

# **A comparative study of soft skills evaluation in software developers using video games**

**Abstract.** Hard skills refer to a particular job or industry; on the contrary soft skills are transferable and applicable across different roles and contexts. In teamwork, soft skills are essential to facilitate interaction among the members; they complement technical expertise and contribute to harmony and high-performing. Its evaluation is commonly based on self-reports such as questionnaires, interviews, or personality tests; however, self-reports are prone to bias due to factors like social desirability, the tendency to present an expected image, memory, or motivation. As an option, the observation method of the individual's behavior can substitute or complement self-evaluations. It is not easy or sometimes possible to set the appropriate observational environment. Therefore, video games are proposed as an alternative to creating artificial situations similar to real-life situations. This paper presents a comparative analysis of proposals to evaluate soft skills for software developers using video games. The research describes relevant factors, variables, and results of different proposals that assess individual and/or social situations. The results confirm self-evaluation performance and highlight the need to create new ways to address this type of analysis.

**Keywords:** behavior observation, personal skills, teamwork, software development team, soft skills.

## **1 Introduction**

As software became more complex, its development required more common of teamwork. By working in teams, individuals with different skills and backgrounds can contribute their expertise to various aspects of the project, leading to more efficient and effective development. Breaking down the software project allows team members to specialize in specific areas, focusing on their strengths and leading to higher productivity and quality outcomes. However, working in a software development team presents challenges such as communication and coordination, building and maintaining positive team dynamics, or personal conflict resolution. These challenges might be related to something other than technical or hard skills.

Soft skills are those personal attributes and interpersonal qualities that enable individuals to interact effectively with others and navigate various social and professional situations. Intrapersonal skills occur within the person, like independence or self-actualization, while interpersonal skills are helpful social skills to relate to others, such as communication, teamwork, or conflict resolution [1,2]

There is no universal agreed-upon soft skills classification. Still, they include psychological aspects like personality traits, mental patterns, judgment or motivations, cognitive aspects such as ease of learning or learning preferences, knowledge sharing, and management or organizational elements such as planning or effort estimation to perform a task [3,4].

Concerning soft skills categorization for the software development area, Ahmed, Capretz & Cambell [5] analyzed 500 advertisements from North America, Europe, and Australia, from organizations hiring people for IT positions that mentioned soft skills. The analysis aimed to understand those highly demanding soft skills and those not included, regardless of their importance. The soft skills identified in the ads were only nine: 1) communication skills, 2) interpersonal skills, 3) analytical and problem-solving skills, 4) team player, 5) organizational skills, 6) fast learner, 7) ability to work independently, 8) innovative, and 9) open and adaptable to change. The ads were for system analyst, software designer, computer programmer, and software tester positions. The authors concluded that there needed to be more understanding of the significant role of soft skills in employees' performance. They highlighted the importance of including richer talent and viewpoints to tackle the inherent complexity of software development.

More recently, Maturro, Raschetti & Fontán [6] systematically mapped soft skills in software engineering. They identified 30 main categories within which the five most mentioned (at least half of the studies mentioned them) were communication, teamwork, analytical, organizational/planning, and interpersonal skills.

Determining the soft skills required in software development underlines its significance and the industry increasing concern on this topic. However, establishing whether or not a person owns or to what extent dominates this type of skill is challenging. To evaluate Soft skills evaluation various methods can be applied, including observation, self-assessment, interviews, psychometric analysis, and feedback from peers or supervisors [3,7]. On the one hand, the approaches based on a self-appreciation (i.e., self-assessment, interviews, and psychometric analysis) are prone to bias due, for example, to social desire, a tendency to present a favorable or expected image instead of the actual one, memory, and motivation [8,9]. On the other hand, the observation approaches (including feedback from peers or supervisors) can be affected due to subjectivity from the observer. In the latter case, it is essential to consider that the context is an aspect that supports a better comprehension of the behavior that should not be assessed in isolation [10].

Considering the significant role of context in the analysis of behavior, Ribber [10] argued that under the same contingencies, that is, similar consequences, signs, and dispositional conditions, individuals tend to maintain a consistent interaction style. Then the interactive styles establish that situations with shared contingency arrangements are faced by a person similarly. In [11], an approach was presented to associate interactive styles when required for software development teams. They proposed for all team members to evaluate achievement or persistence, making decisions/taking risks, signal dependency, and flexibility to change; for the team leader ambiguity tolerance and conflict resolution; and the person in charge of the implementation and the test phases frustration to tolerance.

