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How to Model a Visual Novel Game to Train and Identify Players' Soft Skills?

Jérôme Hernandez¹, Mathieu Muratet¹, Matthis Pierotti², Thibault Carron¹

¹ Sorbonne université, Paris, France

² Origamix-RH, Paris, France

hernandez.jrme@gmail.com

mathieu.muratet@lip6.fr

m.pierotti@origamix-rh.com

thibault.carron@lip6.fr

Abstract: Companies and the human resources (HR) population have shown a growing interest in assessing and developing their employees' soft skills. Management and leadership soft skills are currently the most affected by this trend. Indeed, companies are currently complex human organizations where managers and team leaders have to supervise together a multi-generational / cultural group. That is why soft skills, also referred to as interpersonal or behavioural skills are expected to be valued in HR management.

Companies and HR experts are able to train their peers through different tools, like interactive workshops, instructive videos, and online learning. Likewise, they use interviews and situational judgment tests (SJT) to identify soft skills. In an innovative approach, the process of training and the assessment of the learning progress may be enhanced through game-based learning (GBL) and synchronized into a sole serious game.

To this end, we propose a generic framework enabling the creation of a Gamified Situational Judgment Test (GSJT). The first part of the framework is about the gamification of an SJT to enhance the learning of a soft skill and we rely on a visual novel game approach to support the gamification process. The second part is focused on the evaluation process of the players' learning. We propose a model based on a decision tree enabling the collection of a data set through indicators. These indicators will permit us to evaluate the learning of the different soft skills through the game, and it will point us towards a tendency behavioural profile of the player.

Our framework and models have been instantiated on a serious game intended for managers of an important banking group on an international scale. We will illustrate the instance with four primary leadership soft skills and will demonstrate the possibility to detect soft skills tendency profiles amongst the players.

Keywords: Soft Skills, Gamification, Human Resource, Situational Judgement Test, Clusterization, Visual Novel Game.

1. Introduction

The role of soft skills (SSk) in industries and organizations has gained prominence these recent years (Schulz, 2008). From personality and behavioural traits to interpersonal/social skills through non-cognitive ability, SSks have proved their importance in the success of individual personal life (Heckman and Kautz, 2012) and its performances at work (Ibrahim et al., 2017). The performance of an employee can affect his/her team performance resulting in a companies' productivity fluctuation. Consequently, companies are currently evolving to take SSks into account in their different processes such as recruitment and training.

Indeed, companies' productivity relies heavily on the use of soft skills. Kojongian et al. (2020) argue that companies' success depends on a combination of knowledge and technical skills, also named Hard Skills, with a productive attitude of the employees determined by their SSks' level. Besides, SSks are by nature transferable to any kind of domain and role, increasing the value and the importance of the SSks. Human Resources departments (HR) are the main stakeholder of the SSks used by the companies' employees. One of HR's missions is to provide effective and qualified personnel. Moreover, the HR population is currently facing the challenge to create a cohesive and efficient multi-generational workforce. (Lewis and Wescott, 2017) observed the differences in perspectives, attitudes, values, characteristics, and behavioural challenges that impede the communication between two generations. The importance to train employees' SSks such as teamwork, communication, and critical thinking is essential. Hence, HR is trying to remodel their training and development processes focused on soft skills supplementary to hard skills. In such a difficult context, new approaches explore innovative tools such as Gamification and research around Situational Judgement Test

(SJT). Our work tries to show that we can combine SJT with a visual novel game approach to develop tools to detect soft skills tendency profiles amongst the players.

The remainder of this paper is organized as follows. In section 2, we present a brief overview of related works about learning games (LG) advantages using educational models, then we focus on situational judgment tests and gamified approaches of these latter. Section 3 describes the framework and models enabling the creation of a GSJT. Section 4 presents an instance generated by the framework including a bundle of leadership soft skills. Finally, section 5 deals with the experimental results and discusses them before concluding.

