GAMIFICATION AS A DIDACTIC STRATEGY IN TEACHER EDUCATION

Gamificación como estrategia didáctica. Aplicación en la formación del profesor

Bruno Santos Ferreira
e-mail: brunosfweb@gmail.com
Gilberto Lacerda Santos
Universidada de Brasília. Brasil

RESUMEN
Este proyecto de investigación se centra en el uso de la gamificación como estrategia de enseñanza, más concretamente en la formación de profesores durante el uso de softwares educativos (SE). Esto será analizado a través de nuestro estudio de caso acerca del software de educación matemática GGBook. El punto de partida de nuestra investigación es la hypothesis de que el uso de la gamificación en una herramienta educativa de formación de profesores hace que la situación de aprendizaje sea más efectiva. De hecho, los mecanismos de gamificación, como la motivación, aumentan el interés. Relacionamos estos mecanismos con la teoría de Kolb de los estilos de aprendizaje.

PALABRAS CLAVE: gamificación; software educativo; formación de profesores; estilos de aprendizaje; conocimiento significativo.

ABSTRACT
This research project focuses on the use of gamification as a teaching strategy, more precisely in the teachers' training during the use of educational software (ES). This will be analyzed through our case-study, the mathematical software GGBook. The starting point of our research is the assumption that the use of gamification in an educational tool of teacher training makes the learning situation more effective. Indeed, mechanisms of gamification like motivation increase interest. We correlate those mechanisms with the Theory of Kolb of the learning styles. These latter exposes four different ways individuals engage with a learning situation depending on their knowledge construction process.

KEY WORDS: gamification; educational software; teacher training; learning styles; meaningful knowledge.

Recibido/Received: 19/05/2017
Aprobado/Aproved: 23/12/2017

Cómo referenciar este artículo / How to reference this article:
Ferreira Bruno, S. & Lacerda Santos, L. (2018). Gamificación como estrategia didáctica. Aplicación en la formación del profesor. *Tendencias Pedagógicas, 31*, 113-126. doi: http://dx.doi.org/10.15366/tp2018.31.006

1. INTRODUCTION

The great technological advances of the recent decades has driven changes in the teaching role with the incorporation of computer technology, among them, the educational software and the new practices that it generates. These changes require new skills and knowledge for the teachers to adapt to an innovative teaching role and fit this new reality [1]. Researches show that, in general, few teachers are motivated and prepared to introduce new technologies in their pedagogical actions [2]. Belloni [3] explains that one of the major obstacles to this integration is the teacher's unpreparedness to deal with computing devices due to their complexity.

Indeed, for a significant number of teachers, learning to use an educational software and explore it in all its didactic possibilities is not a simple task and takes time, specific skills and motivation. The questions are thus, how can we produce such skills so that the teachers get involved in technology, and how to motivate them?

In another field, researches show that the gamification technique has a strong potential regarding the motivation of people, and engages with a desired behavior [4]. This technique has been highlighted as an emerging phenomenon, having as strength not only to motivate people, but also to assist the people in solving complex problems and the learning of new skills [5]. Many companies have appropriated the strategy in their training to motivate their employees, making their work activities more enjoyable, stimulating the search for a goal and also to make more attractive technologies in order to encourage people to adopt them or influence the way in which they are used [6].

So, to experiment the strategy of gamification to tackle the approach of the educational software, seems for us an important way to facilitate their use in different educational situations, among them teacher training. However, research findings indicate that individuals engage differently in learning situations and go through different individual paths in their knowledge of construction processes [7]. This implies thus that any educational device should consider different learning paths for their users. These forms of learning, also called learning styles, is a dimension that has to be taken into account along with the gamification strategy in order to make educational software more efficient.

2. LITERATURE REVIEW

2.1. Gamification

Those last years, the gaming industry has made considerable investments in strategies to understand what motivates the targeted audience as well as the loyalty of its products. Based on those results and the consequent popularity of games, the idea of using the structure of the games (principles and mechanics) to motivate and involve people raised in different other areas. This process was called by the term gamification [8].

The gamification has thus become an emerging phenomenon, proving to be a powerful alternative to traditional approaches to conflicts in various sectors such as health, education, public and social policies, sports and others, turning

repetitive tasks of daily life in fun experiences, helping people in the process of assimilation of new technologies [9] and, above all, encouraging people to adopt new behaviors. Among its objectives, we can highlight more specifically in the field of technology and education: making technology more attractive; encouraging users to engage in desired behaviors; showing a path to mastery and autonomy; helping solve problems without distraction and taking advantage of human psychological predisposition to engage in games [10].

