

Chapter B: Research

As game-based assessment becomes more popular, so does the academic debate surround the use of the tool. In recent years there have been more and more studies on the subject. In this chapter, we will review several relevant research topics



1. Can game-based assessments able to predict real-life performance?

Game-based learning and Game Based Assessment are two areas of research that have attracted attention in recent years within the global trend of educational and corporate technology research, recognized as important subjects for study that will become increasingly popular in the next few years. This chapter outlines few researches in both game-based learning and game-based assessment, and tries to answer the question: are the game-based assessments any good? Are they actually able to predict job performance?

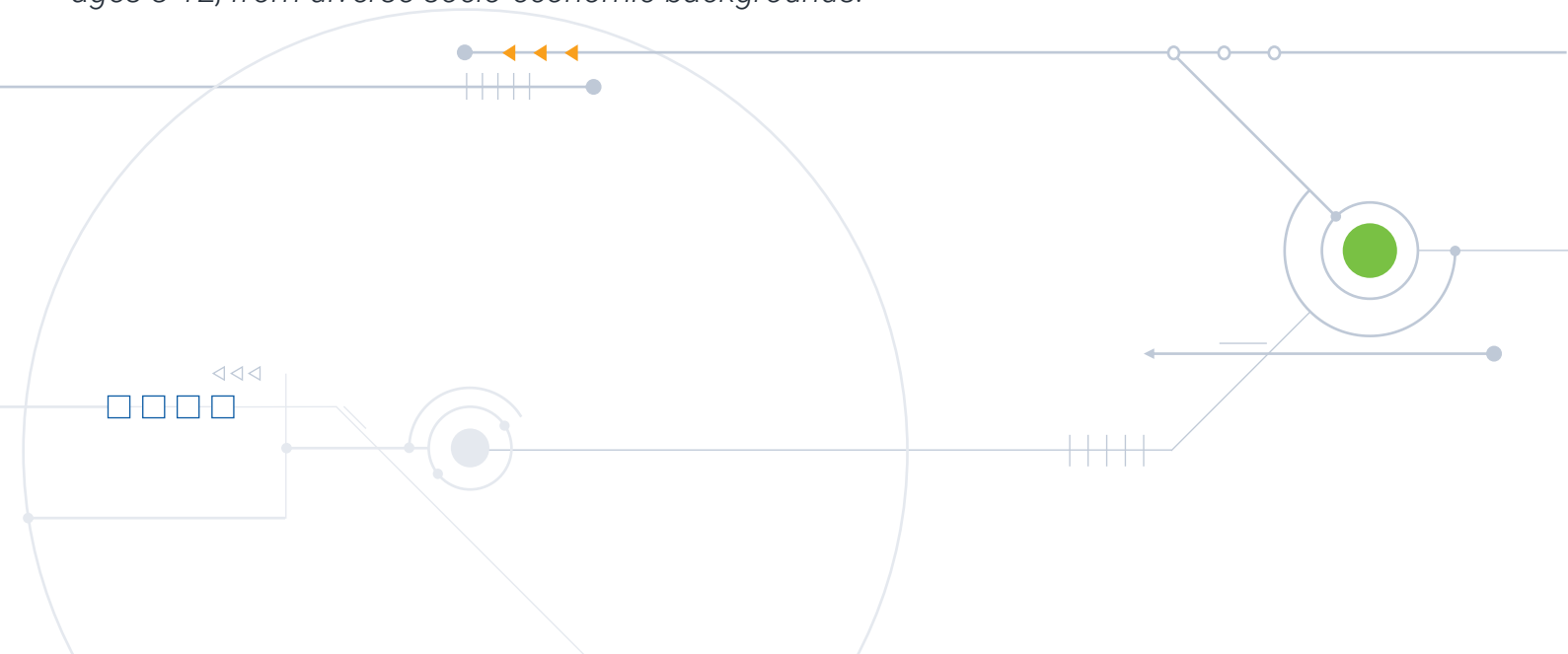


The Impact of games-based learning on learning outcomes

The efficiency of using games in learning and training has been tested in several comparative research projects, most notably that of Professor Donald Green of Columbia University. The different projects confirm that proper use of thinking games under orderly and systematic methodology can significantly improve learners' thinking abilities and life skills. One project tested the hypothesis that children can be taught abstract strategic thinking by learning meta-cognitive models and by being exposed to the applications of these models in strategy games and in real-life situations. The study included children ages 8-12, from diverse socio-economic backgrounds.



