Serious Game for SWOT Analysis of EPC Main Contractors

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Abstract

Current astonishing technological progress demands education and learning methods to keep up with market needs and to prepare new required profiles. Contemporarily, it also provides advancements need to perform this leap through interconnectivity and virtual worlds that yield more engaging and immersive methods. In this context, we use a quite recent paradigm such as serious games to perform a SWOT analysis which has been long used in business strategic analysis. Our serious game may be use either at learning or at professional situations, as a way to enhance communication and debate of concepts and results respectively. Having developed it by means of a game engine, we propose a case study centered on Engineering, Procurement and Construction (EPC) taken from the literature. The game has been used for learning purposes and it has caused very positive impact on the learning process and the engagement of students.

Keywords: SWOT Analysis, Business Strategic Analysis, Serious Game, EPC Main Contractors

1. Introduction

Serious game-based learning has considerably widened the possibilities of teaching methods by highly engaging the student since he is put at the center of the learning process. Although literature on game-based learning is still conservative on whether they provide significant gains regarding academic achievement (Arnab et al., 2012; Perrotta et al., 2013), we believe the combination of traditional teaching methods such as test-based and assignment-based ones with new technologies like video games and virtual or augmented reality may yield a enriched learning experience.

In parallel, interest around the use of videogames in education is greater and greater as literature reflects with countless applications in different domains (Bruzzone et al., 2014; Praiwattana and El Rhalibi, 2017; Uskov and Sekar, 2014; Yildirim, 2010). One of the main reasons to this popularity is the fact that serious games allow users to experience realistic situations in direct relationship with their background or work and that although unlikely, they could happen in the real world. Therefore they can exercise and get ready to tackle certain contingencies that otherwise would be impossible to emulate beforehand in real world due to reasons of safety, cost, time, etc. (Aldea et al., 2014; Susi et al., 2007).

Along with this, numerous studies try to discern the positive qualities of serious game beyond their motivational appeal, by observing and determining their real impact on the learning outcomes (Arnab et al., 2012; Bruzzone et al., 2011; Bruzzone, 2018). This has direct relation with the degree of gamification achieved, which refers to the extent game design elements are introduced in non-context games. In this regard, educational applications range from gamified applications or simulation-based games to proper serious games (Uskov and Sekar, 2014). Likewise, educational games gameplay may have a clear goal, such as a score function to maximize, or be play-based, where the knowledge acquisition is made by means of the gameplay itself regardless of any kind of concrete aim (Uskov and Sekar, 2014).

Despite the numerous frameworks for ludology (study of game and game design (Gibson, 2014)), the majority of them considers three design principles of gamification: mechanics, dynamics, and aesthetics. Mechanics refers to game components at data and algorithm level, that is, goals, rules, settings, interactions, as well as the boundaries of the situation to be gamified. Dynamics concerns the runtime behavior of mechanics acting on player; in other words, strategies like cooperation, competition and relationships between game entities and player (Yanes and Bououd, 2019). Finally, the third layer relates to aesthetics and desirable emotional responses evoked in the player because of game elements (Gibson, 2014). It is of crucial importance to consider the main game design components when designing a serious game if we want to be successful on our venture.

Furthermore, the deeper the knowledge on videogame science is, the more skilled we will be at design effective games and the better we will understand their effects on players.

In our case, we have considered all the aforementioned elements to develop a serious game devoted to business strategy formulation learning and support. We aim at improving the way students pick up skills on strategic analysis and establish medium and long-term strategies within an organization. Hence, we have introduced engaging elements and thought the game as a competition-based game, where user must try to get as many points as he can.

Along with this, the tool may be used in professional contexts to enhance communication and definition of strategic goals. Actually, once brainstorming of both external and internal factors has been carried out, data may be inputted, and the serious game may be used to classify it by nature. The fact that input data is provided through text files greatly facilitate the process without the need for modifying the app.

2. SWOT Analysis

Although its inception dates back to the early sixties, it is since the publication of Competitive Strategy by Michael Porter when SWOT analysis gains general recognition in the strategic analysis of any organization (Leigh, 2010). Nowadays, this tool has become a fundamental part of any curriculum on Business Management in every university worldwide, as it makes up one of the first phases in business strategy development, that is, the strategic planning stage (Namugenyi et al., 2019).

The main aim of SWOT analysis is to identify and examine both internal and external resources, trends and patters and their impact to businesses to eventually evaluate the strategic position of the organization at issue with respect to its competitors. Those factors are split into four groups according to their nature and to what they represent to the organization: Strengths, Weaknesses, Opportunities and Threats. The recognition process must be objective and impartial to get a clear and faithful picture so as to draw effective conclusions. Furthermore, the level and depth at which is applied must be properly establish beforehand to accommodate the scope of the analysis (Leigh, 2010).