Adding the well-known definitions and taking into account the technical potential to influence people to do things normally considered unattractive, Kapp defines gamification as: "(...) the use of thoughts, mechanical and game aesthetic to engage people, motivate actions, promote learning and solving problems. " [11]

The concept of gamification includes thus the principles and mechanics of games. The principles of the games' main idea is transforming activities or routines considered unattractive into engaging and fun experiences through the establishment of clear objectives or through narratives. The mechanics of the games are called balancers elements to obtain an emotional balance with time investment, energy and intellect of the person. Among those elements are clear objectives, rules, narratives, rewarded structure, recognition of levels, competition and collaboration environments. The success of gamification will result from the effective combination of those different elements.

2.2. Motivation

The motivation has to do with the direction, intensity and persistence of behavior over time: the direction refering to the specific choice of conduits within a range of possible approaches; the intensity refering to the effort that a person committed for performing a task; and the persistence relating to engage in a certain behavior over time. Those elements activate factors such as desire, pleasure, fear,… which, according to neuroscience research, are directly related to our emotional system [12]. Indeed, we can find evidence of human motivation in biology, an area that seeks to describe it by means of natural schemes of our brain. Those show that we act according to our physiological and cognitive needs. Researches in the neuroscience sector have established a link between the incremental rewards and pleasure experiences that games offer, with the release of an organic chemical called dopamine [13].

For psychologists, motivation is a multidimensional phenomenon that involves the mechanisms that determine and intervene in the selection, activation and maintenance of the direction of behavior [14]. Among the different dimensions of motivations' analysis, we realize that these dimensions are classified in intrinsic and extrinsic motivation.

Intrinsic motivation is one of the most important advisors in the study of motivation, one of the most researched in recent decades. Its researchers have provided knowledge that allow to help in the difficult task of awakening the interest of individuals. For Deci [15] intrinsic motivation refers to implementation of the activity in which the pleasure is inherent. The individual naturally seeks new challenges with a personnal interest, and not always through the necessity of an external pressures or reward.

Extrinsic motivation refers to a motivation in response to something external as a task or activity in order to obtain social or material rewards or recognition as well as aiming to meet the commands or pressure from others or to demonstrate skills and abilities. The extrinsic motivated person can, for example, conduct a school task to improve its grades or to get awards by this technique. For Martini and Boruchovitch [16], "(...) a student is extrinsically motivated when you perform a given task in order to obtain external rewards, material or social, aiming recognition, demonstration of competence or capabilities relation to other people. "

Although these guiding demonstrate individual differences in intrinsic and extrinsic motivational ratings, several authors have admitted the adaptive character of both, showing that they relate and complete each other [17]. Thus, the fundamental difference between the two types of motivation is the reason for the person to act and causality of the action that can be internal or external.

To orchestrate these elements towards the promotion of motivation and engagement, the gamification is based on theories of cognitive and behavioral psychology focusing on the motivation for desirable experiences of its users. In this sense, we can highlight the self-determination theory of Decy and Ryan [18] and Skinner's theory of operant conditioning [19], which respectively investigated the intrinsic and extrinsic motivation. These theories bring concepts and strategies that inspire the concepts established by the state flow theory [20].

These theories constitute the theoretical background used by games to create, guide and maintain the motivation of the players. The gamification inherits these theoretical strategies and is guided by the concept of the flow state theory, which is understood as the operating state in which an individual is totally immersed and focused on what he is doing. This involves a total mental involvement and continuous engagement in a process or activity. It is believed that this state of consciousness is related to the full and immediate involvement in the activity performance, providing pleasure, satisfaction and meaning [21].

According to Kapp to draw the flow in an environment based on game concepts is not an easy task [22]. However, when this environment appropriates the flow state theory in its structure, it is possible to have a better handle on the achievements of the individuals involved (learners or players). According to the author, the flow is experienced when there is an almost perfect balance between the skill level of an individual and the level of difficulty of the proposed challenge.

In this sense, the game design (theory underlying the construction of games and inspires gamification) searches the correlation between the proposed game and the player's desire. [23] Studies in this area define the players in 4 profiles: killers, conquerors, explorers and socializing, where:

1. Killers. They are driven by the desire to impose themselves and are pleased to provide moments of agony and anxiety in other players. For them to win, someone has to lose. They are frequently present in the top of the leaderboard.
2. Achievers. They are driven by goals in the game to stand out from the other players, usually by some form of accumulating points such as experience points, levels or even discount

coupons. They will be attracted to an inventory of badges or trophies, for example.