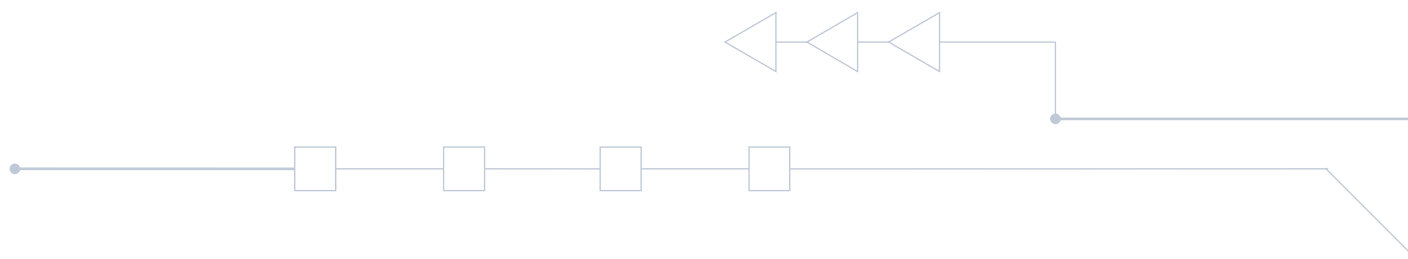
Professor Donald Green



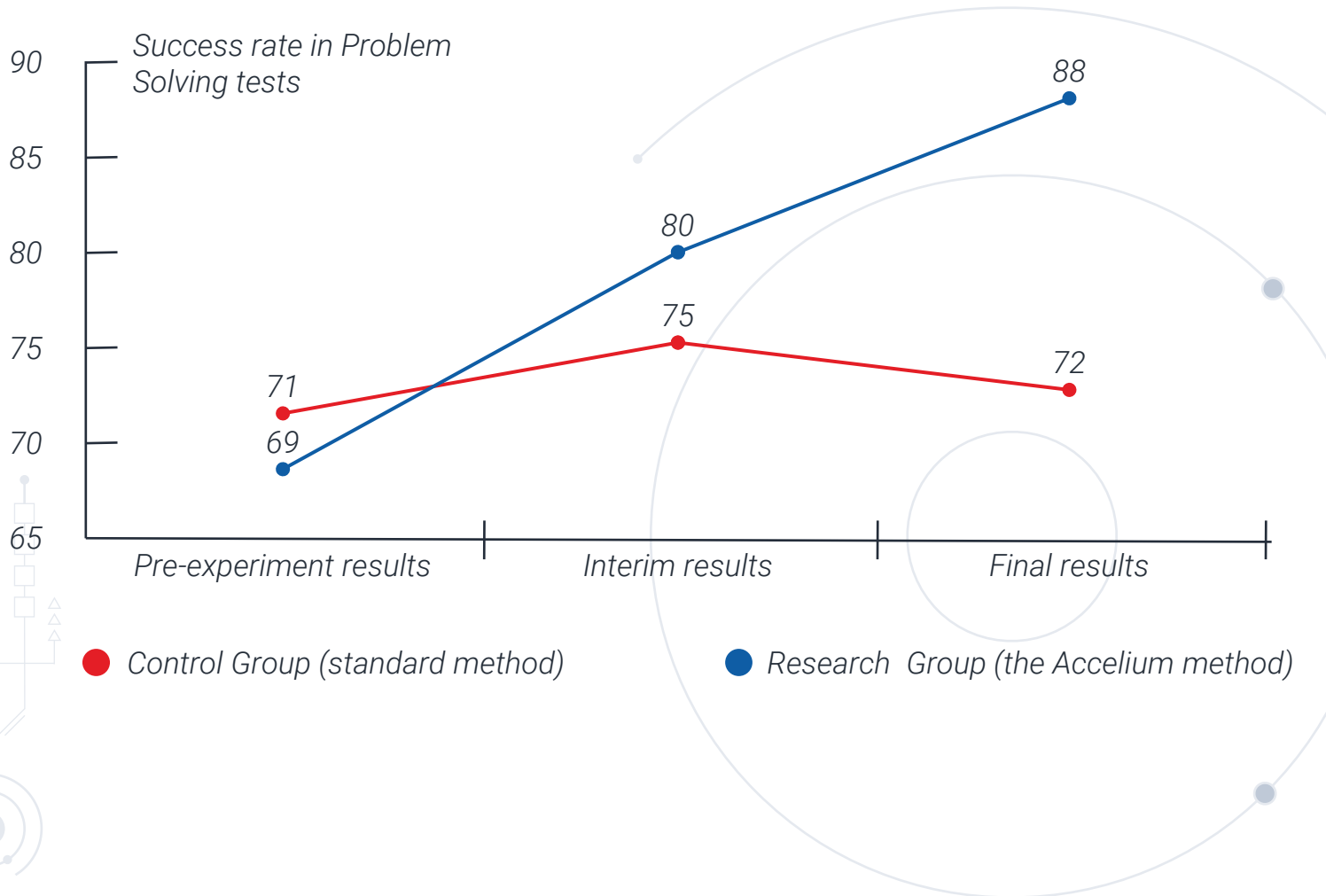
One project tested the hypothesis that children can be taught abstract strategic thinking by learning meta-cognitive models and by being exposed to the applications of these models in strategy games and in real-life situations. The study included children ages 8-12, from diverse socio-economic backgrounds.

In the first stage, all children played an online "puzzle" game. Their game performance and progress were monitored. In the second stage, children in the research group were taught abstract models for problem-solving, and their analogies to real-life situations.

They were then shown how to apply these models in the games. The children in the control group simply participated freely in game-playing sessions. In the third stage, all children were taught a new game. Both groups received identical instruction.



The Accelium Method & Problem Solving



Summary:

- The Children in the research group significantly improved their performance levels comparing to the control group, even though the latter were allocated more time in their game-playing sessions.
- The remarkable fact is that even in Stage Three, the research group achieved notably higher results. In fact, the disparity between the two groups actually increased between Stages Two and Three.
- There is a close connection between how students performed in the game and how they perform in school related tasks.



For further reading: Green, Donald P., and Dan Gendelman. (2003). *Teaching Children to Think Strategically: Results from a Randomized Experiment*. Unpublished manuscript, Institution for Social and Policy Studies at Yale University.

Green, Donald P., and Dan Gendelman. (2004). *Can a Curriculum that Teaches Abstract Reasoning Skills Improve Standardized Test Scores?* Unpublished manuscript, Institution for Social and Policy Studies at Yale University.

The Impact of games-based learning on learning outcomes

A soon-to-be-released study called "Substantial Integration of Game-based learning into schools Curricula," Vanderbilt University in the US had remarkable findings. They measured the impact of using game-based learning tools on students' engagement and school achievements. The research found that the students who played the digital games outperformed their peers on standardized tests. Additionally, teachers saw dramatic increases in engagement and performance. The sample size was large enough—more than 1,000 students in seven states and schools with differing student bodies, socioeconomic factors, and geographical locations.



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Teacher's reported dramatic increases in engagement amongst students who participated in the game based learning.

