversal professional skills to achieve

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the SDGs, as well as ensuring that they will acquire the necessary theoretical and practical knowledge to promote sustainable development.

Skills such as systemic thinking, collaborative thinking, and critical thinking, among others, are essential for the development of future graduates, specifically in Economics and Business students, who should be focused on business decision making. This way, the goal of the present study was to assess which professional skills should be developed through the SG called The Island, to improve the degree of student satisfaction with the incorporation of sustainable curricula.

Thus, the purpose of the present study was to assess, through linear regression models and the inference estimated through the goodness of fit and ANOVA, the potential of the SG as an e-learning tool used to promote sustainable skills in the classrooms.

1.2. State of play

1.2.1. Education for Sustainable Development

Education for Sustainable Development (ESD) is a holistic and transformative education approach (Macarrón, 2012). It addresses the content and results of active learning, pedagogy, and the learning environment, in order to evolve from teaching to learning, and from an instructional to a transformative pedagogical dimension (Rondón, 2018). At this point, the students take action, through collaborative, participatory, and self-directed learning. By means of civic education, the students are empowered and start making conscious decisions, acting responsibly, without losing sight of economic, social, and environmental sustainability of tomorrow (UNESCO, 2017; Edwards & Fogelman, 2018)

The United Nations began promoting changes in students' knowledge, values, and behaviours, with the purpose of achieving a more sustainable society between 2005 and 2014. This project was called The United Nations Decade of Education for Sustainable Development (UNDESD) (Gutiérrez, Benayas & Calvo, 2006).

Throughout the last decades, the international recognition of ESD as a key approach to achieve sustainable development has been increasing steadily, and referenced in the three summits on sustainable development: 1992 United Nations Conference on Environment and Development (UNCED), in Rio de Janeiro (Weiss, 1992); 2002 World Summit on Sustainable Development (WSSD) in Johannesburg (Bunting, Hunt, Walker & De Roode, 2002); and 2012 United Nations Conference on Sustainable Development (UNCSD) in Rio de Janeiro (Naab, 2012). In addition, it is worth mentioning that Article 12 of the 2016 Paris Agreement acknowledges the importance of education to achieve a sustainable planet (UNESCO, 2017). ESD is conceived as education that occurs throughout life. This way, it develops in both formal and informal institutions, and from kindergarten to university (McKeown, Hopkins, Rizi & Chrystalbridge, 2002).

If we focus on university education, during the Ibero-American Conference on the SDGs, Martínez (June 2018) emphasised the transformative role of universities. They are seen as an ecosystem that educates, transmits knowledge and skills, and also investigates, innovates, and seeks solutions. These processes are based on principles such as education for peace and social justice.

When we discuss sustainable development and consider what it has entailed and what it will entail, a profound transformation is required, not only in beliefs, perceptions, and learning styles, but also in the current behaviours of young individuals (Kagawa, 2007; Cebrián, & Junyent, 2015; Pyrini, Varonis & Varonis, 2017). Learning to do and to be requires total involvement in the change and transformation of our society. This way, the students should become active agents of change. We should note that, from this perspective, education is crucial to achieve the SDGs (UNESCO, 2017).

Bokova (2015), Director-General of UNESCO, has indicated that "A fundamental change is needed in the way we think about the role of education in world development, because it has a catalytic effect on the well-being of individuals and the future of our planet. [...] Now, more than ever, education is responsible for taking into consideration the challenges and aspirations of the 21st

century, as well as promoting the right types of values and skills that will lead to sustainable and inclusive growth, and to a peaceful life for all individuals".

1.2.2. Sustainable Development Goals

On 25th September 2015, the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development (UN, 2015). This Agenda resulted from the work performed for more than three years, after the United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, in June 2012. Member States were involved, with the participation of millions of individuals, in a participatory citizenship process.