2. Related work

Gloria et al., (2014) highlight that several LGs can be analysed by following educational theories and learning model approaches. Among the educational objectives models, the Revised Bloom's Taxonomy (RBT) is highlighted as the most popular cognitive approach to design SG. RBT approach provides a seven levels' framework which evaluates and covers all LGs' cognitive learning objectives. Hauge *et al.*, (2013) described and analysed three SGs, in the field of entrepreneurship, through the RBT model and revealed the games' potential support for SSKs development. Similarly, Calderón and Ruiz (2014) analysed five games in the software project management training field. They found that SG's scope is often focused at the basic levels of RBT: (1) knowledge, (2) understanding, and (3) application.

Similarly, (Chavez, 2019) designs CyComEx using RBT in each level of the cognition domain to provide the core dynamics of the game. Lastly, Buchanan et al. (2011) revealed the correlation between the type of games and the effects on different kinds of learning objectives expected. They sustain that interaction and game designers have first, to understand what learning outcomes are aimed at, to secondly, create a SG following such learning objectives. Hence, Buchanan et al. (2011) propose different kinds of games following a specific level of Bloom taxonomy. The revised bloom taxonomy is thus a reliable tool to help game designers to understand the learning outcomes and could be useful in our specific SSK context.

Kolb's experiential Learning Cycle (Kolb, 2014) is a second useful model to design and analyse serious games. Carvalho et al. (2015) revealed the importance of immersive learning experiences for serious game and learning objectives. Indeed, Kolb's model centred the learning process through a cycle of experience, observation, conceptualization and experimentation by the player.

2.1 Situational Judgment Test

Concerning recruitment and skill assessment, a specific test is generally used: the situational judgment test (SJT). SJTs can be written or video-type scenario-based tests where the test takers have to make choices in a given situation enabling the test taker behaviour assessment. In principle, test takers encounter a situation that depicts real-life scenarios and the item responses are commonly limited and pre-conceived by the SJT Designers. This method has proven its effectiveness and reliability to assess soft skills. Lievens (2013) revealed that SJT is fitted to assess interpersonal knowledge and skills for a large volume of test-takers. In addition, Patterson et al. (2012) nurture the cost-efficiency and reliability of an SJT for large-volume selection assessment contexts. Moreover, they not only sustained that SJT enables the measurement of diverse SSKs but also suggested that SJT may be relevant in a training program with the addition of educational tools such as feedback.

2.2 Gamified SJT

An SJT including gamified learning elements brings the player in an additional immersive learning experience. The player encounters different situations (concrete experience) where the player has to make some choices to progress into different paths (reflective observation) with consequences (abstract conceptualization) bringing the player to another situation; which can be of the same kind (Active Experimentation) or new to finally iterate the same processes until the end of the game.

Studies about the gamification of a situational judgment test are recent and still commonly unclear. Armstrong et al. (2016) attempted to clarify the misconceptions about the gamification of an SJT by highlighting that SJT

can be playful through a toolkit of game elements such as narrative content or progress bar and score. Nevertheless, they also revealed that gamification is a much more complex concept than just the use of game elements in non-game contexts and described gamification as a meta-method. Despite the positive result of using Gamification in an SJT for recruitment and job-related assessment purposes (Georgiou et al., 2019), scientific studies using a GSJT to assess players' soft skills and their validity have just risen. Gkorezis et al. (2020) revealed that GSJT can be used to assess soft skills by opposing a normal SJT originally conceived for soft skills assessment to its gamified version.

It is well known that the gamification process is often a long, tedious and expensive step because of a consequent number of actors involved in the process (Marfisi-Schottman et al. 2010). In order to simplify our objective, we looked for generic game types that were based on a simple structure and adapted to our context.

A Visual Novel Game (VNG) is a narrative and computer-based game that a user can experience (Camingue et al., 2020). From a simple reading story to a full role-playing game, VNGs offer an immersive and interactive experience through multimedia and game assets such as soundscape, animations, videos, characters dialogue, or inside mini-games. Besides, decision-making moments may enhance the interactivity of the game by affecting the progress of the player into several storylines. Moreover, VNG gameplay is quick to learn and easy to use even without an instructor. The relative genericity (domain-independent) of this type of game offers a lot of application domain. Technically, the decision tree should let us make assessments and give feedback at each step in-game.