Very high students engagement



High students engagement



Low students engagement



■ With Games ■ Without Games

i **For further reading:** *Substantial Integration of Typical Educational Games into Extended Curricula, Journal of the Learning Sciences, May 2019 edition.*

Game based assessment in corporate training and recruitment

Digital games also provide employees with opportunities to fail, learn from their mistakes, and try again in safe environments.

While Don Greens' study have been carried out in educational settings, there have also been studies relating to the effectiveness of game-based learning for corporate training.

In 2012, the Learnovate centre, a European research and innovation center focused on EdTech and learning technologies, published a comprehensive review of the research evidence for the effectiveness of serious games for corporate training. Learnovate center has listed three key processes in organizations in which games are being used: training, recruitment and marketing and sales. The use of digital games for corporate training and development across many subject domains are increasingly being recognized.



Large organizations such as IBM, Cisco, and Deloitte are increasingly using games to train their workforces in areas ranging from compliance training to leadership training. These organizations recognize that new employees are not engaged and motivated by traditional training forms due to exposure to new and exciting technologies in their everyday lives (including page-turning, linear eLearning), resulting in a poorly trained workforce.

Their review showed that there is an increasing body of empirical research to support the effectiveness of games-based learning. They found research evidence for improvements in attitudes, engagement and motivation. They brought evidence for improved cognitive gains when compared to conventional instructional methods. Furthermore, according to their review, there is research evidence demonstrating positive impact on higher order skills such as Decision Making and Problem Solving.

Game-based assessments are an exciting frontier in recruitment testing because they combine the best of both worlds - a scientifically validated assessment delivered through a candidate-friendly experience.

Learnovate center emphasized the use of digital games in recruitment testing. Pre-employment game-based tests provide an objective and predictive measure of how likely a candidate is to succeed on the job. Assessments are designed to provide employers with an additional layer of objective information to make more informed hiring decisions.

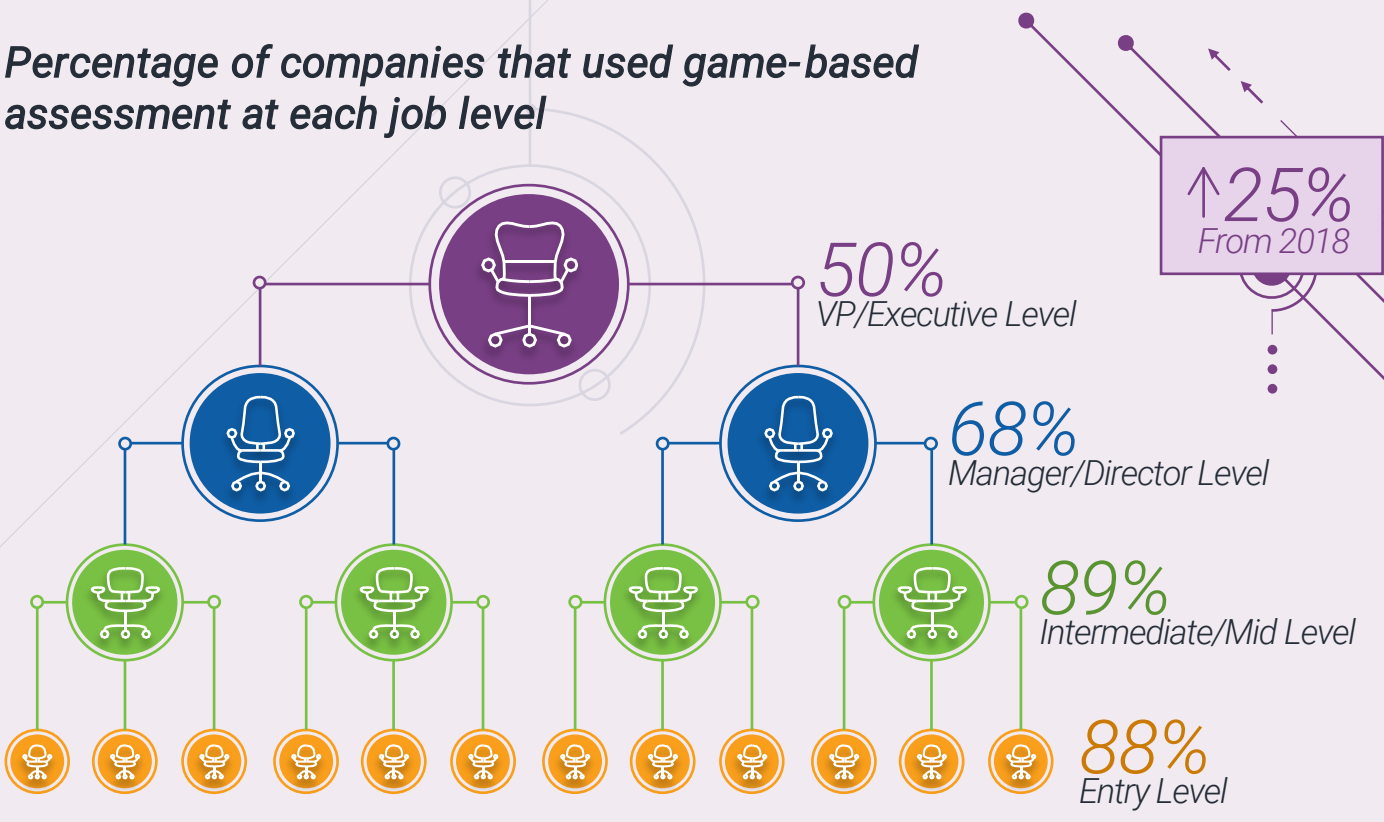
In 2019 Learnovate center held a survey with more than 200 hiring professionals across a wide range of industries to gain a better understanding of how they hire and the ways they incorporate game-based assessments into their hiring process. The results showed that the majority of respondents use game-based assessments to assess entry and mid-level candidates.

