ISSN: 2178-7727
DOI: 10.17648/acta.scientiae.v21iss1id4936

Commercial Videogames and their Potential for Higher Education: A Study with 347 Brazilian Undergraduate Business Management Students

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Received for publication on 3 Dec. 2018. Accepted, after revision, on 5 Jan. 2018.

ABSTRACT

The present study aims to investigate the impacts of videogames and Hyperculture in the development of the skills needed for managers and administrators in the higher education of the 21st Century. Drawing elements from the Cognitive Mediation Networks Theory and other theoretical elements, it is proposed that Hyperculture expands and develop through videogames, which involve forms of interaction that are largely in alignment with the adult modes of learning, thereby providing an opportunity for the development of relevant competences, particularly STEM and general intellectual ability. In order to test that hypothesis, 347 students of management in a higher education institution in Brazil were objectively evaluated in terms of sociodemographics, academic life, Hyperculture, relationship with videogames, personality, IQ, scholastic knowledge, and leadership. The resulting data was submitted to SSA and Facet Theory techniques in order to obtain a synthetic multidimensional view of the complex interactions underlying the phenomenon in question. The findings indicated that: (a) videogames indeed appear to be an extension of the Hyperculture, (b) Hyperculture and videogames have significant and differential effects upon the development of capabilities that are of great importance for executives in the 21st Century, and the sociocognitive processes involved stimulate the development or expression of personality dimensions. It is concluded that Hyperculture and videogames constitute a potentially important element in the development of executive skills, to the point where it is important to not only consider their influence but perhaps even to find ways to integrate them into the formal education of adults in the fields of administration.

Keywords: Videogames. Hyperculture. STEM. Digital Revolution. Management. Adult Education.

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Videogames Comerciais e Seu Potencial para a Educação Superior: um Estudo com 347 Alunos Brasileiros de Graduação em Administração

RESUMO

O presente estudo busca investigar os impactos dos videogames e da Hipercultura no desenvolvimento das capacidades necessárias para gerentes e administradores na educação superior do Século XXI. A partir de elementos da Teoria da Mediação Cognitiva e outros elementos teóricos, é proposto que a Hipercultura se expande e desenvolve através de videogames, os quais envolvem formas de interação que estão em grande parte alinhadas com os modos de aprendizagem dos adultos, de modo a fornecerem uma oportunidade para o desenvolvimento de competências relevantes, especialmente STEM e habilidade intelectual geral. De modo a testar essa hipótese, 347 estudantes de administração de uma instituição superior no Brasil foram objetivamente avaliados em termos de sociodemografia, vida acadêmica, Hipercultura, relação com videogames, personalidade, QI, conhecimentos escolares e liderança. Os achados indicaram que: (a) videogames parecem, de fato, ser uma extensão da Hipercultura, (b) Hipercultura e videogames tem efeitos diferenciais significativos no desenvolvimento de capacidades que são de grande importância para os executivos no Século XXI e (c) os processos sociocognitivos envolvidos estimulam o desenvolvimento ou expressão de dimensões de personalidade. Conclui-se que Hipercultura e videogames constituem um elemento potencialmente importante no desenvolvimento de habilidades executivas, ao ponto de ser importante não apenas considerar a sua influência, mas talvez até encontrar formas de integrá-los na educação formal de adultos em todas as áreas da administração.

Palavras-chave: Videogames. Hipercultura. STEM. Revolução Digital. Administração. Educação de Adultos.

INTRODUCTION

The end of the 20th Century witnessed a series of cultural, social and economic related to the development and dissemination of information and communication technologies (ICT) throughout practically every sphere of life. According to the Cognitive Mediation Networks Theory, the internalization of the goals, tools and practices of the Digital Age has led to the emergence of a new way of thinking and acting called the Hyperculture, characterized by specific cognitive, attitudinal and social elements (Souza et al. 2012). These would include abstract thinking, logical-numerical reasoning, problem-solving, speed of processing, creativity, social computing and more (Souza & Roazzi, 2015, Souza & Rangel, 2015).

The numerous changes brought by the Digital Revolution have created novel challenges for professional executives. In addition to the traditional requirements regarding technical competences, the ability for teamwork and systemic thinking(Katz, 2009; Mumford, Campion and Morgenson, 2012), there are now new skills, involving the mastery of digital technologies, analytics, research methods, mathematical modelling, and scientific knowledge, that are incapsulated in the acronym STEM (Science, Technology, Engineering and Math), which are becoming increasingly demanded (Havice, 2009, Harris, 2012, Davenport & Patil, 2012, Hudson, 2013, Mazzetti et al., 2014, Radant, Colomo-Palacios, & Stantchev, 2016). In order to effectively provide undergraduate

students of management with the skills they will need to meet the professional challenges of the 21st Century, it is necessary to ponder the specifics of adult education. This involves the consideration of things such as autonomy, motivation, interactive practice, experience and prior knowledge (Knowles, 1984, 1984b, Chapnick & Meloy, 2005).