However, to our knowledge, no research studies the use of gamified situational judgment test methods for a soft skill learning process. Hence, this article is describing a generic framework to design GSJT enabling players' soft skills development and behavioural profile assessment simultaneously relying on a VNG approach.

3. Framework and methodologies

This research work aims to propose a generic framework to design a gamified SJT for soft skills learning outcomes. The purpose of the framework is to be used by any entities which need to develop soft skills such as companies or educational institutions. The framework relies on a methodology chronologically structured in three steps (see figure 1): (1) Define and establish the core soft skills, (2) Design the SJT, and (3) Gamify the SJT. In this section, we will firstly discuss the process of each step. Secondly, we proposed a means of assessing simultaneously the learning and the player's soft skills in-game. Due to lack of space, we will not discuss the integration of learning feedback inside the GSJT.

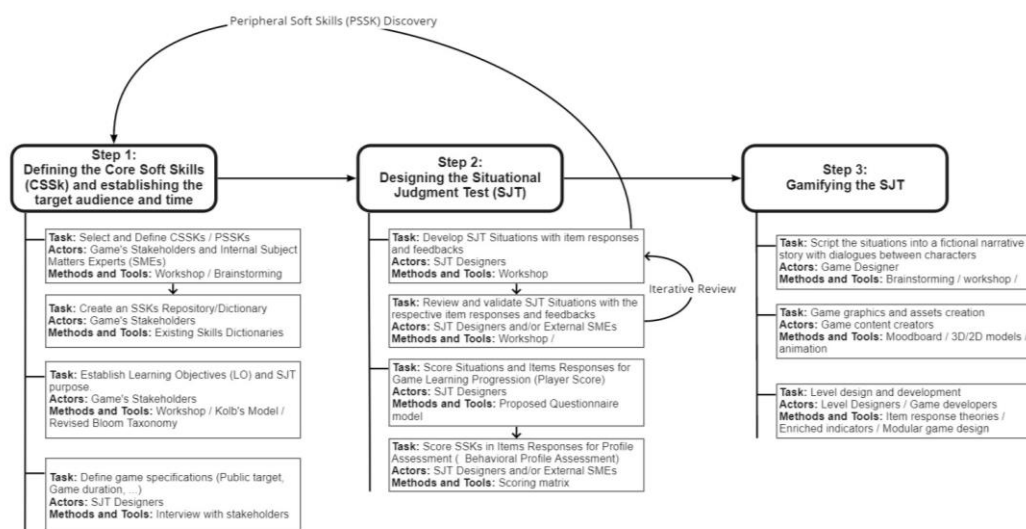


Figure 1. Gamify situational judgement test framework in three steps

3.1 Defining the Core Soft Skills and establishing the target audience and time

The first step is to select and define the core soft skills for the GSJT. We call Core Soft Skills (CSSks) the SSks that are primarily needed by stakeholders, to be assessed and learnt through the GSJT. In contrast with the CSSks, the peripheral soft skills (PSSks) are SSks with less value for stakeholders. In the context of SSk development and training, stakeholders of the game such as teachers, instructors, or the HR population for industries are the main actors of this step. Clear and precise definitions of the soft skills expected and understandable for the player have to be defined with these actors. Origamix RH, an HR consultancy company and a research partner revealed in its history that companies use the same soft skill titles but may differ in the meanings, while some reference dictionaries exist: the IRCC Behavioural and Technical Competency Dictionary by the Canadian Government or the DiCo proposed by the French Government, for example.

Simultaneously, the stakeholders and Subject Matter Experts (SMEs) of the GSJT have to establish the Learning Objectives (LOs) described in the RBT (Revised Bloom's Taxonomy). We presently focus this study on the first levels of the RBT: remembering, understanding and application. For example, in the following table, we can find the results issued of such a step: a CSSk and a PSSk with their description as well the establishment of the LOs.