88% use it for entry-level candidates, while 89% use it for intermediate or mid-level candidates. This isn't too surprising. As we mentioned earlier, many organizations use game-based assessments to filter through large pools of candidates.

The report stated that when moving up to higher job levels, the usage goes down. Just 68% of companies give game-based assessments to manager or director level candidates, and just 50% are giving them to VP or executive level candidates.

This pattern is not surprising. When an organization defines an upper-level role that requires a great deal of experience and knowledge, it is more likely to get fewer applicants overall than entry and mid-level candidates.

Percentage of companies that used game-based assessment at each job level



i For further reading: Donovan, L. (2012 and 2019). The use of serious games in the corporate sector. Learnovate Centre Ireland. Available at: <https://www.learnovatecentre.org/wp-content/uploads/2013/06/Use of Serious Games in the Corporate Sector PRINT FINAL.pdf> (Accessed July 2020)

2. Which skills can be examined using a game-based assessment?

Along with the increasing use of games for learning, there is also a growing development and research around skills assessment.

In 2015, the Education Policy Committee of the OECD launched the OECD Future of Education and Skills 2030 project as an opportunity to step back, explore the longer-term challenges facing education, and help make the process of curriculum design and development more evidence-based and systematic.

The project aims to help countries find answers to two far-reaching questions:

1. What knowledge, skills, attitudes, and values will today's students need to thrive in and shape their world?
2. How can instructional systems develop these knowledge, skills, attitudes, and values effectively?

As one response to these questions, the OECD Future of Education and Skills 2030 project developed the OECD Learning Compass, its an evolving learning framework that sets out an aspirational vision of education in 2030. It provides points of orientation towards the future we want.

The document describes with great accuracy the skills that school graduates will need to integrate into the world of work: "The critical skills that graduates of the education system need to successfully cope with the challenges they expect in adulthood (in the 21st century) are high-order, cross-disciplinary thinking skills. These skills are characterized by non-algorithmic thinking, unclear and predefined thinking patterns, multiple criteria, multiple ideas/hypotheses/solutions..."

The paper also calls for education systems to keep pace with changing times:

"Emerging evidence on how to optimize learning, including the use of technological innovations to deepen and transform learning; and changing expectations on the part of learners, who are demanding an education system that is more connected and relevant to their everyday lives."

Summary:

As computer technologies have displaced labor in routine tasks, they have also created new employment opportunities for workers with non-routine cognitive skills, such as creativity, and social and emotional skills.

To remain competitive, workers will need to acquire new skills continually, which requires flexibility, a positive attitude towards lifelong learning and curiosity.



i For further reading: OECD Future of Education and Skills 2030, Conceptual learning Framework, Learning Compass 2030

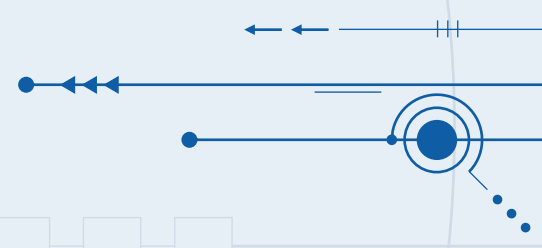
More than half of executives admit their employees are "average" at best in critical thinking, creativity, collaboration, and communication skills.

According to a new survey conducted by the American Management Association (AMA), more than half of executives say there is significant room for improvement in their employees' competencies. Most respondents admit that their employees are average, at best, in the critical four C's areas (critical thinking, communication, collaboration and creativity) - a distressing situation, since three out of four managers and executives surveyed say these skills will become ever more critical in the near future. (Figure 1)



How do you believe your organization will view these skills and competencies (critical thinking, communication skills, collaboration, and creativity) in the next three to five years?

They will become less important	1.4%
They will remain the same	21.4%
They will become more important	74.6%
No opinion	2.6%



In December, AMA conducted the 2012 Critical Skills Survey, asking 768 managers and other executives about the importance of the four C's skills to their organizations. According to the results, executives say they need highly skilled employees to keep up with the fast pace of change in business to compete on a global level.

The survey also shows that managers and executives believe that it is easier to develop these skills in students and recent graduates (59.1%) than to develop them in an experienced worker (27.1%), suggesting that students and recent graduates may be more open to new ideas and tools versus experienced workers with established work patterns and habits.

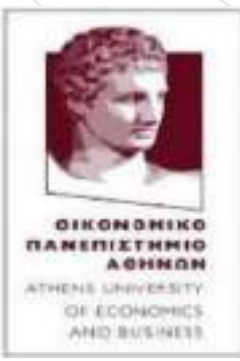
Please rate the following methods for developing employees' four Cs.

	Least Effective	Less effective	Neutral	More effective	Most effective
Prof. development/Training	1.7%	53%	19.6%	553%	18.1%
In-house/Job training	1.4%	7.7%	22.9%	463%	21.6%
Mentoring	0.9%	3.5%	17.6%	46.0%	32.0%
One-on-one coaching	0.1%	2.4%	10.8%	43.5%	43.2%
Job rotation	23%	8.1%	27.9%	43.0%	18.7%