Videogames are an important part of the Digital Revolution, with their development paralleling that of ICTs themselves and incorporating very essence of Hyperculture in terms of knowledge and thinking (Souza, Silva, & Roazzi, 2010, Souza & Vahldick, 2013, Superdata, 2015). In addition, the very nature of the interactions and activities that these games offer are those of the requirements for effective adult education and professional qualification according to the specialized literature (Maraschon & Axt, 2005, Santos & Tarouco, 2007, Raupp et al., 2010, Marques Filho & Pessôa, 2000, Seriosity, 2007). Interestingly enough, there is significant evidence of cognitive benefits arising from engagement in videogames, particularly in the context of commercial games made solely for the purposes of entertainment (Prensky, 2006, 2007, Silva, 2008, Rodehffer & Bartlett, 2008, Souza, Silva, & Roazzi, 2010, Connolly et al., 2012, Kokkinakis et al., 2017). There also appears to be reason to believe that the positive associations between gaming and cognition, in this order, are of a causal nature (Souza, Silva, & Roazzi, 2010, Bediou, 2018). All of this points to the possibility that videogames might have a positive role to play in fostering mental skills in adult higher education, especially those associated to STEM and Hyperculture.

When one attempts to explain an individual's aptitude for a successful professional career, it is crucial to consider the role of personality, either as a mediating factor or at least as a significant influence (Mischel, 1968, Kaplan & Saccuzzo, 2010). In that regard, some concepts arising from the successful "Divergent" sci-fi trilogy, show promise in understanding things such as choice of profession, type of occupation and professional success (Souza & Roazzi, 2016, 2017).

The present paper attempts to ponder all of the above considerations to explore the possible role of videogames and the Hyperculture in the development of the skills that higher education students in the field of management will need to succeed professionally in the Knowledge Society. Given the number and variety of variables included in the investigation, as well as the complex multivariate associations involved, the choice was made to use Smallest Space Analysis and Facet Theory as the main analytical-theoretical framework.

THE DIGITAL REVOLUTION AND ITS IMPACTS

The Digital Revolution has radically transformed the productive forces of society, changing its economy, politics, and culture in many profound ways (Tapscott, 2003; Lévy, 2004; Gelernter & Brockman, 2010; Brynjolfsson & McAfee, 2012). One of its more important implications is that knowledge, rather than raw materials, labor, or capital, has become the main productive resource, and innovation is now the principal driving force of the global economy (Helsper, 2016). Within this Knowledge Society, the most important

competences are those involving the mastery of science, technology, engineering, and mathematics, a set widely known by the acronym STEM (Havice, 2009), however, they are still difficult to develop and find (UNESCO, 2010; OBHE, 2013; EU Skills Panorama, 2014). There also seems to be a significant gender imbalance in such fields, with a far larger proportion of men than of women, something that has been attributed to sociocultural biases, but also to essential differences between the sexes (Eagly & Steffen, 1984, Weiss et al., 2003, Viadero, 2009, Lippa, 2010; Halpern, 2012).

The CMNT is a perspective on human cognition that presents itself as a coherent scientific model of the human mind capable of explaining the relationships between thinking, society and technology. It also aims to explain the impacts of the introduction of the new ICTs into society, something that not achieved in a satisfactory manner by traditional theories (Souza, 2006, Souza et al., 2012). Its central idea is that human beings complement their cerebral information-processing by deploying several types of computational resources available in the environment, which is to say, by means of extracerebral cognition. Cognitive Mediation is the name given to the process where one uses suitable elements from one's surroundings (physical objects, natural phenomena, other individuals, sociocultural systems, tools, machines, and so forth) as information-processing aids (External Mechanisms), something that can only be achieved if the workings of such elements are present in one's mind in the form of mental representations (Internal Mechanism). The CMNT establishes that the internal thought structures of an individual are, to a great extent, shaped by the structure and dynamics of the elements he or she interacts with in order to perform extracerebral cognition, and that such an influence can be very strong and long lasting (Souza, 2006, Souza, Silva, & Roazzi, 2010, Raupp et al., 2010, Souza et al., 2012, Souza & Roazzi, 2015, Souza & Rangel, 2015, Andrade Neto & Pieper, 2015).

According to the CMNT, the Digital Revolution has led to the development of the Hyperculture, a new form of cognitive mediation that uses ICTs and related sociocultural systems as External Mechanisms, with the corresponding knowledge, values and attitudes as Internal Mechanisms. There have been several studies producing evidence of the psychosocial impacts of this new form of thinking and acting (Souza, 2006, Lima, 2008, Raupp et al., 2010, Souza, Silva, & Roazzi, 2010, Souza et al., 2012, Souza & Roazzi, 2015, Souza & Rangel, 2015, Andrade Neto & Pieper, 2015), finding that it is associated to:

• Frequent, intense and broad use of digital technologies in general, along with a high level of mastery in their daily use;

• Higher levels of logical, analytical and abstract reasoning, visuospatial mental representations, speed-of-processing, multitasking, social computing, and emotional-intuitive creativity;

• Better results in IQ tests, measures of educational achievement, knowledge of scientific contents and methods, self-evaluation of mental skills, and assessments of leadership and sociability;

• Greater tendency towards openness to experience, conscientiousness, and emotional stability, as well as to a high degree of intellectualism, and to assign more personal value to knowledge, success, maturity, and aesthetics;

• Greater levels of professional updating, continued education, professional versatility, and entrepreneurism, as well as a tendency to assign greater professional importance to knowledge, individual competence and the mastery of technology.

Many of these elements are equivalent to STEM competences (Havice, 2009, Gonzalez & Kuenzi, 2012), but they also include many, if not all, of the other attributes found to be crucial for the attainment of concrete results in implementation of ICTs in the productive sectors and for overall career success in the 21st Century (Harris, 2012, Davenport & Patil, 2012, Hudson, 2013, Radant, Colomo-Palacios, & Stantchev, 2016).