3. Explorers. They are driven by the desire to find out all you can about the game, ranging from the mapping of the geographical area to the understanding of the mechanics. They are curious and want to understand why and how to comply with a proposed challenge.
4. Socializers. They are interested in the other players. The game is just a backdrop to socialize with other players. Socializers are the interested in status and motivating challenges in team.

These players' styles are related to four existing dimensions in games: action, interaction, player and the game world, which are related dialectically in two distinct tensions: action-interaction and player-world. Consequently these styles determine types of strategies, elements and content consistent with their individual characteristics. Thus, in the context of games, knowing the player's style is an effective strategy to determine a good setting for the application of gamification strategy. However, when dealing with situations of formal learning, where the user is not a player but a learner, it is the learning styles that we should consider [24].

2.3. Learning Styles

The theory of learning styles designed by David A. Kolb is based on the theory of experiential learning that values the interaction of the individual's experience (their experiences, feelings and actions), the environment in which it appears (its concepts, influences external), and it defines learning as the process by which knowledge is created through the experience of transformation [25]. Experiential learning proposes therefore four learning modes: a concrete experience (CE), reflective observation (RO), the abstract context (AC) and active experimentation (AE). These modes make up a circle of learning where an individual must practice to learn all modes of the cycle in an orderly manner. However, for Kolb, learning does not only come from sequential transition between the suggested bases, the knowledge being constructed in different ways depending on the mode that experience is captured and / or processed. These bases of the learning process are related dialectically in two distinct dimensions: AC-CE (which corresponds to the way the subject captures the experience) and AE-RO (corresponding to how it transforms the experience).

According to Kolb [26], the structural basis of the learning process is the relation among the transition of the four modes of learning and the way to resolve the dialectical tension AC-CE and AE-RO. In AC-CE tension, the individual will have to solve a dialectical tension among the concrete (EC) and the abstract (CA), which can be accomplished in two opposite ways of capturing the experience: through conceptual interpretation or symbolic representation. The second tension is the AE-RO tension between reflection (RO) and action (AE), which can also be resolved in two opposite ways: through a process of internal reflection and / or active manipulation of the outside world.

Kolb says that the knowledge building process results in different elementary forms of knowledge and thus synthesizes them into four concepts:

1. When the experience is captured by apprehension and transformed by purpose, it results in a "divergent" knowledge;
2. When the experience is captured by comprehension and transformed by an intention, it results in an “assimilative” knowledge;
3. When the experience is captured by comprehension and transformed though an extension, the results in a “convergent” knowledge;
4. When the experience is captured by apprehension and transformed by extension, it results in an “adaptive” knowledge.

Thus, the experiential learning proposes that the learning cycle varies according to each individual "Learning Style". Not only elapsing of sequential transition among the suggested steps but being constructed in different ways, depending on the mode that experience is captured and / or processed. These modes reveal our individual preferences before learning situations. This is what Kolb defines as diverging, assimilating, convergent and adaptative.

The preferred combination reveals the dominant learning style of the individual. However, Gagnon [27] says that all individuals have in itself all the learning styles, even those that do not enjoy the same way, do not dominate all styles equally or that do not use them in the same way.

3. METHODOLOGY AND RESEARCH MATERIAL

The research problem is related to the development of SIGA, an educational device for teacher’ training. The SiGA is a Plug-in for educational software, which aims to add to the original software the criteria and gamification strategies according to the individual characteristics of styles and learning. For this it seeks to understand which game elements suits the best the individual characteristics proposed by learning styles.

Technically, the SiGA was developed based on the concepts of widgets, which are nothing more than floating items that can be opened quickly. The main advantage of being a widget, is the non-visually intrusiveness of the SiGA in the educational software. The items follow are represented in 4 tabs that are located discreetly on the side or bottom of the browser.