The universality and the indivisibility of the 2030 Agenda are crucial aspects. The signatory countries committed to align their individual commitments with the universal, transformative, and inclusive objectives of the 2030 Agenda (UNESCO, 2017). The purpose of the 17 objectives with their 169 goals was to ensure a sustainable, peaceful, equitable, and prosperous life for all the inhabitants of our planet, now and in the future. We are facing global challenges that affect everyone, i.e., the survival of our species. Environmental limits and thresholds of natural resources should be set, and poverty eradication actions should be aligned with economic development strategies, without forgetting social needs and climate change (UNESCO, 2017).

The spirit of the 2030 Agenda is based on the 17 Sustainable Development Goals, which summarise the actions to be performed over the next few years by public administrations, private companies, non-profit entities, universities, and citizenships in general (Figure 1). In order to achieve these objectives, it is necessary that the different participants, i.e., private companies, public administrations, civil society, and every citizen meet the commitments (UNESCO, 2017). If we focus on the specific field of action of higher education, we can observe that universities play an important role in multi-stakeholder alliances, in addition to leading by example, thus being pioneers with respect to the SDGs proposals (Aldeanueva, Rojo, Pastor, Gurmu, Stott & Mazorra, 2017; Martínez, June 2018).

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Figure 1. Sustainable Development Goals.

1	END OF POVERTY		End poverty, in all its forms, throughout the world.
2	ZERO HUNGER		End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.
3	HEALTH & WELLNESS		Ensure a healthy life and promote well-being for all individuals at all ages.
4	QUALITY EDUCATION		Ensure inclusive, equitable and quality education, and promote lifelong learning opportunities for all individuals.
5	GENDER EQUALITY		Achieve gender equality and empower all women and girls.
6	CLEAN WATER AND SANITATION		Ensure water availability and its sustainable management, and sanitation for all individuals.
7	AFFORDABLE AND NON-POLLUTING ENERGY		Ensure access to affordable, safe, sustainable, and modern energy for all individuals.
8	DECENT WORK AND ECONOMIC GROWTH		Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all individuals.
9	INDUSTRY, INNOVATION, AND INFRASTRUCTURES		Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation.
10	REDUCTION OF INEQUALITIES		Reduce inequality in and between countries.
11	SUSTAINABLE CITIES AND COMMUNITIES		Make cities and human settlements inclusive, safe, resilient, and sustainable.
12	RESPONSIBLE PRODUCTION AND CONSUMPTION		Ensure sustainable consumption and production modalities.
13	ACTION FOR THE CLIMATE		Take urgent measures to combat climate change and its effects.
14	UNDERWATER LIFE		Preserve and use the oceans, seas, and marine resources in a sustainable manner to ensure sustainable development.
15	LIFE OF TERRESTRIAL ECOSYSTEMS		Protect, restore, and promote the sustainable use of terrestrial ecosystems.
16	PEACE, JUSTICE, AND SOLID INSTITUTIONS		Promote equitable, peaceful, and inclusive societies for sustainable development.
17	ALLIANCES TO ACHIEVE OBJECTIVES		Strengthen the means of implementation and revitalise the global partnership for sustainable development.

Source: adapted from UNESCO (2017).

Universities can promote research activities that entail subsequent transfer of knowledge, and sensitise the citizens about the SDGs. The ways through which these goals can be achieve should be

set by the creativity of each institution. For example, the Conference of Rectors of Spanish Universities (CRUE) faces the challenge of raising awareness among students (Ruiz & González, 2017).

The 2030 Agenda impacts on the universities, because it represents: (a) an internal transformation that leads to rethinking 'what', 'how', and 'what for' the universities teach; (b) an external transformation, due to the repositioning of the universities within society; and (c) university contexts that articulate the participants and generate inclusive alliances (Stewart, 2015; Preece, 2017; McMillan, 2018).

1.2.3. The key skills for sustainability in university students

As we have commented, it is essential to introduce environmental and social perspectives in the curricula of future graduates, not only oriented towards the professional, but also the personal life. This process is known as 'curricular sustainability' (Granados & Junyent, 2015), which was an evolution of the concept of 'curricular environmentalisation' (Pujol & Villanueva, 1998), with the aim of addressing sustainable aspects and not only environmental concepts as the latter did.