CHALLENGES FOR 21st CENTURY MANAGERS

According to Katz (2009), writing in 1974, an administrator is one who directs the activities of other persons and undertakes the responsibility for achieving certain objectives through these efforts. According to him, in order to be successful in this, there one has to master three types of skill: (a) technical, (b) human or interpersonal, and (c) conceptual or systemic. In the same direction, Kraut et al. (1989) point to seven factors, which are: managing individual performance, instructing subordinates, planning and allocating resources, coordinating interdependent groups, managing group performance, monitoring business environment and representing one's staff. Likewise, Mumford, Campion and Morgenson (2012) categorize group skills into cognitive, interpersonal, business and strategic. There seems to be a significant deal of agreement on the matter.

Given the sociocultural and economic changes brought by the Digital Revolution, it is now required of managers and executives not only a deep understanding of the goals, functioning, context, and strategy of the enterprise, but also advanced STEM skills involving computer science, particularly programming, database management platforms, machine learning, data mining, and networks, as well as a sophisticated knowledge of statistical data analysis, mathematics, research methods, and scientific model-building. This involves specific abilities and traits, such as logical and analytical reasoning, abstract thought, visual-spatial thinking, adaptability, versatility, creativity, communication and collaboration skills, powers of persuasion, and initiative. So far, this combination of competences has proven to be extremely difficult to find and even more so to produce (Harris, 2012, Davenport & Patil, 2012, Hudson, 2013, Mazzetti et al., 2014, Radant, Colomo-Palacios, & Stantchev, 2016).

Another relevant aspect of a successful career as a manager or, indeed, any other type of endeavor, is mental health. This is directly associated to performance and it can be promoted as a skill, even if one acknowledges the existence of a strong influence of eventual biological tendencies or situational elements (Bond & Bruce, 2003, Bond

& Flaxman, 2008). At the very least, it is a marker with predictive value (Goetzel et al., 2001).

ADULT LEARNING AND HIGHER EDUCATION

The term "Andragogy", which replaces the Greek *paidos* (child) for *andros* (man) in "Pedagogy", was created by the German educator Alexander Kapp (1799-1869) to designate educational strategies oriented towards adults rather than children. However, the word and its basic concept attained popularity through the works of the American educator Malcolm Shepherd Knowles (1913-1997), who proposed a theoretical framework for adult education based on the assumption that fully mature individuals have forms of functioning that differ from those of children and, therefore, have different requirements (Knowles, 1984a, 1984b).

According to Knowles (1984a, 1984b), the motivations forms of learning in adults differ from those of children in relevant ways. This lead to the identification of principles for adult education that include: strong inner motivation and self-direction, practical and targeted learning, active practice and participation, problem-solving, consideration of prior knowledge, collaborative environment, and support for self-orientation.

Australian educators Stewart Hase and Chris Kenyon have taken the notion of a learner-oriented education one step further by creating the word "Heutagogy", from the Greek *eaftós* (self), indicating the study of discovery of oneself. It designates as a basic principle the idea that the learner should be at the center of his or her own learning, not the teacher or curriculum. Such an approach has been considered of particular use in the context of Internet-mediated distance education (Chapnick & Meloy, 2005).

It has been pointed out that, perhaps, Andragogy, Heutagogy, Self-education, Autodidactism and similar perspectives do not actually differentiate adults from children, but rather constitute approaches that focus on the learner than on the teaching, therefore, should be considered as an approach for lifelong education regardless of age (Knowles, 1989; Hanson, 1996, Rachal, 2002, Merriam, Caffarella, & Baumgartner, 2007).

An adequate approach to effectively implementing adult education is, by definition, a key element for the ability to qualify individuals with the ability to both prosper in their professional careers and effectively contribute to society. This is of particular importance in the context of management, given that the emergence of the Knowledge Society and the Hyperculture make intellectual capabilities, scientific knowledge and mastery of technology play a central role.

THE POTENTIAL OF VIDEOGAMES

The emergence and development of videogames has followed very closely that of the ICTs as a whole, acquiring greater sophistication as the various types of hardware, software and networks evolved (The Video Game Revolution, 2007, Silva, 2008, Donovan,

2010, Souza, Silva, & Roazzi, 2010, Souza & Vahldick, 2013). It is a global multi-billion dollar industry that, in the U.S. alone, reaches nearly two thirds of all households (ESA, 2017).

Videogames involve engaging in complex activities towards specific goals within an abstract context in a virtual environment, something that requires significant degree of problem solving, decision-making and planning, therefore, of learning (Rogers, 2014). Such actions are user-driven, independently performed and self-motivated, occurring in the continuing relation with a responsive interactive system, but also permeated by social exchanges present within or surrounding the game (Kent, 2001, The Video Game Revolution, 2007, Donovan, 2010, Souza & Vahldick, 2013). This makes computer gaming an activity that is inherently in alignment with the characteristics of adult learning (Knowles, 1984a, 1984b, 1989, Hanson, 1996, Rachal, 2002, Chapnick & Meloy, 2005, Merriam, Caffarella, & Baumgartner, 2007).