However, it presents some limitations mainly related to oversimplification or lack of accuracy. Sometimes, SWOT analysis may prioritize issues of secondary importance or fail to provide alternatives (Sarsby, 2016). Likewise, it may become too subjective if not carried out under suitable conditions and by skilled personnel, so the analysis becomes unfaithful to reality. If so, consequences might be devastating since the formulation of the firm's long-term business strategy would be based on erroneous data. Therefore, the person in charge of undertaking the SWOT analysis must be sufficiently skilled no to fall into the trap and perform a careful yet precise analysis.

In addition, sometimes SWOT analyses are follow by a situational analysis by means of a confrontation matrix called TOWS (Weihrich, 1982). This conceptual framework aims at combining the external and internal factors considered in the SWOT analysis and formulate strategies by matching them (Weihrich, 1982). More concretely, it considers four types of possible strategies (Dyson, 2004):

- Defensive: Preserve Strengths while facing Threats.
- Offensive: Exploit Strengths to take advantage of opportunities.
- Reorientation: Correct Weaknesses by taking advantage of Opportunities.

- Survival: Face Threats by hindering Threats.

3. SWOT Analysis Serious Game

The Serious Game presented here aims at changing the way SWOT analysis and business strategy formulation is currently being learned. Out main objective is to put the learner, that is, the business management student at the center of the learning process, so that he becomes the one to understand the nature of analysis initial data. In this sense, if we were to imagine the traditional way this tool is taught at colleges, we can ascertain three main parts:

- Tool explanation: Introducing the tool within its context, its origin and purpose is essential to understand its functionality and later make use of it.
- Demonstration by means of an example: Generally, Professor will start from an illustrative example from the literature on the analysis of a contemporary company or project. The traditional methodology will be the presentation of SWOT factors, their classification and the formulation of strategies based on them.
- Final Grade Task: Students are asked to complete a final take either in group or individually on a SWOT analysis of a given company. This way they test their ability to perform such an analysis and assess their understanding of the tool.

We believe that the leap between the second and third step in the learning process may be reinforced by making the student feel actively participant since the exposition of the example by the professor. In this way, he is already actively performing a task in group to realize foreseen mistakes and heed corrections and advice yet freed of fear of failure and negative grading involved in the final task.

Regarding the methodology, the game has been developed as a standalone application by means of game engine Unity3D. Thus, it can be played on either a laptop (Windows) or phone (iOs or Andorid). Users can simply download the app and play it right away on their devices.

Input of data to the game is done by means of a comma-separated file by following specific format. This file can be changed anytime so application is fully flexible to adapt to any case study.

4. Game mechanics

To do so, we have developed a mini–Serious Game made up of two different but intertwined parts. First, the game presents the user with a SWOT analysis chart including both the external and internal aspects, and a set of factors in a list below. The gameplay is quite simple: user must scroll through possible factors and drag each of them to the right place, in other words, assign what it represents to the organization (Figure 1).

Score system has been designed as follows:

- If user is right on the first go, he scores 10 points.
- If user is right on the second go, he scores 5.
- If user is right on the third attempt or later, he scores 0 points.
- Every time user fails to classify the choice, he scores -10 points.

In this way, is up to user to decide how many times he will try

selecting the right square if he fails to classify a factor. Furthermore, depending on whether and when user is right, the game displays a pop up window with the answer consequence and a comment (Figure 2 and Figure 3).
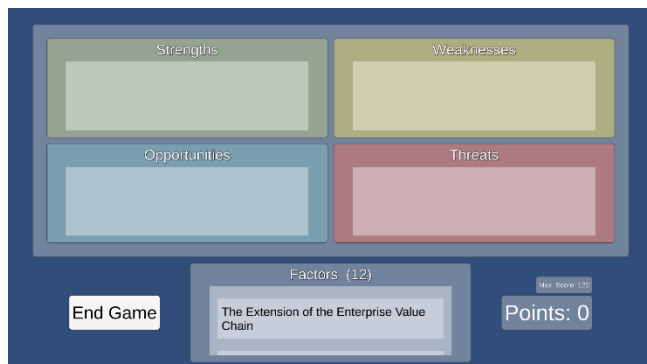

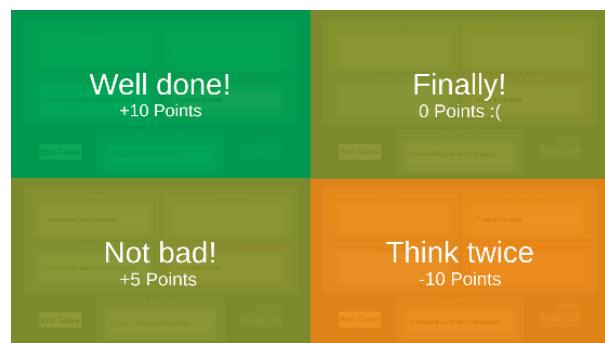Figure 1. Start game screen a main interface.