Table 1. Description of some CSSk, PSSk and the learning objectives issued from the first step of the methodology

<p>Definition of the core soft skills (CSSk) and peripheral soft skills (PSSK)</p> <ul style="list-style-type: none"> • Innovation (CSSk): Foster the emergence of new ideas and allow them to be tested in a more agile environment, capable of valuing the diversity of talents • Analytical Mind (PSSk): The capacity to fuse, create and give consistency to information about a given situation, document, procedure or process. Being able to focus on the essential elements and extract key points.
<p>Definition of the learning objectives, the player has to:</p> <ul style="list-style-type: none"> • remember the core soft skills titles at the end of the game • understand the soft skills meanings and how they can be involved in various situations • demonstrate his knowledge of the CSSks in realistic and simulated situations

Along with the LO's establishment, the GSJT's specifications generated after an analysis of the target audience and the game duration will affect the two next parts of the framework: designing the situational judgment test and the gamification of the SJT.

3.2 Designing the situational judgment test

The development of this part is mainly performed by SJT designers which are the SJT stakeholders and SMEs. Moreover, this part can be subdivided into two objectives: (1) Development of SJT's elements and validation of the SJT's elements and (2) set up the scoring key to assess the learning and to analyse the player's behavioural profile.

The game stakeholders are the most suitable to depict the realistic situations the player may encounter at work and the SMEs can help with the several item response possibilities. The SMEs designers have to take into account the main CSSk to create an item response pool for each situation. Each situation item response will engage one or several CSSks. At this stage, SJT designers can reveal the existence of PSSks and add PSSks to the situation or item response description. Besides, the feedback has to be written by the SJT designers following the establishment of LO in the previous section. This stage may be iterated as often as necessary.

Afterwards, SJT designers have to label each item response with two kinds of scoring. First, they will monitor the player learnings through a player score. Second, SJT designers and particularly the SMEs have to score each soft skill, CSSks and PSSks combined, contained in each item response. This second scoring system will monitor the player's behavioural profile and its fluctuation through the game.

3.3 Gamifying the situational judgment test

Finally, the main actors of the last step are the SJT designers and game designers such as writers, game artists, and developers who will design the GSJT. Firstly, whatever the learning process is, the next step consists of converting the SJT into a Visual Novel Game (VNG). The stealth assessment method highlighted by Shute (2011), can enhance player's engagement, motivation and experience. We believe that creating a fictional or fantasy world and scenario as cognitive and emotional mediums revealed by Malone (1987), may reduce the player's test anxiety generated in a traditional SJT. Furthermore, multimedia assets and graphics do not only enhance the immersion of a player but also affect the player's game flow. GBL or serious games are often sidelining the graphics because of lack of resources. Nonetheless, graphics play an important part in player motivation and attractiveness to a game even more in a VNG where the core elements are scenario and graphics. In addition to the player's learning progress objectives, Shabalina et al. (2014) advises blending the game elements into two intertwined modes, learning mode and game mode to keep the game both educational and engaging. Because the learning goals and game objectives (GO) are different, the game creators have to be cautious about game elements aiming at LOs, GOs, or both at the same time. The game creators may use narrative content, scenario and endogenous fantasy (Malone, 1987) to ease the blend between the game objectives and learning objectives. Furthermore, LOs establishment may affect the assessment process and the level design of the game and its structure. For instance, if the LOs are not satisfied by the players, a try again type of feedback (Shute, 2011) may be displayed to them and ask the players to play a game part, a game level or the game itself (see figure 2). Game designers may use narrative techniques and procedural level generation (Asperti et al., 2017) with modular structures to reduce the sensation of failure or discouragement until the learning objectives are reached. Based on these techniques we break down the structure of GSJT with VNG approach (see figure 3). Furthermore, to touch a large public panel through the digital LG without external intervention, instructional support such as briefing, debriefing and scaffolding based on Garris et al. (2002) input-process-outcome game model may be added into the game structure.