There is a strong potential for ICTs to boost education through the enrichment of the interactions between learners, instructors and content (Maraschin & Axt, 2005) and the provision of cognitive support (Santos & Tarouco, 2007). This seems to be especially true regarding the learning of abstract concepts in STEM fields by means of interaction with their explicit, consistent, and dynamic audiovisual representations in videogames (Wu & Shah, 2004, Raupp et al., 2010). There is also evidence that the professional qualification and leadership capabilities of executives in the corporate setting can be fostered by computer games (Marques Filho & Pessôa, 2000, Seriosity, 2007). Indeed, the engagement in videogames has been linked to increases in various types of cognitive abilities, including visual perception and sensorimotor skills, visuospatial thinking, logical-numerical reasoning, problem-solving, decision-making, and general intelligence (Prensky, 2006, 2007, Silva, 2008, Rodehffer & Bartlett, 2008, Souza, Silva & Roazzi, 2010, Connolly et al., 2012, Clark, Tanner-Smith, & Killingsworth, 2014, Bediou, 2018, Kokkinakis et al., 2017). Interestingly, such findings are more commonly found in commercial games made solely for the purpose of entertainment rather than those that were developed specifically for educational purposes (Bakar, Inal, & Cagiltay, 2006, Young, Slote, & Cutter, 2012, Clark, Tanner-Smith, & Killingsworth, 2014), perhaps due to economic incentives towards a greater investment in technical quality and to design products that are simultaneously alluring and engaging.

Thus, it appears that videogames promote the new forms of thinking and acting of the Digital Age, with numerous positive psychological and sociocultural consequences, including positive implications for cognitive development, education and professional qualification. This represents a significant potential for initiatives that could use such games to produce important benefits for higher education.

DIVERGENT FACTIONS, PERSONALITY AND WORKING LIFE

Since their origins in the early 20th Century, personality tests were developed to aid organizations in activities such as personnel selection, career counselling, coaching, team formation, evaluation of group dynamics, leadership training, marketing, and management of the quality of working life (Mischel, 1968, Kaplan & Saccuzzo, 2010).

The successful "Divergent" sci- fi trilogy by writer Veronica Roth portrays a dystopian and post-apocalyptic society that is divided into five "Factions", each with a specific social function and personality type (Roth, 2013). Though fictional and without any scientific claim or ambition, such Factions constitute a compelling typology of personality that suggests dimensions that may provide a significant contribution to personality studies and even have relevant practical applications, such as the understanding of several aspects of professional life in organizations. Indeed, investigation with 217 Brazilian adults using multiple psychological tests and a questionnaire regarding working life has produced evidence that largely corroborates the scientific values of the Factions in terms of dimensions that effectively describe an individual's overall psyche and is predictive of working life choices and experiences (Souza & Roazzi, 2016, 2017). Table 1 provides a summary of both the characterizations from Roth (2013) and the findings from Souza and Roazzi (2015, 2017).

The findings from Souza and Roazzi (2015, 2017) rely on an instrument called Faction Quiz, which is a nonscientific form created solely for entertainment purposes (Roth, 2013). The robustness of the associations involved was high enough to allow the hypothesized results to emerge from statistical analyses in spite of the relatively crude measure used, however, it is important to note that better instruments, with improved psychometric qualities, must eventually be developed for future investigations.

MANAGEMENT PROGRAM AT UFPE

The Federal University of Pernambuco (*Universidade Federal de Pernambuco*, UFPE) is a public university located in Recife, Brazil, established in 1946, with 70 undergraduate and 175 postgraduate courses, over 35 thousand students and more than two thousand professors (UFPE, 2017), being recently ranked as the 11th top Brazilian university (RUF, 2017). Its undergraduate program in Enterprise Management was created in 1965 and it is a major involving three thousand hours of coursework over nine semesters oriented towards qualifying students to perform managerial functions in organizations through the mastery of technical skills, the development of critical thinking, and an orientation towards innovation and entrepreneurship (UFPE, 2017). The program currently ranks 20th among Brazil's best undergraduate programs in management (RUF, 2017).

Table 1
The five Factions as characterized by Roth (2013) and their associations with individual psychological and working life as found by Souza and Roazzi (2016, 2017).

Faction	Characterization by Roth (2013)		Associations from Souza & Roazzi (2016, 2017)	
	Description	Social Role	Psychological	Working Life
Abnegation	Altruism, supports others, focus on duties and obligations, attention to details, organization, self-discipline, religiousness	Government, public service and social assistance	Values pertaining to tradition, obedience, social support, affectivity, health, personal stability and religiosity, plus emotional regulation, conscientiousness, agreeableness and low neuroticism	Satisfaction with work and working in commerce
Amity	Pacifism, values social harmony, forgiveness, desire to please, taste for pleasure and entertainment, hedonism	Agricultural production, counselling and caretaking	Values pertaining to belonging to a group and experiencing pleasure, plus the amount of daily sleep	Having a background in agrarian and rural sciences and/or in arts, working in agriculture or industry, and having a private sector job
Candor	Frankness, callous honesty, energy, seeks attention and interaction with others, positive emotions, talkativeness	Application of the Law and trials	Extroversion (assertiveness, talkativeness, frankness, and a tendency toward seeking company and attention)	Having one's own enterprise and the quality of the relationship with co-workers
Dauntless	Thrill-seeking, courage, capacity to overcome fear, competitiveness, assertiveness, importance given to physical fitness	Defense and maintenance of order	Values pertaining to power, prestige, emotion and sexuality, as well as time spent on physical exercises and the practice of sports	Having a background in biological sciences and health, doing autonomous work or not having a job, unclassified or nontraditional background and/or work
Erudite	Intelligence, curiosity, eloquence, appetite for knowledge and information, creativity, critical thinking, appreciation of art	Teaching, research, technology, medicine and librarianship	Values pertaining to knowledge, maturity and aesthetics, plus openness to experience, IQ, level of education, eclecticism, and Hyperculture, as well as time spent working and on activities other than work, exercise or sleep	Having a background in human and social sciences and/or in exact sciences and technology, working in services or in unclassified/ nontraditional segments, having a public sector job, and success at work in terms of increasing position and income

STUDY GOALS

The present paper aims to investigate the possible positive impacts of various aspects of engagement in videogames on the development of traits in higher education students of management that are desirable in professional executives, including intelligence, scholastic knowledge, academic performance, extracurricular academic activities, interest in STEM subjects, and leadership, as well as considering the role of Hyperculture.