## **2 Related works and Background**

### **2.1 Related works**

To establish a process for analyzing the soft skills of software developers [12] presented an approach based on several proposals that studied behavior in different contexts using video games, next briefly described.

Guardiola and Stéphane [13] designed a methodology to generate a psychological profile of the player. They recommended comparing the game results with reliable data collection, such as a scientifically validated traditional instrument. Their process was applied for students' vocational guidance.

Allonza et al. [14] used commercial video games with open source to be modified for data collection. Their process aimed to use video games as a platform to improve social skills.

Mayer [15] used commercial multiplayer games for team training and assessment. Their results support the premise that in-game can be internally valid for team research and assessment purposes.

McCord et al. [16] compared traditional personality instruments to game-like ones. Their design is a narrative scenario that gives the player the impression of progressing based on the chosen options, but options are related to a personality characteristic. The authors established the importance of preventing players from choosing options contrary to their nature to score in the game.

Pouzevara et al. [17] suggested using the framework ECD (Evidence-Centered Design) based on domain analysis, domain modeling, and conceptual assessment to break down the skill to be evaluated in measurable parts.

Zulkifty [18] proposed adapting a personality theoretical framework for a serious game by relating a psychometric test associated with the specific behavior to be studied and the game metrics to capture it.

Ammannato & Chiesi [19] used a MOBA (Massive Online Battle Arena) with competitive and cooperative dynamics where the game logs were used to analyze data by machine learning. They compared psychometric tests with their results of predicting personality traits.

Haizel et al. [20] developed an RPG (role-playing game) with free choices. Players were asked about their gaming habits to understand and consider their tendencies in the psychometric evaluation.

Peña Pérez Negrón et al. [21] recommend analyzing the context according to the interactive style, then establishing expected values and selecting the game. In this approach, video games have been the main method for interactive style analysis.

### **2.2 Software Development Teams**

The increasing complexity of software caused its development to depend on teamwork.

Teamwork is a group of individuals who interact and work towards achieving a common goal. In other words, it is a combined action of people seeking efficient and effective collaboration [22].

Software development teams have some unique characteristics and challenges that set them apart from other types of teams because the development of software requires specialized technical skills and knowledge, such as managing code complexity, integrating multiple systems, and staying up-to-date with rapidly evolving technologies, all of which represents diverse challenges for team members [23].

In this context, while technical skills are essential in software development, soft skills are also crucial for building effective teams that deliver high-quality software products.

However, team members of the software development process are commonly selected within a group of candidates available focused on their experience or an intuitive perception or subjective to the person in that team [24]. Then, the various factors influencing member assignments are challenging to estimate, quantify, or even determine. Besides, it is essential to highlight that the correct designation of roles does not ensure the success of the projects, but it does help to reduce the risk of failure [5].

### **2.3 Common problems with Software Development Teams**

Teams can experience many potential problems working on a project. Next, a list of three of the most common issues is provided:

- Team members may disagree on the best way to develop a project; this problem can cause disagreements and conflicts, having consequences such as slowing down the project and causing frustration among team members.
- Team members may not have the necessary skills to develop or complete the project. This can cause delays because team members should learn new skills or how to solve problems, creating difficulties in completing tasks they cannot achieve [25].
- Team members may be unable to work together effectively due to miscommunication, lack of cooperation, and conflict.

The three problems mentioned above are some possible problems that teams may experience when working on a project; understanding them and taking preventive measures improves the chances of completing a project successfully.

### **3. Soft skills for Software Development Teams**

The concept of soft or personal skills refers to the combination of skills, attitudes, habits, and personality traits that are generally acquired through experience and that allow people to perform better at work or academia, complementing technical and educational skills and influencing the way each person behaves and interact in a workgroup.

According to Matteson et al. in [26], soft or personal skills are "*Personal qualities related to emotional and social intelligence...are enhanced by treating others and are*

*cultivated throughout life through contact with other people, without the need for courses and qualifications."*

Like technical or hard skills, soft skills affect the quality of performance efficiency in such a way that there is a need for team members to develop them to carry out their activities effectively and efficiently. Therefore, soft skills are as necessary as hard ones during project development since they allow a good coexistence and a correct collaboration between the project members.