According to the latest study conducted by UNESCO (2017), current and future challenges include greater degrees of complexity and uncertainty than in past times. This way, new generations face greater individualisation, social diversity, degradation, and social and environmental vulnerability, among other factors. Facing these issues requires a creative and autonomous behaviour, in addition to having truthful, clear, and concise information on all the variables that can affect the resolution of the problems and challenges that may arise.

Therefore, university students should have the necessary and sufficient ability to collaborate and perform with the goal of obtaining a positive change in society and the surrounding environment (UNESCO, 2015), i.e., becoming true sustainable citizens (Wals, 2015; Wals & Lenglet, 2016).

The role of universities, as a vehicle for sustainability among students, society, and entities, is fundamental (Larrán, Andrades & Herrera, 2018). Educating by means of a sustainable manner in the curricula of university students implies developing a series of essential professional skills. The implementation and achievement of these skills will allow students to face the future challenges that the current globalised labour market, with exponential technological growth, will demand.

As a result of the acquisition of these skills, students will be able to participate in a responsible and constructive manner in the future of a sustainable economic, social, and political environment (Barr, 2016; Knox, Marston, & Imort, 2016; Carter, 2018) (Figure 2).

Figure 2. Essential skills for sustainability.

SYSTEMIC THINKING SKILL	**Students should be able to: (a) recognize and understand the relationships that originate in society; (b) analyse complex and disparate systems; (c) understand how these systems are integrated within the various domains and scales; and (d) fight against risk and uncertainty.**
ANTICIPATION SKILL	Students should have the ability to: (a) understand, analyse, and evaluate different future scenarios, differentiating between possible, probable, and desirable; (b) create their own perspectives of what will happen in the future; (c) be cautious; (d) evaluate the consequences of the actions they take; and (e) deal with the resulting risks and changes.
REGULATORY SKILL	Future graduates should acquire the necessary skills to understand and reflect on the norms and values that underlie their own actions.
STRATEGIC SKILL	Universities should encourage their students to collectively develop and implement innovative actions that promote sustainability.
COLLABORATIVE SKILL	Students should learn from each other and understand and respect the needs, perspectives, and actions of others, through empathy and empathic leadership, addressing group conflicts and facilitating problem solving in a collaborative and participatory manner.
CRITICAL THINKING SKILL	All students should question the norms, practices, and opinions that surround them. In addition, they should reflect on the values, perceptions, and, especially, their own actions, adopting a stance based on a discourse focused on sustainability.
SELF-AWARENESS SKILL	Reflecting on the role that each future graduate will play in the community and society is essential, as well as constantly evaluating and promoting the actions that one performs, dealing with personal feelings and desires.
INTEGRATED PROBLEM-SOLVING SKILL	Students should learn to apply different problem-solving frameworks to complex sustainability problems, and devise equitable solutions that foster sustainable development by integrating the other essential skills described above.

Source: adapted from UNESCO (2017).

These skills describe specific attributes that students need for action and autonomy in different situations and complex contexts, including not only motivational, but also cognitive, affective, and volitional elements (UNESCO, 2017).

The essential professional skills are those acquired through action, supported by the basis of experience and reflection, i.e., they are not taught, but developed throughout studies (Weinert, 2001; UNESCO, 2015). These skills proposed by UNESCO (2017) have been defined as crucial for the progress of sustainability (de Haan, 2010; Wiek, Withycombe & Redman, 2011; Rieckmann, 2012).

1.2.4. The development of ESD through the SG The Island

The use of ICTs to promote active learning processes in higher education represents an improvement in the education process that allows teachers to promote new skills in the students (Goldin & Katz, 2018). In the case of ESD, using SG as an e-learning tool can allow implementing the transversal skills mentioned above in a more positive way (Breuer & Bente, 2010; Katsaliaki, 2013, Corrigan, Zon, Maij, McDonald & Mårtensson, 2015).