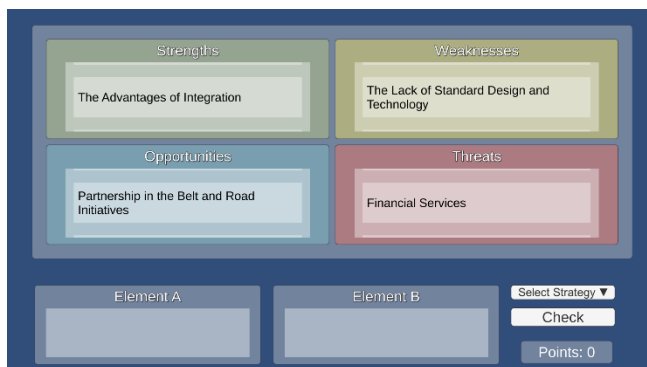Figure 2. Pop-up windows as engaging element.

Figure 3. Second part of the game: Strategies formulation.

Score is indicated through a static panel in the lower right corner on the screen. There is also a maximum score record in case user tries the game more than once. Maximum score is recorded every time he plays the game and is kept for subsequent goes.

Once the user has finish classifying all factors, he is allowed to go ahead to formulation strategy mini game. The interface of this part has been kept pretty similar to the first, so user is already used to playing it. In this case, the game starts with all factors already classified into their right nature. So, the first thing user can do is to check wrong responses and reflect on them. Afterwards, he can define strategies among those factors (Figure 4). By following TOWS analysis framework, he must first select the type of strategy he is going to implement from a dropdown menu.
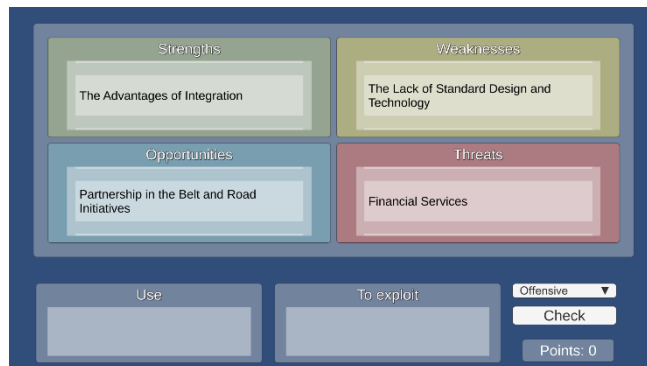

Figure 4. Selection of strategy.

Right after that, headings the squares presented in the lower part of the screen will adapt to that strategy type. Then user, must drag one factor to each square hence completing the formulation of the strategy. If the answer is right and the strategy has been correctly formulated, he scores 20 points and factors vanished. Otherwise, he scores -5 points and must change selected factors to reformulate it. The end games once he thinks there are not more possible combinations and all strategies have been devised. Final score is recorded, and he is offered to repeat the gameplay to improve.

5.   Proposed Case Study

As case study, we propose the SWOT analysis of an EPC company in line with other activities developed by Simulation Team at different courses of University of Genova. The example is taken from (Nikjow et al., 2021), devoted "to understanding the current status quo of EPC for Belt and Road Initiative (BRI) in West Asia (WA). The activity is not just restrained to the case study, but participants must first examine the background of the case and understand the necessity to perform a SWOT analysis. Once modeler has introduced the solution in the game, out of the list of factors displayed by the game they have to reason where and why each one is to be assigned to a certain type.

6.   Experimentation

The game has been used as educational tool at Business Management course of the 3rd academic year of the Bachelor's Degree in Industrial Design at University of A Coruña. Students were guided by the professor by being asked in-person and out loud where every factor was to be assigned to. Thus, on the basis of the information on the case previously provided, they had to determine which was the right option.

Students said the experience was much more engaging than traditional methods, and they feel they have apprehended the concept more easily. Moreover, they were also awarded with little rewards in case of good performance based on score points.