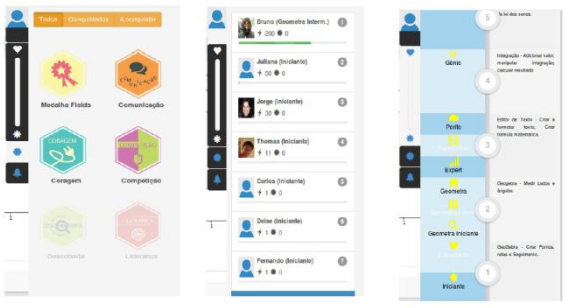

Figura 1: The widgets of SiGA

Like observable in Fig. 1, each tab contains an icon that represents the set of informations and strategies, which in this case are: a ranking panel (competitive perspective) or a panel communication between users (collaborative approach); a panel that controls the system and user levels as well as the learning objectives; a panel that lists the badges that can be won and the one adquired; and, finally, a panel which stores all information (feedback provided by the system).

The planning and the development of the SiGA where developped based on methodologies that would help us in the process of parallel understanding between computational and educational requirements of the resource in question. This has been found in the principles of software engineering and guided respectively to the modeling of cooperation of Lacerda Santos [28].

To verify the effectiveness of the use of gamification in a situation of teacher training and the possible merging of the particular characteristics which define the teachers' learning styles and motivational ideas, we chose the qualitative approach of the study case, consisting of empirical investigation of nature that investigates a fenômento in a particular context [29].

Therefore, we applied our plugin SiGA, into the educational software of GGBOOK like observable in Fig. 2. In order to analyze the possible interactions between the gamification and the learning styles. Concretely, the sample in the study was consistituted by 30 teachers of Mathematics based on following criteria: not knowing the Sofware GGBOOK and have experience in the classroom without the use of technologies. To perform this study, there had to be at least one representative of each learning style. For this, a laminating process in the sample of the participants was performed to ensure the existence of characteristics required for the study. To define and highlight the learning styles, we worked with the questionnaire developed by David Kolb, in its latest version dated 2005 - Learning Style Inventory - Version 3.1 (LSI 3.1). Finally, four specific cases where analyzed more in depth: the case of the teacher with the divergent style; assimilative style; convergent style; and adapter style.

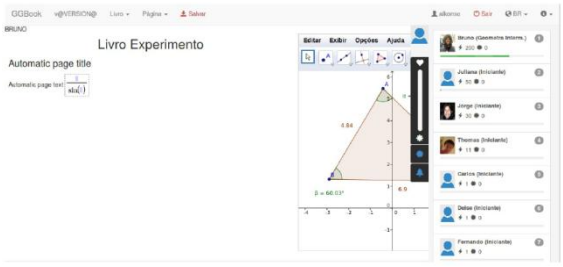

Figura 2: SiGA integrated in the educational software GGBOOK

4. RESULTS

SiGA revealed us, during the collection of the date, information related to the behavior of the teachers, the aspects of interest, involvement, satisfaction,

integration and, finally, autonomy. These elements realize the presence of intrinsic motivation in an individual.

Through the tracking conducted in SiGA's database, we obtained the Table 1, which gave us: the time that teachers were logged, the number of connections made and the permanence during each connection. It showed that teachers who completed the training in its entirety just left the software after reaching all the stipulated objectives, noting the effectiveness in the promotion of issues of interest and involvement. We associate this data to the aspects of interest and involvement of participants with the purpose of training offered.

HISTORY

Users	*Access type*	*Time stamp*
User 1	in	2015-02-27 11:41:25
User 11	in	2015-02-27 11:45:01
User 1	out	2015-02-27 12:15:33
User 2	in	2015-02-27 12:15:50
User 2	out	2015-02-27 12:30:10
User 11	out	2015-02-27 13:15:30
User 1	n	2015-02-27 13:45:27
User 1	out	2015-02-27 13:55:45
User 25	in	2015-03-04 21:45:58
User 25	out	2015-03-04 22:05:05

Other data, obtained in Table 2 informed us about the intersections between the learning styles and gamification. This table also gave us information on the actions of communication between participants and refers as well to the preference of the teacher's environment (collaboration or competition). Through these data, we were allowed to analyze the aspects of satisfaction and integration. The same table also gave us the opportunity to evaluate the overall performance criteria between meeting the learning objectives and the integration with the gamification device.

INTERACTIONS

Users	*chat*	*likes*	*helps*	*Changed of ...*	*Followed...*
User 1	6	3	2	0	2
User 2	0	0	0	0	1
User 11	2	1	4	1	0
User 25	2	6	0	1	3

Table 3 gave us the data on the permanence of participants in a competitive environment by the end of the training. By studying this table, we also complement the analysis of the appearance of satisfaction and if the local environment (between competition and collaboration) would have a direct impact on motivation according to the participant's profile.