'The Island' is the name used in a SG, in which students, in a given time-space domain, should make economic, social, and environmental decisions that allow them to effectively and efficiently

govern a defined territory. In this way, and always keeping in mind the optimal achievement of the most possible SDGs, the students should collectively decide what actions, and how and when they will be implemented in The Island to satisfy the citizens, avoiding negative ecological impacts, and limited to the available budget.

The SG helps developing sustainable skills, given that, through the simulator, the students observe and value the various future scenarios that arise in the game. In addition, the students know and perceive the relationship between the decisions to be taken and the citizens, using different problem-solving frameworks in the face of the different situations outlined by the SG. Likewise, students are offered the possibility of questioning their own practices and opinions or those of others, reaching conscious decisions and acting responsibly from an economic, social, and environmental perspective.

2. Material y methods

2.1. Descriptive data

In our eagerness to develop as key agents in the sustainability transformation processes, we are committed to promoting these sustainable values in the students. Training future graduates in sustainable transversal skills that allow them to achieve the SDGs and develop theoretical and practical knowledge necessary for their future work and personal aspects is a top priority in both institutions. Therefore, using business simulators or SG through active methodologies in the classrooms will help the students include sustainable transversal skills that can be useful in the labour market and in their personal lives.

However, implementing new education systems does not mean that students will acquire every skill demanded in the 2030 Agenda. To test it, a questionnaire was applied to 88 students (50 women and 38 men), of which 69 were attending the third year of the Undergraduate Programme in Management of Business Marketing, 12 were attending the Master's Degree Programme in Accounts Audit and Higher Accounting (MAAHA), and seven were attending the Master's Degree programme in Actuarial and Financial Sciences (MAFS).

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Table 1. Descriptive statistics: Sample frequencies.

		Frequency	Percentage	Valid percentage	Cumulative percentage
SEX	MAN	38	43.2	43.2	43.2
	WOMAN	50	56.8	56.8	100
	Total	88	100	100	
WORK	YES	18	20.5	20.5	20.5
	NO	70	79.5	79.5	100
	Total	88	100	100	
VOLUNTEERISM	YES	14	15.9	15.9	15.9
	NO	74	84.1	84.1	100
	Total	88	100	100	
UNDERGRADUATE/ MASTER'S DEGREE	CUBS	69	78.4	78.4	78.4
	MAAHA	12	13.5	13.5	91.9
	MAFS	7	8.1	8.1	100
	Total	88	100	100	
N_COUR_SG	0	24	27.3	27.3	27.3
	1	52	59.1	59.1	86.4
	2	8	9.1	9.1	95.5
	2	4	4.5	4.5	100
	Total	88	100	100	
N_COUR_SUST	0	2	2.3	2.3	2.3
	1	38	43.2	43.2	45.5
	2	32	36.4	36.4	81.8
	3	12	13.6	13.6	95.5
	>3	4	4.5	4.5	100
	Total	88	100	100	

Note. N_COUR_SG = number of courses using Serious Games; number of courses addressing sustainability. Source: prepared by the authors.

The data were collected during the academic year 2017/18, considering the courses related to Accounting and Financial Information Management Specialty, as well as those related to Professional Skills and Corporate Social Responsibility. Given that the present study was focused on sustainability, the respondents were asked whether they were currently working, of which 18 were active and 70 were not. In this case, it is worth mentioning that those works performed through agreements between the universities and companies were not taken into account. On the other hand, we checked the number of students who are volunteering (yes = 14; no = 74). In addition, we wanted to determine the number of courses in which the students had worked with SG (N_COUR_SG), and the number of courses in which the students had dealt with issues related to sustainability (N_COUR_SUST) (Table 1 and 2).

Table 2. Descriptive statistics: sample statistics.

		SEX	WORK	VOLUNTEERING	N_COUR_SG	N_COUR_SUST
N	Valid	88	88	88	88	88
	Lost	0	0	0	0	0
Mean		1.57	1.80	1.84	0.91	1.75
Median		2.00	2.00	2,00	1.00	2.00
Mode		2	2	2	1	1
Standard deviation		0.498	0.406	0.368	0.737	0.887
Variance		0.248	0.165	0.135	0.543	0.787

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Source: prepared by the authors.