7.   Conclusions

SWOT analysis is a well-established method in business strategy analysis as precursor to strategies formulation. Its flexibility allows strategic analysis at different levels, but its simplicity may yield too subjective and unfaithful evaluation. Thus, our serious game aims at overcoming these limitations by putting the learner at the center of the analysis since the beginning. The experimentation at a Business Management course shows promising results on the use of this kind of methods to enhance learning. As main insight, we deem the application as worthy for further use at professional level, as a tool to support the analysis phase when multiple participants

are involved.

As future work, the serious game may be hosted and accessed through internet to remove the necessity of downloading the app. Furthermore, users would be able to directly input data to a server in charge of getting results for further comparison and grading. Regarding interactivity, we also planned to add a timer so that higher pressure is put on user, whose score may be decreased if it takes too long to respond.

References

Aldea, A., Iacob, M.E., Hillegersberg, V.J., Quartel, D., Franken, H., 2014. Serious gaming for the strategic planning process. Proc. - 16th IEEE Conf. Bus. Informatics, CBI 2014 1, 183–190. https://doi.org/10.1109/CBI.2014.45

Arnab, S., Berta, R., Earp, J., de Sara, F., Popescu, M., Romero, M., Stanescu, I., Usart, M., 2012. Framing the adoption of serious games in formal education. Electron. J. e-Learning 10, 159–171.

Bruzzone, A., Massei, M., Longo, F., Madeo, F., 2011. Modeling and simulation as support for decisions makers in petrochemical logistics, in: Proceedings of the 2011 Summer Computer Simulation Conference. pp. 130–137.

Bruzzone, A.G., 2018. MS2G as pillar for developing strategic engineering as a new discipline for complex problem solving, in: 30th European Modeling and Simulation Symposium, EMSS 2018. pp. 405–411.

Bruzzone, A.G., Massei, M., Agresta, M., Poggi, S., Camponeschi, F., Camponeschi, M., 2014. Addressing strategic challenges on mega cities through MS2G, in: 13th International Conference on Modeling and Applied Simulation, MAS 2014. pp. 231–240.

Dyson, R.G., 2004. Strategic development and SWOT analysis at the University of Warwick. Eur. J. Oper. Res. 152, 631–640. https://doi.org/10.1016/S0377-2217(03)00062-6

Gibson, J., 2014. Introduction to Game Design, Prototyping, and Development: From Concept to Playable Game with Unity and C#.

Leigh, D., 2010. SWOT Analysis. Handb. Improv. Perform. Work. 2, 115–140. https://doi.org/10.1002/9780470592663.CH24

Namugenyi, C., Nimmagadda, S.L., Reiners, T., 2019. ScienceDirect ScienceDirect Design of a SWOT Analysis Model and its Evaluation in Diverse Digital Business Ecosystem Contexts-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0/) Peer-review under responsibility of KES International. https://doi.org/10.1016/j.procs.2019.09.283

Nikjow, M., Liang, L., Qi, X., Financial, S.S.-J. of R. and, 2021, undefined, 2021. Engineering Procurement Construction in the Context of Belt and Road Infrastructure Projects in West Asia: A SWOT Analysis. mdpi.com. https://doi.org/10.3390/jrfm14030092

Perrotta, C., Featherstone, G., Aston, H., Houghton, E., 2013. Game-based learning: Latest evidence and future directions, NFER (National Foundation for Educational Research).

Praiwattana, P., El Rhalibi, A., 2017. Game-Based Crisis

Simulation and Generation Framework: Design and Implementation Structure, in: Lecture Notes in Computer Science. Springer Verlag, pp. 75–84. https://doi.org/10.1007/978-3-319-65849-0_9

Sarsby, A., 2016. A guide to SWOT for business studies students, in: A Guide to SWOT for Business Studies Students. pp. 5–9.

Susi, T., Johannesson, M., Backlund, P., 2007. Serious Games : An Overview.

Uskov, A., Sekar, B., 2014. Serious games, gamification and game engines to support framework activities in engineering: Case studies, analysis, classifications and outcomes. IEEE Int. Conf. Electro Inf. Technol. 618–623. https://doi.org/10.1109/EIT.2014.6871836

Weihrich, H., 1982. The TOWS matrix—A tool for situational analysis. Long Range Plann. 15, 54–66. https://doi.org/10.1016/0024-6301(82)90120-0

Yanes, N., Bououd, I., 2019. Using gamification and serious games for english language learning. 2019 Int. Conf. Comput. Inf. Sci. ICCIS 2019. https://doi.org/10.1109/ICCISCI.2019.8716451

Yildirim, S., 2010. Serious Game Design for Military Training. Games Des. Res. Conf. 9.