According to Paul Heltz in [27], there are 14 expected soft skills for software development teams:

- Construction of external connections refers to the connections team members should make outside the work group with other teams or organizations worldwide, as they are helpful for personal and professional growth.
- Awareness of cultural diversity refers to enough empathy that team members should have to see problems and situations from the perspective of a person with a different cultural background, showing due respect for the customs of other cultures.
- Emotional intelligence means that team members should be able to promote a healthy work environment, be pleasant person to work with, be empathetic, humble, and generous.
- Moral trust refers to the fact that team members should fulfill what was promised, be able to deliver progress or work on time, act with integrity, and share relevant information about the project.
- Confidence in competencies refers to team members who should inspire confidence in their abilities by being able to explain to other team members and contribute to them.
- Strategic thinking refers to team members having a vision of the future to think in a broad panorama and consider a vast range of possibilities in developing long-term projects.
- Obtaining emotional commitment means that team members should inspire others with a sense of success and a strong desire to get results.
- Empowerment of third-party skills means team members should encourage others to bring out the best in co-workers and improve their skills and competencies through constructive criticism, understanding, and motivation to effectively generate results.
- Initiative refers to team members' proactivity, taking advantage of opportunities, generating action, and influencing events to advance projects.
- Decision-making refers to the way team members should consider all the variables of the problem to be solved and its alternatives, committing to generate viable action paths for the continuous progress of the project, mainly when decisions are complicated so that they can be taken on time.
- Conflict resolution refers to how team members should behave, promoting diplomacy and harmony in the work team.
- Persuasion refers to the fact that team members should get the acceptance of proposals and practical negotiation skills.

- Resilience means that team members should remain calm between failures and mistakes and respond effectively to pressure and criticism without becoming defensive.
- Flexibility refers that team members should be able to accept new ideas outside of one's own considering different perspectives and adapting to changing conditions on the project.

The acquisition of soft skills is a systematic, conscious, and continuous process necessary to evaluate personal and behavioral characteristics. Moreover, a problem in identifying them is establishing methods to determine them objectively.

In this context, the most widely used instruments to assess soft skills are based on self-reports, either questionnaires or interviews. However, self-reports can be compromised by the impartiality of the evaluated subject and a tendency to present a favorable image of oneself [28].

As an alternative, a situational evaluation can be recommended, which is considered a non-invasive method of observation and behavior analysis. This alternative can include scenarios where situations like those to be evaluated are presented so people can interact and make decisions. This alternative can encourage the evaluated people to react genuinely, showing their personality and skills.

This paper provides a comparative study of proposals using video games or games for behavior analysis for measuring personality traits.

## **4 Soft skills evaluation for software developers**

In [29], recognized the validity of observing a subject in a natural environment to understand behavior, but also cannot control the actions and the others in the setting of these situations. According to [29], a virtual environment offers ecological validity without compromising experimental control.

Several advantages of using an immersive virtual environment in social science study were enumerated by [30]. A more authentic setting compared with a laboratory one, eliciting more genuine reactions; virtual environments offer variety; can create stimuli unavailable or challenging to manage in the real world; can make virtual humans as confederates; can replicate the same stimulation and shared for countless iterations, decreasing variations that may impact outcomes.

In the study of interactive styles, for example, in analyzing a tendency to take risk, achievement or persistency and ambiguity tolerance [31,32], were used only video games over time to observe consistent behavior.

Furthermore, we analyzed all these approaches in the Related work section to identify the empirical evaluation, objective, soft skills to evaluate, metric, validation, and results from each one defined to get some conclusions. Table 1 shows the data found in related works.

**Table 1.** Empirical objective, validation and results of approaches to measure personality traits through video games.

Paper	Objective	Soft skills to evaluate	Metric	Validation	Results
[13]	Tracking a psychological trait of the player during the game	Vocational preference	Mini-game score and Mini game replay	Comparing results from the game to other reliable means.	They correlated a psychometric test with the game results. They claim their approach seems promising and with significant coefficients.
[14]	Establish if commercial games can be used to improve soft skills	Persistence, risk, and spatial reasoning	Pre and post-standardized tests to measure skills improvement after the video game training	Comparing scores after training	They claim that their global interpretation suggests that video games can boost specific soft skills
[15]	To validate team training and assessment through video games	Psychological safety and team cohesiveness	Team structure factors, team quality constructs, and in-game performance measures	Pre and post-game questionnaires on constructs for team quality	They claim their results support the premise that in-game assessment can be internally valid for team research and assessment purposes
[16]	Addressing misleading and careless responses stem from a lack of internal motivation or interest in the task	Personality assessment (IPIP-50 personality instrument)	30 instrument items with three response options each	Comparison of a traditional personality instrument and a game-like instrument to assess personality	Correlations showed moderate-to-strong correlations on the Five-Factor Model inventory
[17]	Game-based assessment for skills gap in youth	Industriousness, procrastination, refrainment, control caution, task planning, and perseverance	A scoring framework using "proportion of dirty spots"	Comparison of the game-based assessment with a problem-solving traditional test	The correlation between the test and the game was low/moderate