COMPETITION RANKING

Users	*Position*
User 2	1
User 25	2

Table 4 gave us the total rewards (points and badges) collected during the research. The rewards collected are inherent to the shares held in both environments (cooperation and competition) proposed by gamification. However, the competitive environment is more conducive to achieve such rewards. In order to have no conflicts between the objectives of motivational strategies and learning objectives, all reward were strictly linked to the learning objectives of the study.

EARNED BADGES

Users	*points*	*badges*
User 1	10	1
User 2	2000	6
User 11	400	2
User 25	1500	4

Finally, Table 5 gave us an overview in relation to the percentage of completion of the stipulated goals. This table also informed us that for the four independent analyzed cases (one of each style), we had a 93.2% utilization in three cases and only one escape of abandonment. However, even though that participant has not completed the proposed objectives, we understand through a triangulation of data on social interaction, tracking and interaction with the tool,

that: 1) during the period in which it was involved that participant was active in a collaborative environment, interacting with other participants; 2) although our driving strategies have not had the desired effect, we were able to motivate that participant to return to the environment after his escape.

GOALS

Users	*Goal 1*	*Goal 2*	*Goal 3*	*Goal 5*	*Goal 6*
User 1	100%	66%	0%	0%	0%
User 2	100%	66%	100 %	100 %	100 %
User 11	100%	66%	100 %	100 %	100 %
User 25	100%	66%	100 %	100 %	100 %

5. CONCLUSIONS

The aim of this article is to seek if gamification, when used as a teaching strategy in a learning environment, may be able to make this a more effective environment. This idea led us to look for clues in the existence of a the learning theory and applied it in a gamified context to facilitate learning situations.

As seen in this study, learning styles propose individual characteristics that define the preferences of people learning situation. This assists in developing the sense of knowledge, to mastery autonomy according to the related theories of learning motivation, that indicates us the importance of intrinsic motivation (most valuable type of motivation in this contexts). Thus, we realize that the different learning styles of the participants have some elements in common with the motivational aspects. This realization led us to the conclusion that the most significant way to produce autonomy is by using the process to learning styles. This led us also realize that it is necessary to calibrate the users of effort, so that the effort used to perform a task is not exaggerated in relation to that required by the learning context. This is also valid in the opposite situation, where the learning context requires a higher level of effort of what the user can provide. We therefore conclude that adjusting the training process to the participant's learning style is an excellent strategy for the appearance of motivation in learning situations.

The SIGA, as we have seen, is an innovative approach to gamification strategy as a teaching strategy for the use of complex educational software, in the case of this research, the educational software GGBOOK. Based on the studies of Gagnon [30] and Kolb [31], our SiGA could provide a suitable environment for research possibilities regarding to gamified educational devices in order to develop more lasting knowledge.

Since this is an unprecedented event in the scientific community interested in the study of didactics, we believe that, in addition to providing

various new paths of research for this study, it is also an object of study for potential future research around the team of teacher's training for the use of educational software. The research also provides contributions to the field of study related to educational engineering software, as its design and development process reveals unique ideas that can give greater scope for the development of new software with the same or similar purpose. The head was originally designed to work in partnership with the educational software of mathematics GGBOOK, however, because of the independency of SiGA as a plugin, it can be applied to other educational software of other fields as well. Therefore, we encourage new researchers to use the follow research as the basis for new scientific productions in the field of didactics.

6. REFERENCES

M. F. Garcia, Novas Competências Docentes Frente às Tecnologias Digitais Interativas. *Revista teoria e prática da educação do Departamento de Teoria e Prática da UEM,* Maringá, vol. 14, nbr. 1, jan./abr. 2011

- H. Becker, Internet Use by Teachers: Conditions of Professional Use and Teacher- Directed Student Use. In: *Teaching learning and computing.* A national survey of schools and teachers. Center For Research on Information Technolgy and Organizations – CRITO, 1999.

D. Galanouli and V. McNAIR, Students' Perceptions of ICT-related Support in Teaching Placements, Journal of Computer Assisted Learning, vol. 4, Issue 17, pp. 396-409, 2001.
A. Baylor and D. Ritchie, What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classroom? Computers & Education, pp. 395-414, 2002.

M. L. Belloni, O que é mídia-educação. Campinas: Autores Associados, 2001.

- M. L. Belloni, O que é mídia-educação. Campinas: Autores Associados, 2001.