Specifically, we assessed the relationship and the degree of association between the overall satisfaction with the use of the SG: The Island «Ch» to favour the development of the sustainable curriculum «SAT_GEN», based on the degree of perception about the improvement of each professional skill through the application of the SG: The Island.

To assess all explanatory or dependent variables defined, we used a 5-point Likert scale (1 = very low; 2 = low; 3 = medium; 4 = high; and 5 = very high). These variables were:

STS = Systemic thinking skill.

AS = Anticipation skill.

NS = Normative skill.

SS = Strategic skill.

CS = Collaborative skill.

CTS = Critical thinking skill.

SAS = Self-awareness skill.

PSS = Integrated problem-solving skill.

The multiple linear regression model resulted in:

$$SAT\_GEN \quad = \alpha + \sum_{h=1}^{8} \beta_h \cdot C_h$$

Where:

α : Constant.

β_h : Partial relationship between each h-th explanatory variable and the explained variable.

C_h : H-th explanatory variable.

2.2. Data analysis

We used the SPSS Statistics 24 software and performed a stepwise selection of the variables in order to carry out a multiple linear regression analysis. The purpose was to find, among all the possible explanatory variables «Ch», those that best explained the degree of satisfaction of the independent variable «SAT_GEN», without any of them being a linear combination of the remaining ones.

This way, we determined the transversal skills that influenced the degree of «SAT_GEN», based on their development through the application of the SG: The Island:

H0: The transversal skill «Ch» does not affect the degree of «SAT_GEN».

That is, *H0 = ßX = 0*

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3. Results. Predictive model for the satisfaction degree based on the skills

Through the stepwise regression procedure, and based on the goodness of fit of the data for the multiple linear regression model, we observed that the last proposed model (model 5) was the one that reached the highest multiple correlation coefficient (*R*) (Table 3).

This way, on the one hand, it can be affirmed that «AS» (t = 13.348; p <0.05); «STS» (t = -5.198; p <0.05); «PSS» (t = 2.449; p <0.05); and «CTS» (t = 0.229; p <0.05) explained the independent variable «SAT_GEN» more intensely by means of a positive linear association. On the other hand, we observed how the «NS» (t = -0.190; p <0.05) explained the independent variable «SAT_GEN» more intensely, but by means of a negative linear association. Also, the coefficient of determination (R^2) indicated that the variability explained by the model was 94.8%, which was very close to the adjusted coefficient of determination.

Table 3. Model Summary.

Model	*R*	*R*-Square	*R*-Square adjusted	Standard error estimation	Change statistics				
					Change in *R*-Square	Change in *F*	gl1	gl2	Sig. Change in *F*
1	**0.956**[a]	**0.913**	**0.912**	0.150	0.913	906.774	1	86	0.000
2	0.966[b]	0.932	0.931	0.133	0.019	23.910	1	85	0.000
3	0.968[c]	0.938	0.936	0.128	0.006	7.463	1	84	0.008
4	0.970[d]	0.941	0.939	0.126	0.003	4.900	1	83	0.030
5	0.974[e]	0.948	0.945	0.119	0.007	10.589	1	82	0.002

Note. Sig. = significance

a. Predictors: (Constant), AS

b. Predictors: (Constant), AS, STS

c. Predictors: (Constant), AS, STS, PSS

d. Predictors: (Constant), AS, STS, PSS, NS

e. Predictors: (Constant), AS, STS, PSS, NS, CTS

Source: prepared by the authors.

Based on the analysis of variance, we performed an ANOVA test (Table 4) and observed that, in model 5 (the one that integrated these five skills), the p-value associated with the F-statistic was lower than the level of significance. Therefore, H_0 was rejected: Transversal skills («AS»; «STS»; «PSS»; «NS»; «CTS») did not affect the degree of «SAT_GEN».