[18]	Exploratory process of adapting a framework to design serious games for personality assessment	Personality traits (HEXACO model)	Different game scores like performance, spending time, breaking the rules, and choosing difficulty challenge, among others	Correlation between personality factors and the game predictions	There was no significant correlation between any personality factor and the games' predictions
[19]	Investigate the use of the way a player interacts in a competitive video game to assess personality traits	Personality assessment (HEXACO model)	A custom script to collect all the gamers' inputs. The categorization of results using IA is according to the instrument	A trained deep neural network with different personality traits	Results suggested a likelihood of identifying the player trait above chance with a medium to high margin of error in the classification
[20]	Create a game that can predict personality	Personality assessment (Five-factor model)	12 choices based on the IPIP Big-Five; each option increased the personality score	Comparison of the results of a personality questionnaire with the created game	Their results were not conclusive. Some results were similar, but others were very different.
[21]	Using video games to evaluate interactive styles	Persistency, tolerance to ambiguity, and frustration	Game scores	Comparing results with self-assessment	Results represent inconsistencies. Authors claim they have to be confirmed by other studies

A look at the results in the fourth column makes one wonder if the game approach for studying personality really works. We only found correlations with significant coefficients in [13] and [14]. However, in [13], the test was applied to understand the player preferences and not evaluate a personality characteristic. In [14], the test is not used to measure soft skills but to train in a soft skill. They got good results because they used the test before and after using the game, then compared the test results.

In [15] highlights that a game works for both training and assessment, but they do not compare results between test and play. They suggest that the game should be validated internally.

The other related works did not get good results in finding correlations [16, 17, 18, and 20] compared the test results and the game; then, they obtained low to moderate results. In [21], the game's results are compared with a self-assessment without getting correlation results too.

Finally, [19] proposes the use of artificial intelligence. However, this tool requires much data to look for patterns. Therefore, the results are not conclusive.



After analyzing the related works, we can conclude that using an instrument approach like self-evaluation or tests to compare with the video game results is not the proper validation approach for soft skills characteristics.

Therefore, the validation approach required for soft skills characteristics can follow two paths:

- The use of several observations in which the person faces different situations or situations with different morphology but with a shared contingency arrangement. Several studies of interaction style have empirically proven temporal and situational consistency behavior [11].
- An Artificial Intelligence technique can be applied when there is a small data sample, like the Bayesian approach. The Bayesian inference is a statistical inference method that uses Bayes' theorem to update the probability for a hypothesis as more evidence or information becomes available. Moreover, the Bayesian approach allows specifying a prior distribution over parameters that must estimate. The information a researcher knows can be prior reflected without referencing the dataset on which the model is estimated. A prior can be formed in a time series context by looking at out-of-sample historical data.

## **5 Conclusions and future work**

Using video games to analyze the soft skills required in software developer teams is an innovative way that is increasing interest by researchers because it allows measuring soft skills characteristics without forcing team members to perform software development activities. However, researchers are not always obtaining good results; after analyzing nine research works, it was identified that the most common way to perform a validation was based on self-assessments or tests where can find not strong results. Besides, most trust the psychometric instrument more than the games they use. Moreover, they did not get measurements according to their psychological instruments.

Therefore, we concluded that self-assessments should not be what guide, therefore we argue that the validation should be supported either by an extended observation of the behavior using different situational contexts but with the shared arrangement, such as in games in which similarity of a game with real life are achieved using situations similar to real life so that it will be possible to find consistency in behavior through various games.

A second option can be using an AI technique proper for small data sets, such as the Bayesian approach.

In future work, authors are applying such modifications to create an alternative validation of the approach when using video games or games to measure soft skills characteristics in a team based on the comprehension of the situations present during the software development cycle.

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