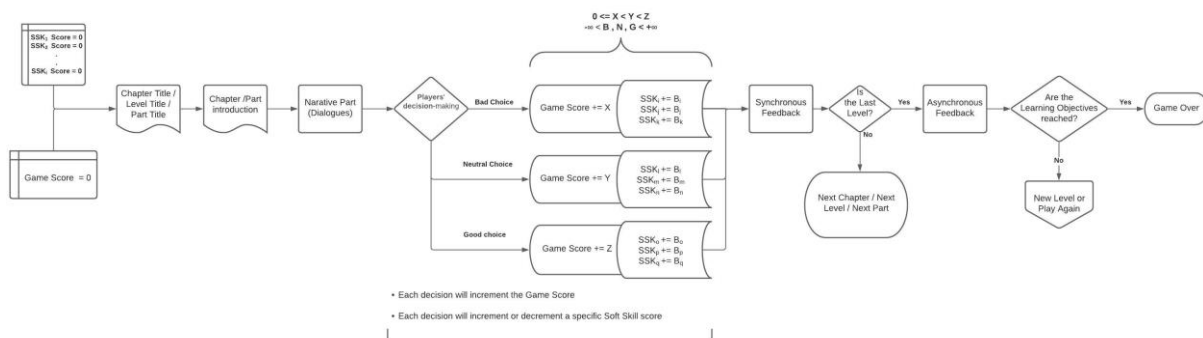


Figure 2. The modular structure of the whole system (GSJT with VNG approach).

4. Dynamic concerns

In this section, we will describe some additions to classical SJT that are crucial features in our context of SSK profile (behavioural profile) elaboration.

4.1 Measure

In order to develop our framework to design a GSJT to learn and assess the next player's soft skills, we based the two scoring systems described above, on a decisional tree model. Both systems use the decisional tree model to monitor the player's path. Each node of the tree represents a choice made in a situation inside the situational judgment test, and each node will fluctuate using a corresponding scoring matrix to measure as a scoring grid the player's game score as well as the player's behavioural profile. Eventually, in terms of scoring, each situation of the game may be depicted and ruled by a scoring 2D Matrix as a combination of each item response scoring matrix for a situation.

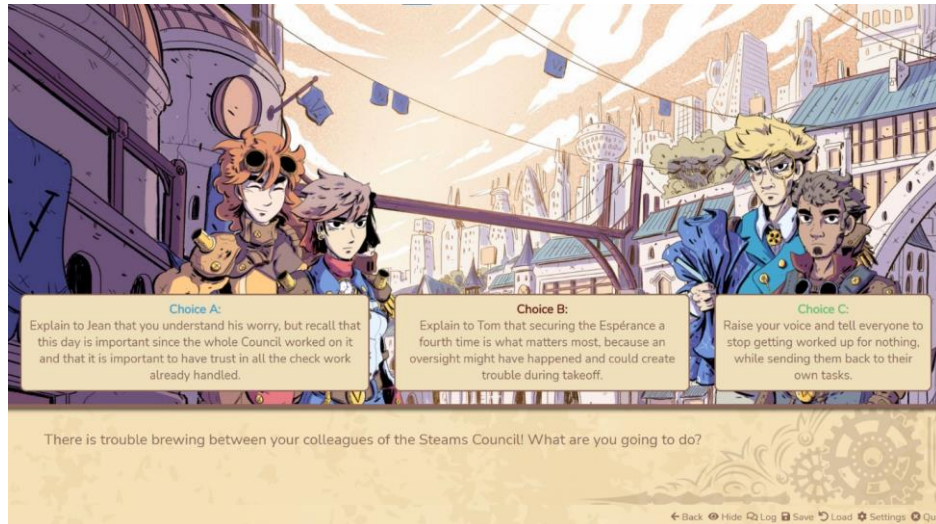


Figure 3. A screenshot of our GSJT supported by the VNG.

4.2 Analyse

In addition to the assessment of the learning through the player's score, we measured the validity of the framework to help the player's learning process using Kirkpatrick's model (Kirkpatrick, 2013). The four levels of Kirkpatrick's model (KM) are covered in a post-game survey through self-assessment by the player. Besides, the fluctuation of the game score may be an indicator of CSSk's knowledge acquisition and transfer that occurred covering the second level in addition to the self-assessment. Finally, we are also interested in the analysis of behavioural profiles. We applied a k-means clusterization method on high-dimensional data and an elbow method after a dimensionality reduction, to find potential clusters using the players' soft skills profiles (nine weighted soft skills) as the data set.

It is important to keep in mind that the HR sector is interested in identifying amongst a lot of candidates, people that are the most adapted to their specific needs. As we will see in the following section, the clusterization helps us to extract several groups of persons with the same relevant profile. Naturally, the results are guided by the scoring matrix elaborated with the appropriate weighting decided with the HR persons in charge.