- K. Kapp, *The gamification of learning and instruction*: game-based methods and strategies for training and education. Pfeiffer: San Francisco, 2012.

- K. Kapp, *The gamification of learning and instruction*: game-based methods and strategies for training and education. Pfeiffer: San Francisco, 2012. A. Baylor and D. Ritchie, What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classroom? Computers & Education, pp. 395-414, 2002.

- B. Feld, Gamify Your Site In Five Minutes With BigDoor's Minibar, MIT Technology Review, October 14, 2010.

- D. Muir, Adapting Online Education to Different Learning Styles. National Educational Computing Conference, Building on the Future, pp. 1-15, 2001.

K. Kapp, The gamification of learning and instruction: game-based methods and strategies for training and education. Pfeiffer: San Francisco, 2012.

- B. Feld, Gamify Your Site In Five Minutes With BigDoor's Minibar, MIT Technology Review, October 14, 2010.

- E. Corcoran, The Gamification of education. *O'Reilly Media*, October 29, 2010.

K. Kapp, The gamification of learning and instruction: game-based methods and strategies for training and education. Pfeiffer: San Francisco, 2012, p.10.

J. E. Zull, The Art of Changing the Brain: Enriching the Practice of Teaching by Exploring the Biology of Learning. Stylus Publishing, LLC., 2002.

S. Wolfram, Predictive Reward Signal of Dopamine Neurons. *Journal of Neurophysiology*, vol. 80, nbr. 1, pp.1-27, 1998.

A. Bandura and D. H. Schunk, Cultivating competence, self-efficacy and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology*, Washington, vol. 41, nbr. 33, pp. 586-598, 1981.

- Deci cited in: M. L. Martini and E. Boruchovitch, A teoria da atribuição de causalidade: Contribuições.

- para a formação e atuação de educadores. Campinas: Alínea, 2004.

- Deci cited in: M. L. Martini and E. Boruchovitch, A teoria da atribuição de causalidade: Contribuições para a formação e atuação de educadores. Campinas: Alínea, 2004.

- R. M. Ryan and J. Stiller. The social contexts of internalization: Parent and teacher influences on autonomy, motivation and learning. In: P. R. Pintrich and L. Maehr (Ed.). Advances in motivation and achievement. Greenwich, CT: JAI Press, 1991. pp. 115 -149.

- B. F. Skinner. "The Design of Experimental Communities", International Encyclopedia of the Social Sciences, Vol. 16, New York: Macmillan, 1968.

- M. Csikszentmihalyi, Beyond Boredom and Anxiety. Jossey-Bass, San Francisco, CA, 1975.

- F. L. Massarella, Motivação intrínseca e estado mental de flow em corredores de rua. 2008. 121f. Dissertação (Mestrado em Educação Física) – Faculdade de Educação Física da Universidade Estadual de Campinas, Campinas, 2008. Disponível em: <http://libdigi.unicamp.br/document/?code=vtls000 431342>. Acesso em: 08 dez. 2014.

K. Kapp, *The gamification of learning and instruction*: game-based methods and strategies for training and education. Pfeiffer: San Francisco, 2012.

R. Bartle, Designing Virtual Worlds, New Riders Games, p,145, 2003

R. Gagnon, Jogar com estilo para ter sentido. In: G. Lacerda Santos (Org.). Gamificação como estratégia educativa. Brasília: Link Comunicação e Design, 2015.

- D. A. Kolb, Experimental learning: experience as the source of learning and development. New Jersey: Prentice-Hall, 1984.

- D. A. Kolb, Experimental learning: experience as the source of learning and development. New Jersey: Prentice-Hall, 1984.

R. Gagnon, Jogar com estilo para ter sentido. In: G. Lacerda Santos (Org.). Gamificação como estratégia educativa. Brasília: Link Comunicação e Design, 2015.

- G. Lacerda Santos, Proposta de uma Estratégia Holística para a Engenharia de Softwares Educativos. Revista Brasileira de Tecnologia Educativa, nbr. 148, pp. 22-26, 2000.

R. K. Yin, Estudo de Caso: Planejamento e Métodos. 2. ed. Porto Alegre: Bookman, 2001.

R. Gagnon, Jogar com estilo para ter sentido. In: G. Lacerda Santos (Org.). Gamificação como estratégia educativa. Brasília: Link Comunicação e Design, 2015.

- D. A. Kolb, Experimental learning: experience as the source of learning and development. New Jersey: Prentice-Hall, 1984.

****