3. Motivation, gender, age, and biases in GBA-recent studies

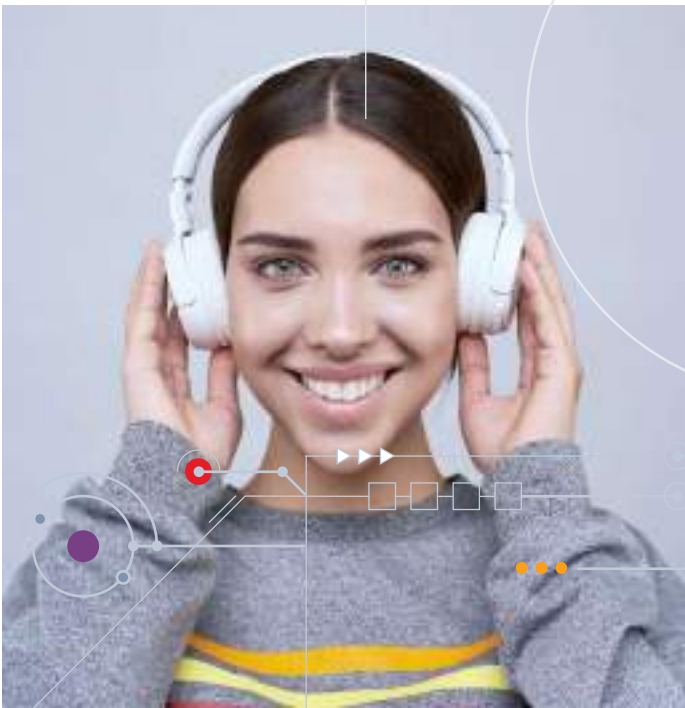
Attitudes and Motivation

Applicants report higher levels of satisfaction and in turn, perceived fairness and organizational attractiveness when the gamified assessment method is used compared to its traditional version.



Researchers from the department of management science and technology in Athens University of Economics and Business have conducted a study aimed to **compare the applicants' reactions between a game-based assessment method and a traditional text-based assessment method**. The experimental group has been asked to complete an online game-based assessment, following an online questionnaire measuring their reactions to the assessment method, while the control group has been asked to complete an online text-based assessment, following an online questionnaire, measuring their reactions, as in the experimental group.

Their findings indicated that applicants report higher levels of process satisfaction and in turn, perceived fairness and organizational attractiveness when the gamified assessment method is used compared to its traditional version.



i For further reading: Georgiou, K. and Nikolaou, I., (2020). Are applicants in favor of traditional or gamified assessment methods? Exploring applicant reactions towards a gamified selection method. *Computers in Human Behavior*. 106356. 10.1016/j.chb.2020.106356.

“Our students have changed radically. Today's students are no longer the people our educational system was designed to teach”.

This is how Marc Prensky, an American writer and speaker on education recently (2001) stated the problem with education today.

Prensky suggests that the arrival of digital technology in the last decade of the 20th century can be marked as a "singularity" - a dramatic break in the flow of generational change. Prensky therefore holds that "today's students think and process information fundamentally differently from their predecessors". He even suggests that these changes might be found in the very manner in which the new generation's brain functions. As far as thinking patterns are concerned, Prensky is confident that thinks have already drastically changed.



Prensky calls this new generation of high technology usage "Digital Natives", holding that "Our students today are all "native speakers" of the digital language of computers, video games and the Internet". Consequently, all people born before the beginning of the digital era are termed by Prensky as "Digital Immigrants".



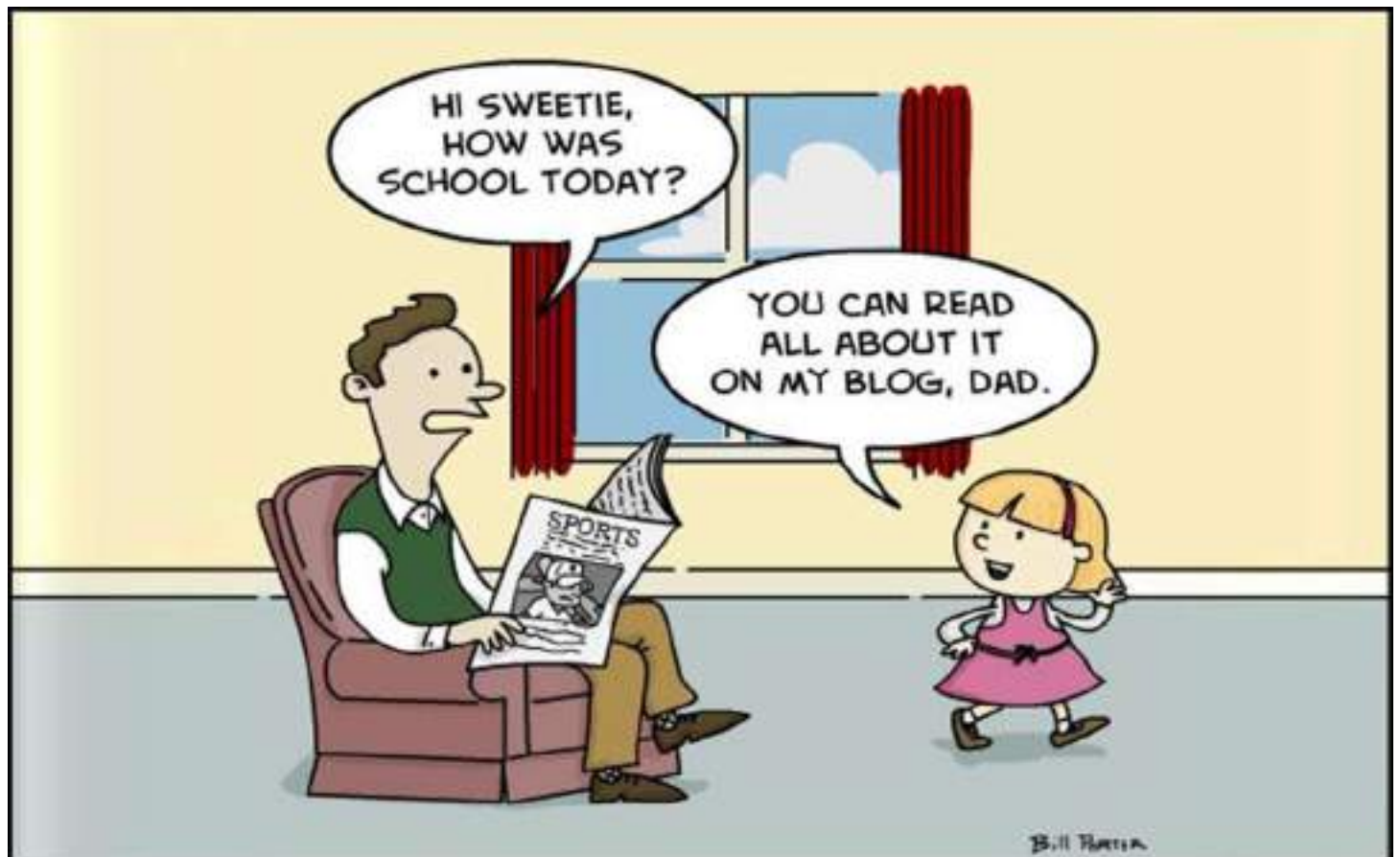
The problem that Prensky identifies regarding education is that "our Digital Immigrant instructors, who speak an outdated language (that of the pre-digital age), are struggling to teach a population that speaks an entirely new language", thus creating a cross-generational dissonance and de motivate the students.