5. Experimentation and Results

This section validates the proposed approach to generate a GSJT. A GSJT relying on a VNG was made to sensitize managers of an international bank into common leadership soft skills meanings. According to the proposed framework, four CSSks and five PSSKs (see Table 1) have been defined and used as the base to create the SJT. The RBT's understanding level was determined by the stakeholders with a game duration of 15 min. Consequently, the generated decision tree is based on seven situations with three or four different choices per situation. To simulate real-life situations where crucial choices may happen with drastic consequences, the fifth situation of the game may be the player's last choice and ends the game if the player picks one of the wrong choices. The hereinafter presents an online experiment made with the generated VNG followed by the self-assessment survey using also as a debrief for players.

5.1 Participants and procedure

Forty-eight players (twenty-three females, twenty-three males and two undefined aged between 18 and 75) over sixty-five answered the self-assessment survey. 66% of them come from the professional world with fourteen players who occupy a managerial position. Eleven activity areas are represented and seven players are non-gamer. This experiment took place online with a group of five players who have a live session with an instructor whereas the sixty others were lone players with only the in-game tutorial as briefing and the self-assessment survey as debriefing. The live session instructor starts by presenting short instructions on how to

play the game and explain the learning objectives of the game, then a post-game debriefing with the group of five was realized.

5.2 Results and discussion

The survey results showed that every player of the experiment finds the gameplay easy to use without an instructor. Also, the validity of the first level of Kirkpatrick's model (KM) is revealed with a mean value of score game satisfaction by the player of 7.9 for a scale of one to ten. The VNG assets such as the scenario, graphics assets, and sound design were appreciated by all the persons as immersive and engaging content. The immersive aspect was also enhanced by blending realistic situations into a fantasy scenario according to the live session players and 90.6% of the survey respondents who already live such situations in their professional or student life. However, the user interface still has to be enhanced as the live session revealed some inconvenience by the players. The live session supported by the results of the survey also revealed that debriefing with an instructor is essential to fully validate the KM's second level. Besides, the survey showed that a briefing with an instructor may also be required to transfer the learning objectives to the players. The two last KM's levels were also investigated by asking players if this kind of serious game may change their behaviours in the future and if this kind of game may enhance the performance at work. A favourable answer was emitted by 71,9% of the players for the former question and by 90.6% of the players for the latter. The experiment also revealed that eight of the fifteen players who attest to already know a minimum of three on four CSSks meanings before the game performed successfully the game with the maximum or a high game score whereas the other players scored a medium score. This statement may be correlated to their behavioural profile.

Player	Choice 1	Choice 2	choice 3	Choice 4	Choice 5	Choice 6	Choice 7
#1	0	1	2	2	2	2	2
#2	0	2	2	1	1	1	1
#3	0	1	1	1	1	1	1
#4	2	2	2	1	1	1	1
#5	1	1	0	0	0	0	0
#6	1	1	0	0	0	0	0
#7	1	1	0	0	0	0	0
#8	0	0	0	2	2	2	2
#9	0	0	2	2	2	2	2
#10	0	0	0	0	0	0	0
#11	0	1	2	1	1	1	1
#12	0	1	2	1	1	1	1
#13	0	1	2	2	2	2	2
#14	0	0	0	0	0	0	0
#15	0	0	0	0	0	0	0
#16	2	2	2	2	2	2	2
#17	2	2	2	1	1	1	1
#18	0	1	1	1	1	1	1
#19	0	0	0	0	0	0	0
#20	0	0	0	0	0	0	0
#21	0	0	0	0	0	0	0
#22	0	1	1	1	1	1	1
#23	0	0	0	0	0	0	0
#24	1	1	1	2	2	2	2
#25	0	0	2	1	1	1	1
#26	0	1	2	2	2	2	2
#27	0	0	0	0	0	0	0
#28	0	2	0	1	1	1	2
#29	1	1	0	0	0	0	0
#30	0	0	0	0	0	0	0
#31	0	0	0	0	0	0	0
#32	0	0	0	0	0	0	0
#33	1	1	0	1	1	1	2
#34	0	0	0	0	0	0	0
#35	0	0	0	2	2	2	2
#36	0	0	0	0	0	0	0
#37	0	0	0	0	0	0	0
#38	0	0	0	0	0	0	0
#39	0	0	0	1	1	1	2
#40	0	0	0	0	0	0	0
#41	0	1	2	2	2	2	2
#42	0	0	0	0	0	0	0
#43	1	1	2	1	1	1	1
#44	0	0	0	0	0	0	0
#45	0	0	0	0	0	0	0
#46	1	1	0	0	0	0	0
#47	0	0	0	0	0	0	0
#48	0	0	0	0	0	0	0