It is hypothesized that Hyperculture expands and develop through videogames, which involve forms of action and interaction that are largely in alignment with the independent, interactive and self-motivated adult modes of learning as described by Andragogy and Heutagogy. This would uniquely foster the development of the knowledge and skills that embody the Digital Age and that are required of managers and administrators in the 21st century enterprise. Personality would come into play as mediating factor.

METHOD

Subjects: Total of 347 participants from the undergraduate course in Management at the Universidade Federal de Pernambuco (UFPE), in Recife, Pernambuco, Brazil, during the latter half of 2016, being 114 in the 1st through 3rd periods, 114 in the 4th through 6th periods, and 120 in the 7th through 9th periods, as well as 175 studying in the morning and 172 in the evening, with a total of 172 men (49.7%) and 175 women (50.3%), as well as a mean age of 22.7 years (SD=2.67), ranging individually from 17.9 to 39.3 years.

Materials:

• One form with questions regarding sociodemographics, academic life, and various aspects of relationship with videogames.

• Mental health items of the MOS 36-Item Short Form Survey from the World Health Organization (McHorney, Ware, Lu, & Sherbourne,1994);

• Hyperculture Scale with 14 items regarding the relationship with ICTs and related sociocultural structures (Souza et al., 2010);

• Leadership Mini-Scale with 10 items for self-evaluations of charisma, eloquence, conflict resolution, pragmatism, reliability, support of others, confidence, knowledge & intellect, intuition & creativity, and ability to delegate (Oliveira & Souza, 2015);

• Micro IQ Test with five questions, each to be answered verbally within 10 seconds (Souza et al., 2010);

• Middle School Knowledge Test with 10 true-false questions regarding knowledge of mathematics, physics, chemistry, biology, history, geography, English and Portuguese (Souza et al., 2010);

• Factions Quiz containing seven questions pertaining to choice of behavioral response to a hypothetical scenario among five given alternatives (Roth, 2013).

Procedures: A total of 33 students from the undergraduate course in Management at UFPE, enrolled **in** the discipline "Special Topics – Hyperculture in Individuals and Organizations", obtained a sample of convenience of their colleagues stratified by sex, period and shift, with the instruments being applied in the facilities of the UFPE Campus.

ANALYSIS

Facet Theory is a powerful mathematical approach that allows one to integrate theory and observations in complex phenomena by means of a meaningful visual holistic representation of the relationships within a dataset. It is based on a particular form of Multidimensional Scaling, called the Smallest Space Analysis (SSA), where the association between two variables is inversely expressed as the distance between them in a graph (the stronger the association, the smaller the distance). Groupings of variables (as in Cluster Analysis), as well as the identification of latent dimensions (as in Factor Analysis), are achieved by means of the geometrical partitioning of the graph into regions that are interpreted as both clusters and constructs. The technique is robust enough to deal with practically any type of data and measure of association between variables. It is no exaggeration to state that it may be one of the most sophisticated and far-reaching forms of multivariate data analysis in existence (Guttman & Greenbaum, 1998, Levy, 2005, Borg, Groenen, & Mair, 2012). For all of these reasons, SSA and Facet Theory were chosen as the main form of data analysis for the present investigation.

ETHICS STATEMENT

As established by the ethical guidelines for scientific research with human subjects in Article 1, Subsection V, of Resolution no. 510 from the Brazilian National Council on Health, the present study was exempt from registration or evaluation from the country's Council of Ethics in Research and National Council of Ethics in Research due to the fact that no identification of subjects was registered or even asked for, no experimental intervention was done on the participants that might generate any risks above those of daily life, and no form of diagnosis or counseling was offered either as a consequence of the responses or any other basis. In accordance to international principles regarding research ethics, the participation in the present study was fully informed and strictly voluntary.

RESULTS

Academic Achievement

The average grade on all academic courses taken by a student, measured on a 0-10 scale, had a mean of 7.40 (SD=1.009) and a Coefficient of Variation of 13.6%, with 60.9%

having an average grade of 7.00 or more (grade level that is enough to pass a given course without the need to take a final exam) and 97.1% having an average grade of 5.00 or more (minimum grade to pass a course). Roughly, 73.3% were progressing through their major at the regular speed, 21.0% were delayed and 5.7% were ahead of time. Approximately 12.6% were class monitors (undergraduate teaching assistants), 13.2% were receiving a scientific initiation scholarship (undergraduate research assistance scholarship) and 5.2% were engaged in scientific initiation without a scholarship.