Education today rests on the assumption that learners are the same as they ever were. This is according to Prensky no longer a valid assumption. Traditional education cannot meet the needs and inclinations of the new digital immigrants.

According to Prensky, this gap has to be addressed by the traditional education system that needs to adapt itself to the new Digital Natives in both content and methodology.

Prensky claimed that games should be used for learning as a mean to close the gap. He has coined the term digital game-based learning and listed games' motivating elements: they have goals and rules - which gives us structure and motivation, they are interactive - which gives us an active role, they are adaptive - which allows flow and maximizing motivation, they have outcomes and feedback, they have win states, they have characters and story -which gives us emotion, and more.

“Learners in this century have grown up with the Internet as part of their cultural experience. The very fact is that game based learning is now a consistent part of their social experience. It means that the game in the learning and assessment processes contributes to the motivation of the learners and may improve their performance!



i For further reading: Prensky, M., (2001) Computer games and learning: digital game-based. And Prensky, M., (2001). Digital Game-Based Learning. McGraw-Hill Education

Here is a brief overview of 3 additional studies that examined the relationship between motivation and games as a tool for learning and assessment.

1. A research conducted in the University of Southern California has examined the effect of emotional arousal on human's memory. One of their conclusions was that people pay more attention to the small details, and better remember information that are highly relevant to them and when they are emotionally involved. These findings indicate that games, which elicit a strong emotional involvement and commitment may yield high recall and long-term retention rates.



i **For further reading:** Sakaki, M., Fryer, K. and Mather, M. (2014) Emotion strengthens high-priority memory traces but weakens low-priority memory traces. *Psychological Science* 25(2): 387-395.

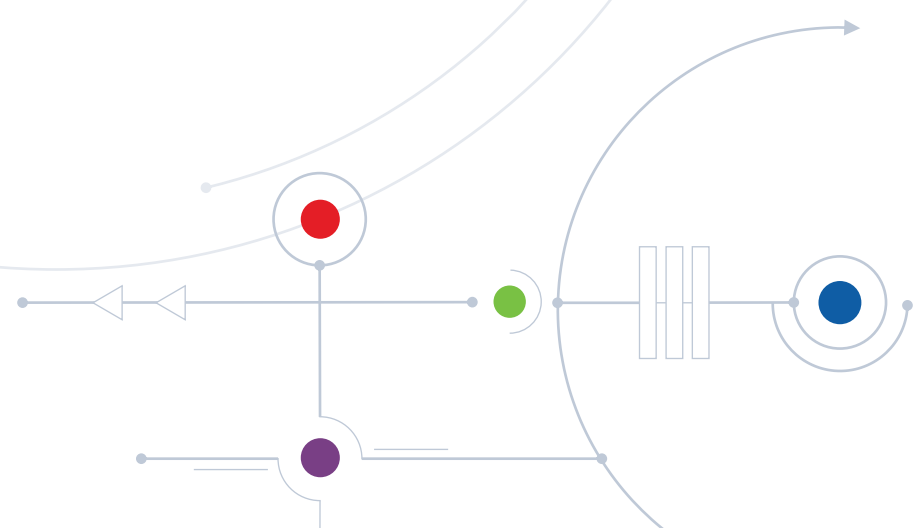
2. The Educational Testing Service (ETS), the world's largest private non-profit educational testing and assessment organization, has published a comprehensive review addresses the impact of motivation on assessment scores.



In that review they pointed out an important concern about the impact of motivation on test performance and validity.

Specifically, they focused on educational measures and the problem of low motivated students and their impact on the test validity.

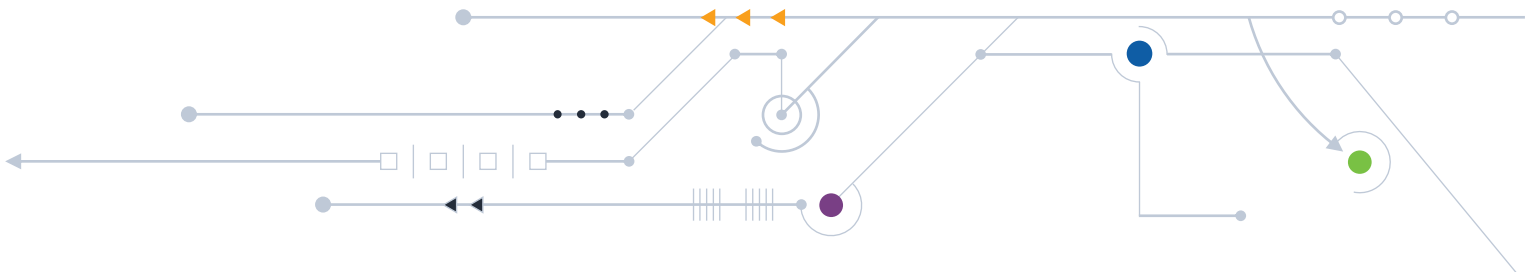
i **For further reading:** Finn, B. (2015). *Measuring Motivation in Low-Stakes Assessments*. Educational Testing Service Research Report ETS RR-15-19.