Figure 4. Clustering evolution of the forty-eight players

We initiated the clustering analysis with the subset of players (forty-eight players) who were able to finish the game with the maximum number of choices possible to make (seven choices). We conducted a cluster analysis for each situation enabling the clustering evolution studies through the game. This study firstly revealed three

clusters and secondly revealed that after the fourth choice, the presence of an individual into a cluster is not expected to change significantly (see figure 4). Only three of the forty-eight players (#27, #32, #38 see figure 4) have seen their cluster connection changed for another cluster after the fourth situation. This revelation shows a high predictive value from the fourth game situation. This value enables a second cluster analysis of the dataset including players who fall into the premature end of the game (wrong choice into the fifth situation).

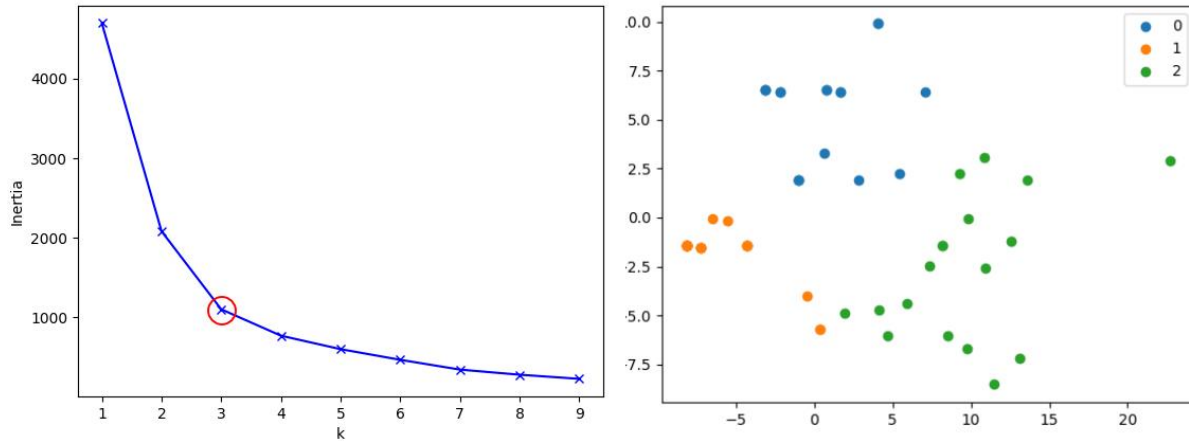


Figure 5. Elbow method and K-means clustering on the sixty-five players after the fifth game situation