Table 4. ANOVA[a].

Model		Sum of squares	gl	Root mean square	*F*	Sig.
1	Regression	20.385	1	20.385	906.774	0.000[b]
	Residual	1.933	86	0.022		
	Total	22.318	87			
2	Regression	20.809	2	10.405	586.122	0.000[c]
	Residual	1.509	85	0.018		
	Total	22.318	87			
3	Regression	20.932	3	6.977	422.948	0.000[d]
	Residual	1.386	84	0.016		
	Total	22.318	87			
4	Regression	21.010	4	5.252	333.166	0.000[e]
	Residual	1.309	83	0.016		
	Total	22.318	87			
5	Regression	21.159	5	04.232	299.442	0.000[f]
	Residual	1.159	82	0.014		

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	Total	22.318	87

Note. Sig. = significance
a. Dependent variable: «SAT_GEN»
b. Predictors: (Constant), AS
c. Predictors: (Constant), AS, STS
d. Predictors: (Constant), AS, STS, PSS
e. Predictors: (Constant), AS, STS, PSS, NS
f. Predictors: (Constant), AS, STS, PSS, NS, CTS

Source: prepared by the authors.

Therefore, the predictive variables that became part of the equation were «AS», «STS», «PSS», «NS», and «CTS» (Table 5). On the other hand, the excluded skills were «SS» (t = -1.509; p >0.05), «SAS» (t = 0.986; p >0.05), and «CS» (t = 1.925; p >0.05) (Table 6): *SAT_GEN = -1.176 + 0.925·AS + 0.2176·STS + 0.112·PSS – 0.136·NS+ 0,112·CTS.*

Table 5. Coefficients[a].

Model		Non-standardised coefficients		Standardised coefficients	*t*	Sig.
		B	Standard error	Beta		
1	(Constant)	-0.167	0.149		-1.118	0.267
	AS	1.033	0.034	0.956	30.113	0.000
2	(Constant)	-1.061	0.226		-4.698	0.000
	AS	1.094	0.033	1.012	33.233	0.000
	STS	0.146	0.030	0.149	4.890	0.000
3	(Constant)	-1.286	0.233		-5.525	0.000
	SAS	0.950	0.062	0.879	15.439	0.000
	STS	0.219	0.039	0.223	5.583	0.000
	PSS	0.131	0.048	0.190	2.732	0.008
4	(Constant)	-1.098	0.243		-4.521	0.000
	AS	1.016	0.067	0.939	15.145	0.000
	STS	0.179	0.042	0.182	4.234	0.000
	PSS	0.145	0.047	0.211	3.069	0.003
	NS	-0.085	0.039	-0.119	-2.214	0.030
5	(Constant)	-1.176	0.231		-5.088	0.000
	AS	0.925	0.069	0.856	13.348	0.000
	STS	0.217	0.042	0.220	5.198	0.000
	PRA	0.112	0.046	0.163	2.449	0.016
	NS	-0.136	0.040	-0.190	-3.427	0.001
	CTS	0.159	0.049	0.229	3.254	0.002

Note. Sig. = significance.a. Dependent variable: SAT_GEN. Source: prepared by the authors.

Table 6. Excluded variables[a].

Model		Beta	*t*	Sig.	Partial correlation	Co-linearity statistics Tolerance
1	PSS	-0.073[b]	-1.221	0.225	-0.131	0.282
	SS	-0.147[b]	-2.234	0.028	-0.236	0.221
	STS	0.149[b]	4.890	0.000	0.469	0.858
	SAS	0.032[b]	0.223	0.824	0.024	0.051
	CS	-0.034[b]	-1.004	0.318	-0.108	0.902
	CTS	-0.070[b]	-1.175	0.243	-0.126	0.282