3. The use of engaging and exciting games, in which the examinee is emotionally involved and high motivated, may improve assessment validity. In recent years, more researches about the validity of game-based assessment tools which assess examinee's high-levels skills, have been conducted: In one example, researchers from Florida State University and University of Luxembourg used game-based assessment to measure middle-school students' problem-solving skills. To validate their assessment, they compared their results with two external problem-solving measures. Their results indicated that the problem-solving estimates derived from the game significantly correlated with the external measures deals with measuring problem solving skills.

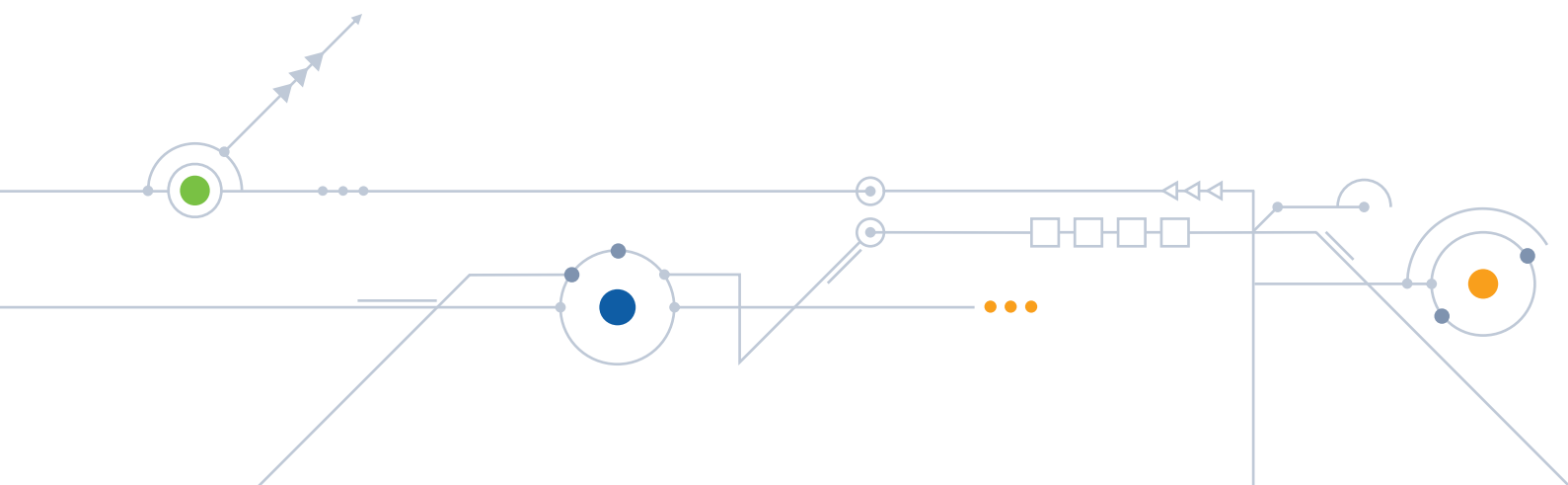


i **For further reading:** Shute, V., Wang, L., Greiff, S., Zhao, W. and Moore, G. (2016). Measuring Problem Solving Skills via Stealth Assessment in an Engaging Video Game. *Computers in Human Behavior*, 63, 106–117.



Summary:

- Technology is already transforming the way we teach, learn and assess.
- The research evidence to date suggests that game-based learning and game-based assessment can appropriately positively impact learning outcomes, improve engagement and motivation, and influence behaviors and attitudes both in adults and young students.



Games for Learning and Assessment: Does Gender and age Make a Difference?

Several studies tested social factors such as gender, age, and cultural identity on the acceptance, usage, and performance of digital games used for assessment. Little is known about how candidates may react to this type of assessment, and what implications this can have for organizations using this method to assess candidates.

In collaboration with Arctic Shores, Athens University of Economics & Business conducted a study with more than 250 participants to check the reaction and effect GBA has on examinees of different ages. Findings from previous research suggest older adults have increased anxiety and lower self-efficacy about using technology. Age has been found to be associated with longer response time, more errors, and lower performance levels. Based on this, It is feared that older individuals may be discriminated against by this assessment method.



There were 2 research questions:

- 1- Dose age predict performance within game based assessment?
- 2- Do candidate perceive the game based assessment differently depending on their age?

The initial correlational analysis shows age does not predict performance on a game-based test. No findings were found indicating discrimination based on the examinee's age. It is concluded that GBAs are equal as a suitable assessment method for candidates across a range of age groups and cultures.

i **For further reading:** Kerr G., Montefiori L., Close L., Nikolaou I., (2019). *The Effect of Age and Game Experience on Candidates' Reactions to Gamified Assessments*. Arctic Shores website. Downloaded from:
<https://www.arcticshores.com/wp-content/uploads/2019/09/Research-Poster-Cultural-Differences-and-Faking.pdf>

4. Accelium GBA – Adam Milo Validation Research

Any HR leader, hiring manager, or recruiter who is interested in using game-based assessment knows how important is for the tests to be validated. After all, the goal of using game-based assessment is to drive better hiring decisions, which in turn lead to better performance outcomes across the entire organization. The validation process provides the backbone for a test's ability to predict and drive these positive outcomes. The validation process is by no means simple, often requiring a careful study that involves gathering different pieces of evidence to provide a scientific basis for interpreting the test scores in a particular way. There are a variety of different validity measures that can be used to provide this evidence, from criterion validity (how well a test correlates with a certain outcome, such as job performance or turnover) to construct validity (whether a test is measuring what it's supposed to be measuring).