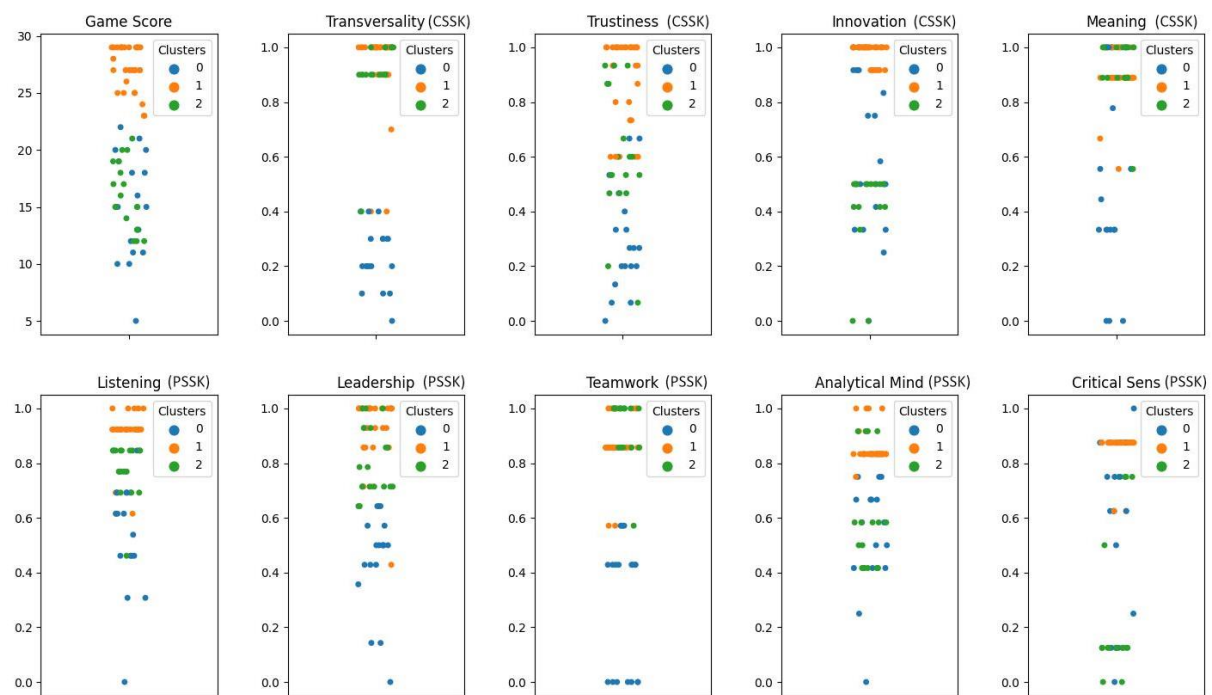


Figure 6. Players distribution by game score and soft skills

The second cluster analysis (see figure 5) was performed on all players (65 players). We can observe a pattern with the individuals of the cluster #1 tending to have higher results in every soft skill following by the individuals of the cluster #2 and #3. This pattern may be explained by the choice of the CSSKs and PSSKs (cf. Table 1) which are semantically close to each other. Yet figure 6 reveals the existence of what we called macro-SSKs such as leadership and trustiness in our experiment. We define a macro-SSK as a soft skill that contains or is highly related to other soft skills. Our scoring model revealed that the “Leadership Soft Skill” and the “Trustiness Soft Skill” have higher maximum scores because of their omnipresence in the item responses and the ratio of links between all SSKs. Yet more studies are needed to understand the nature and the impact of the links between soft skills. Furthermore, the assessment objectives and the structure of the model of assessment are also explaining the results in figure 6. The assessment objectives bring the design of the VNG

to focus on the assessment of soft skills highly related to leadership and management. This focus defined what we called a referential behavioural profile (RBP) for the stakeholders composed of the nine soft skills generated through the framework. In the context of recruitment or formation in companies, this RBP will be compared to the player's behavioural profile generated after the game. In other words, the member of cluster #1 is more likely to be close or even equal to the RBP as this is the case in our experimentation.

6. Conclusion

In this paper, we propose a framework in three steps to gamify an SJT relying on a VNG approach. The aim of the framework is on one hand to be cost-efficient and time-efficient in the design for the serious game stakeholders. On the other hand, the VNG approach enables a large volume of diverse players to be immersed and engaged in a soft skill learning game. Furthermore, the analysis revealed that the stakeholders may use the game not only for formative purposes but also as a behavioural profile assessment tool. The recruitment process or performances enhancement process may have the use of such a tool, especially in the domain of leadership and management.

Nevertheless, the present study has some limitations that should be noted. First, the GSJT structure may not be relevant for specific soft skills such as oral communication. Second, the higher level of RBT taxonomy has not been taken into consideration. Therefore, future research could focus on the integration of the higher level as well as diverse soft skills. Third, the difficulty of the situations does not fluctuate throughout the game. Item response theory combined with the GSJT capacity to be a computer adaptive test may enhance the framework and the predictivity of the GSJT for behavioural profile assessment. Finally, the results have to be validated on a larger and enriched dataset with the managers of the international bank group.

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