Relationship with Videogames

A total of 194 of the students (55.9%) declared to engage in videogames at some level, the fraction by gender being 68.6% of the men and 43.4% of the women. This group of players:

• Played a mean of 5.1 (SD=2.64) different genders of game out of 11 possibilities (strategy, adventure, action, first person shooter, piloting, simulation, puzzle, board, RPG, MOBA or others), with 91.2% playing more than one gender;

• Had approximately 48.1% playing tactical games (strategy, simulation and/or adventure), 44.1% dynamic games (first person shooter, action and/or piloting), 30.0% abstract games (puzzle and/or board), 24.2% multiple player games (RPG and/or MOBA), and 20.7% other types of game;

• Included 78.7% engaged in single player games, 50.8% in multiplayer games and 33.0% in MMOs, with 33.4% playing more than one of these types;

• Had roughly 84.0% using smartphones, 67.6% using desktops or notebooks, 53.7% using consoles, 35.1% using browsers and 11.2% using other platforms, with 75.8% using more than one platform.

The players spent a mean of 7.5 (SD=8.67) hours per week playing, with 79.8% playing 10 hours per week or less, 14.2% playing between 11 and 20 hours per week and 6.0% playing 21 hours per week or more. On average, they had been engaging videogames for 8.5 years (SD=5.32), 35.4% for six years or less, 33.5% for seven to 12 years, and 31.1% for 13 years or more. The mean age when gaming began was 15.3 years (SD=6.03), with 22.5% starting at the age of 10 or less, 23.5% between the ages of 11 and 15, 23.5% between the ages of 16 and 20, and 25.5% at the age of 21 or more.

Videogames, Hyperculture, Academic Life and Psychosocial Variables

Figure 1 shows the diagram for a Smallest Space Analysis for the variables regarding IQ, middle school knowledge, academic grades, progress on the major (regular, ahead, delayed), academic extras (working as monitor for undergraduate courses or as a research assistant), preference for STEM (preference for quantitative over qualitative courses,

and for systemic vs. people-oriented courses), leadership, psychological well-being (frequency of feeling well, lively or badly in the last four weeks), personality dimensions according to the Factions Quiz (Abnegation, Amity, Candor, Dauntless and Erudite), Hyperculture, smartphone use, digital experience (years of experience with computers), digital precociousness (one divided by the age in which regular contact with computers began), time spent playing videogames, experience with games (years since began playing), gaming precociousness (one divided by the age in which regular videogaming began), number of different types of gaming platforms used, number of different types of videogame played, sociability of games (index of how social the videogames played are), information literacy (skills in searching for online information on videogame strategy) and flow (amount and usefulness of the videogame information found online).

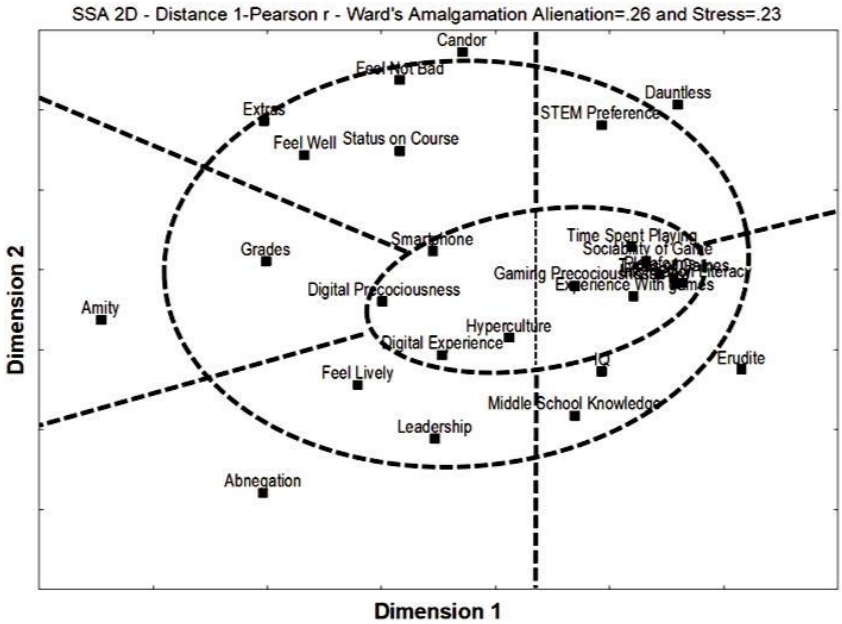

Figure 1. SSA and partitions for the variables regarding academic life, cognitive abilities, leadership, preference for STEM courses, videogames, psychological well-being and personality.

The relational structure shown in the SSA is indicative of a radex. The modular pattern consists of hypercultural and ICT-related variables in the center, surrounded by sociocognitive processes which, in turn, are surrounded by personality dimensions. The polar partitions distinguish leadership, academic performance, academic advancement, preference for STEM and cognitive performance. It is relevant to note that the central modular portion with hypercultural and ICT-related variables, named "Hyperculturality", can be divided into two portions: one containing Hyperculture, smartphone, digital experience and digital precociousness, (Hyperculture and digital experiences) with the other comprising all the variables relating to videogames (gaming). Also worth noting

is the fact that the origin of the diagram (coordinate "0, 0") is located near the upper left portion of the capital letter "G" of the label "Gaming Precociousness" in Figure 1.

The mean age in which the players began to interact with computers was 11.8 years (DP=3.77) and the mean age in which they began playing videogames was 15.3 years (DP=6.02), a statistically very significant difference ($p<.01$ on the Wilcoxon Test).