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	NS	-0.195[b]	-4.181	0.000	-0.413	0.388
	PSS	0.190[c]	2.732	0.008	0.286	0.153
	SS	-0.108[c]	-1.814	0.073	-0.194	0.217
2	STS	-0.045[c]	-0.358	0.721	-0.039	0.050
	SAS	0.069[c]	1.957	0.054	0.209	0.622
	CS	0.172[c]	2.538	0.013	0.267	0.162
	CTS	-0.097[c]	-1.730	0.087	-0.185	0.248
	SS	-0.114[d]	-1.991	0.050	-0.214	0.217
	SAS	0.000[d]	0.000	1.000	0.000	0.049
3	CS	0.048[d]	1.351	0.180	0.147	0.581
	CTS	0.134[d]	1.954	0.054	0.210	0.152
	NS	-0.119[d]	-2.214	0.030	-0.236	0.243
	SS	-0.106[e]	-1.880	0.064	-0.203	0.216
	SAS	0.170[e]	1.241	0.218	0.136	0.037
4	CS	0.083[e]	2.310	0.023	0.247	0.516
	CTS	0.229[e]	3.254	0.002	0.338	0.128
	SS	-0.082[f]	-1.509	0.135	-0.165	0.211
5	SAS	0.129[f]	0.986	0.327	0.109	0.037
	CS	0.067[f]	1.925	0.058	0.209	0.503

Note. Sig. = significance

a. Dependent variable: SAT_GEN

b. Predictors in the model: (Constant), AS

c. Predictors in the model: (Constant), AS, STS

d. Predictors in the model: (Constant), AS, STS, PSS

e. Predictors in the model: (Constant), AS, STS, PSS, NS

f. Predictors in the model: (Constant), AS, STS, PSS, NS, CTS

Source: prepared by the authors.

4. Discussion and conclusions

Several studies have indicated that SG favour active student learning (Liarakou, Sakka, Gavrilakis & Tsolakidis, 2012; Katsaliaki & Mustafee, 2015; Thirouard, Bernaert, Dhorne, Bianchi, Pidol & Petit, 2015; Calabor, Mora & Moya, 2018). We concluded that the use of the SG: The Island as an e-learning tool increased the degree of student satisfaction in higher education with respect to the improvement of their sustainable curricula thanks to the development of the following professional skills: anticipation; critical thinking; systemic thinking; and problem solving.

It has been pointed out that, in order to achieve an optimal citizenship education, it is necessary to develop adequate curricular sustainability in the students (Willemse, Ten Dam, Geijsel, Van Wessum & Volman, 2015; Chung & Park, 2016; Goren & Yemini, 2017). However, as we have mentioned, the SG: The Island promoted competitiveness among the students, given that it is a game whose final output is the ranking of the best decisions made, leaving, therefore, several undeveloped skills.

Therefore, we consider that, for the success of ESD, university teachers should use new active methodologies that allow the students to participate collaboratively in this game, thus incorporating «SS» (collectively developing and implementing innovative activities in the classrooms that promote sustainability, such as brainstorming, SWOT analysis, etc.), «CS» (favouring empathic leadership and facing group conflicts, through feelings charts, multidisciplinary teams or scrums, etc.), and «SAS» (promoting group actions that deal with personal feelings and desires, through constructive interactions, discussion groups, workshops, etc.). This way, student empowerment could be achieved.

In addition, we recommend encouraging «STS» (performing activities such as Paper Tear, historical memory, etc.), «CTS» (carrying out Coffee House Chat, Worldly Words, etc.), and «PSS» (through cause-effect diagrams, toolkits, etc.).

Finally, we consider that the use of simulation games for the development of sustainability skills should not only focus on higher education; it would be advisable to extrapolate it to other educational levels as advocated by Bender and Peppler (2019), given that sustainable education should begin and develop in a transversal manner with the rest of the content learned.

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Key ideas

The use of ICTs to favour active learning processes is an improvement in education, allowing teachers to develop new skills in the students.

The SG: The Island helps students to successfully develop their sustainable curricula, allowing them to improve the skills of anticipation, systemic thinking, problem solving, and critical thinking.

For the success of Education for Sustainable Development, university teachers should use new active methodologies that allow the students to participate collaboratively in serious games.