DISCUSSION

Academic Achievement

The undergraduate program in Enterprise Management at UFPE is well established and considered to be among the best in Brazil, however, the current evidence suggests that the probability of obtaining a passing grade in its courses is quite high for the students and that there is a significant degree of homogeneity of performance in that regard. This might be due to a selection bias where only topnotch students are accepted for enrollment (saturation effect), to a tendency to award excessively high grades (lax evaluation) or a combination of both. On the other hand, the actual timely progression through the courses is not so likely, and only a small portion of the students engage in more advanced academic endeavors of being a class monitor or participating in research. Such things are more likely to require the dedication of substantial amounts of time and effort. It seems, therefore, that good grades are relatively easy to obtain, whereas effectively progressing through the program and getting involved in intellectually demanding activities are harder to achieve.

Videogaming Among the Student Body

Engagement in videogames appears to be the rule, rather than the exception, among those enrolled in UFPE's undergraduate program in Enterprise Management, with more than half of the students declaring to play such games. Those who do play generally dedicate only a few hours per week to this activity, but have been involved with these games for a number of years, usually starting out before the age of 21.

Most of the players report engaging in a variety of videogames instead of just one type. Almost all play more than one gender and the majority state that they use more than one platform. The exception to this is the fact that single player varieties are much more common than multiplayer or MMOs, though even here there is still a substantial portion that plays a combination of these.

Overall, it seems that a little over half of the students engage in videogames, and have been doing so for years, since childhood or adolescence, but usually not in problematic amounts. These players also tend to embrace different types of game instead of just one specific variety.

Multidimensional View

In light of Facet Theory (Guttman & Greenbaum, 1998, Levy, 2005, Borg, Groenen &, Mair, 2012), the SSA diagram in Figure 1 and the relational structure identified in it can be interpreted as revealing a specific set of mechanisms and processes. The concept map in Figure 2 illustrates such an interpretation.

From the structure that was identified, one can derive a deeper understanding of the psychosocial phenomena involved.

The finding of a continuous partition encompassing all the variables pertaining to the relation to ICTs, Hyperculture and videogames in the SSA of Figure 1 indicates that these elements all share a common aspect, thereby constituting a construct that might be called "Hyperculturality". The fact that such a partition was situated at the center of the diagram indicates that such a construct is associated to the whole constellation of psychosocial variables and constructs in the analysis, very possibly in a causal role. This corroborates the notion that the Digital Age has brought new forms of thinking and acting that are profound and far-reaching (Souza, 2006, Souza, Silva & Roazzi, 2010, Raupp et al., 2010, Souza et al., 2012, Souza & Roazzi, 2015, Souza & Rangel, 2015, Andrade Neto & Pieper, 2015).

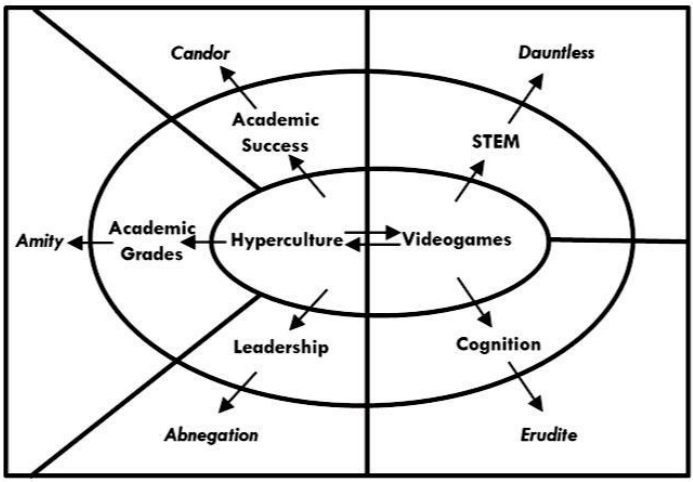

Figure 2. Concept map derived from the SSA.

The fact that Hyperculturality can be subdivided neatly into two juxtaposed portions of Hyperculture and Videogames is indicative of the two being separate, but strongly related, as would be expected if, as theorized, one thing emanates from the other (Silva, 2008, Silva & Roazzi, 2010, Raupp et al., 2010). It appears that, at least for the group studied, videogaming is something that emerges as a new extension of the Hyperculture, as suggested by previous studies (Silva, 2008, Souza, Silva &, Roazzi, 2010, Souza & Vahldick, 2013). The fact that the mean age with which students begin to interact with

computers was two and a half years younger than the age in which players begin to engage in videogames suggests that the causal relationship goes from Hyperculturality towards videogames, though it stands to reason that feedback in the opposite direction eventually occurs.

The clear separation between Hyperculture and Videogames is also depicted in Figure 2, though their mutual interaction is also indicated. As it was explained before, this suggests the two are strongly related, but discernible from each other, most likely because Hyperculture produced Videogames which, in turn, reinforce Hyperculture, both things having profound psychosocial implications.

In Figure 2, surrounding Hyperculturality, one has an annular partition comprising all the variables related to cognition, interest in STEM courses, academic achievement, and leadership, which can be collectively labeled as Sociocognitive Processes. This corroborates the notion of Hyperculture and Videogames having profound psychosocial implications. Surrounding Sociocognitive Processes, in turn, are the measures of personality as characterized by the five Factions. This suggests that Hyperculturality influences Sociocognitive Processes and that the latter influences the expression of personality traits.

In the polar partitioning, those regarding Hyperculture and Videogames had different associations to Sociocognitive Processes. The former was related to Leadership, Academic Grades and Academic Achievement, whereas the latter was linked to Interest in STEM and Cognition. Likewise, each portion of Sociocognitive Processes was shown to be associated to the expression of a particular personality dimension or Faction.

The humanistic values and social components of Hyperculture in general (Souza, 2006, Souza, Silva & Roazzi, 2010, Raupp et al., 2010, Souza et al., 2012, Souza & Roazzi, 2015, Souza & Rangel, 2015, Andrade Neto & Pieper, 2015) might explain its associations to Leadership, Academic Grades and Academic Achievement. On the other hand, the kind of thinking involved in computer games (Kent, 2001, The Video Game Revolution, 2007, Donovan, 2010, Souza & Vahldick, 2013), which is in alignment with adult learning (Knowles, 1984a, 1984b, 1989, Hanson, 1996, Rachal, 2002, Chapnick and Meloy, 2005, Merriam, Caffarella, & Baumgartner, 2007), as well as a tendency to value game dynamics, audiovisuals and achievement that was observed in the present study, could possibly account for the association between Videogames and Interest in STEM and Cognition.

Leadership comprised the result on the "Leadership Mini-Scale" and the "Feel Lively" item of the MOS 36-Item Short Form Survey, indicating an unsurprising association between capacity to lead and a degree of excitement and enthusiasm. The proximity to Abnegation suggests that the measured leadership abilities tend to translate into a propensity to be in the service of a group. This might be expected from the fact that there is a conceptual overlap of the Leadership Mini-Scale items of "conflict resolution", "reliability" and "support of others" with the findings of Souza and Roazzi (2016, 2017) that Abnegation seems related to the values of "social support" and "affectivity", as well

as to the emotional regulation and conscientiousness. In addition, government is the explicitly stated role of Abnegation in the fictional Divergent series (Roth, 2013).

Academic Grades were associated to Amity, which appears to make sense only when one recalls that, within the context of the sample studied, obtaining a passing grade seems like a task requiring a low level of effort, and that the performance in that regard showed relatively little variation between individuals. This may simply reflect an academic reality where a focus on grades is the path of least resistance.

Academic Success comprised "progress on major" and "academic extras", along with the "Feel Well" and "Feel Not Bad" items of the MOS 36-Item Short Form Survey, suggesting that an academic achievement beyond obtaining a passing grade is related to psychological well-being, something that can be considered both cause and consequence of performance. The observed association with Candor is indicative of the tendency for positive emotions and extroversion as a consequence of achievement, which would explain why anyone would be motivated towards achievement in the first place. It also accounts for why this was not associated to grades (i.e., because they are too easily attained to constitute actual relevant achievement).

Interest in STEM was shown to be related to Dauntless, which can conceivably be explained by the fact that both are usually more intense or frequent in males than in females. Indeed, research has shown that, compared to women, men overall tend to have higher levels of visuospatial and logical-numerical thinking, as well as stronger interest in things and systemization, both traits being characteristic of the STEM fields (Weiss et al., 2003, Lippa, 2010; Halpern, 2012). They are also to be more inclined towards assertiveness, risk-taking, and sexuality (Lippa, 2010), which are elements of the Dauntless personality dimension (Souza & Roazzi, 2017). This might also provide an explanation for the higher percentage of male gamers in countries such as the U.S. (ESA, 2017) and in the present investigation.

The association of Cognition to Erudite seems obvious, given that the latter has been previously shown to relate to IQ, level of education, and positive attitudes towards knowledge (Souza & Roazzi, 2017).

Potential Professional Implications

In the present investigation, Hyperculture and Videogames were found to be associated to Sociocognitive Processes which, in turn, were shown to be related to the Factions (personality dimensions). Based on the results from Souza and Roazzi (2016, 2017) regarding the relationship between the Factions and working life in organizations within the same context of the Metropolitan Region of Recife, it is reasonable to infer that the forms of thinking and acting of the digital age have repercussions that affect the personality traits linked to practically every aspect of one's career in a company.

Of particular importance is the chain association from Videogames to Cognition to Erudite found here, with Souza and Roazzi (2016, 2017) showing evidence that the latter

is related to career progression in the form of increases in position and income in time. This is in agreement to expectations regarding the impacts of videogames on thinking (Silva, 2008, Souza, Silva, & Roazzi, 2010, Souza & Vahldick, 2013), as well as those regarding the importance of such cognitive skills for success in the 21st Century (Havice, 2009, Harris, 2012, Davenport & Patil, 2012, Hudson, 2013, Mazzetti et al., 2014, Radant, Colomo-Palacios, & Stantchev, 2016).

CONCLUSIONS

The present study attempted to investigate the possible role of Hyperculture and videogames in the development of relevant skills and traits in the context of higher education students in management and administration. For that purpose, a total of 347 individuals enrolled in one of the most prestigious universities in Brazil were assessed as to their academic life, leadership, IQ, personality, emotional status and preference for STEM subjects, as well as relationship with ICTs and computer games.

A multivariate analysis done through the use of SSA and Facet Theory, along with other statistical techniques, produced evidence indicating that:

i. Videogames can be seen as a differentiated extension and development of the Hyperculture;

ii. Hyperculture and experiences with digital technologies tend to promote leadership, academic performance and participation in academic extracurricular activities;

iii. Videogames favor the development of cognitive skills and the preference for STEM courses at a university;

iv. Hyperculture and videogames appear to produce effects that impact human personality in profound ways;

v. Hyperculture and videogames seem to have a potential for the development of capabilities that are of great importance for executives in the 21st Century.

It is concluded that Hyperculture and videogames constitute an important element in the development of executive skills, to the point where it is important to not only consider their influence but also perhaps even to find ways to integrate them into the formal education of adults in the field of administration. Future studies should focus on this possibility.

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