Adam Milo research

Adam Milo is the leading and largest company in Israel in the field of human resources. With more than 50 years of experience in recruiting, diagnosing, placing, developing, and advising employees and organizations in Israel and around the world.

Adam Milo has tested some of Accelium's assessment products before integrating them into their solutions. The data they accumulated support its use as a diagnostic support tool.

In one of the validation tests, Adam Milo conducted a large-scale study with about 1000 participants to examine the internal consistency of two central Accelium's evaluation tools: the first tool is based on the game Move It, and the second tool is on the game PingWins.

AdamMilo

Elevating Your Human Factor

Internal consistency: assesses the consistency of results across items within the Accelium tests. The most common internal consistency measure is Cronbach's alpha. Most often, the goal is to get an "alpha" of at least 0.7. Assuming the tested items are positively correlated with each other. The results showed that for both tools, Kronbach's alpha was 0.89- 0.90.

It means that in the tests a consistency was found between the different levels of the test.

Further studies have examined Accelium's tool validity. In early 2019, Adam Milo incorporated in their standard recruitment process one of the Accelium assessment tools to test the tool's validity.

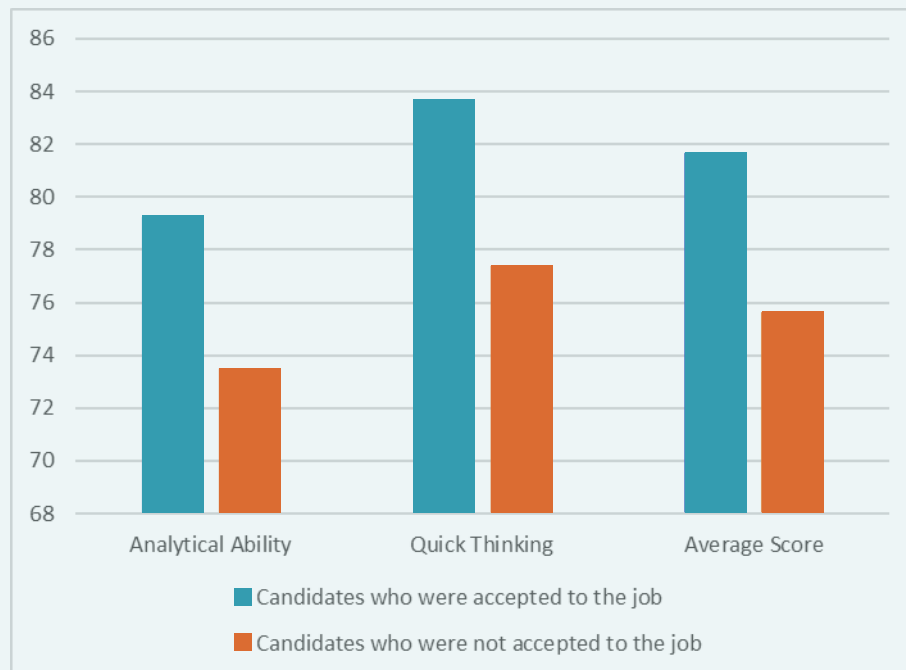


The focus was on two main skills: Analytical Ability and Quick thinking. Both skills were defined as significant by the decision-makers in the organization that participated in the study.

It is important to emphasize that the Accelium tool results were not provided to the decisionmakers (i.e., organizations' decisions regarding the candidates relied only on the data obtained from Adam Milo standard assessment tools).

At the end of the recruitment process, a comparison was made between the candidates' results in the Accelium assessment tool who were accepted for the position and the candidates who were not accepted for the position they were examined for.

The chart below shows that significant differences were found in their performances.



In addition to the validation analyses described above, the same group of examinees also participated in a set of tests aimed to examine the correlation between the Accelium Assessment tools to other skill tests Adam Milo is using.

They measured the correlation between Thinking Speed and Analytical Thinking (assessed in the Accelium tests) with understanding instructions, verbal logic, abstract reasoning, and general thinking. For these skills, a high positive correlation was found!

In contrast, a low correlation was found for reading comprehension skills. This finding is not surprising since the Accelium assessments are game-based and do not require examinees to demonstrate this ability.

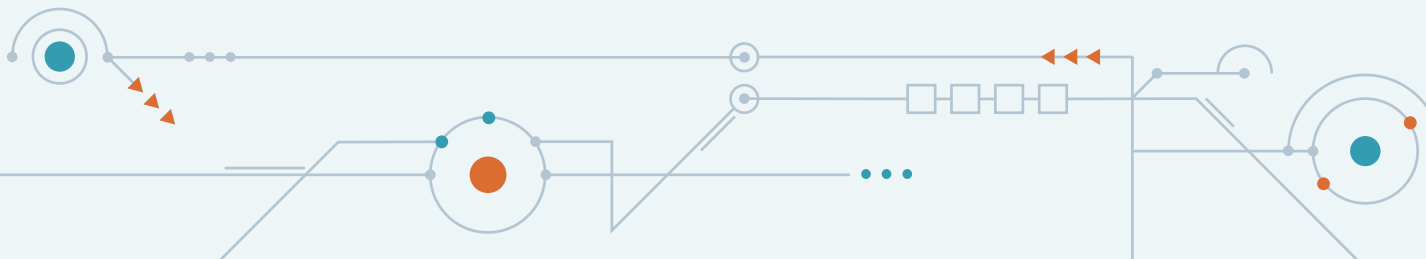
Figure 2 shows the correlations found between Accelium results and other test results:

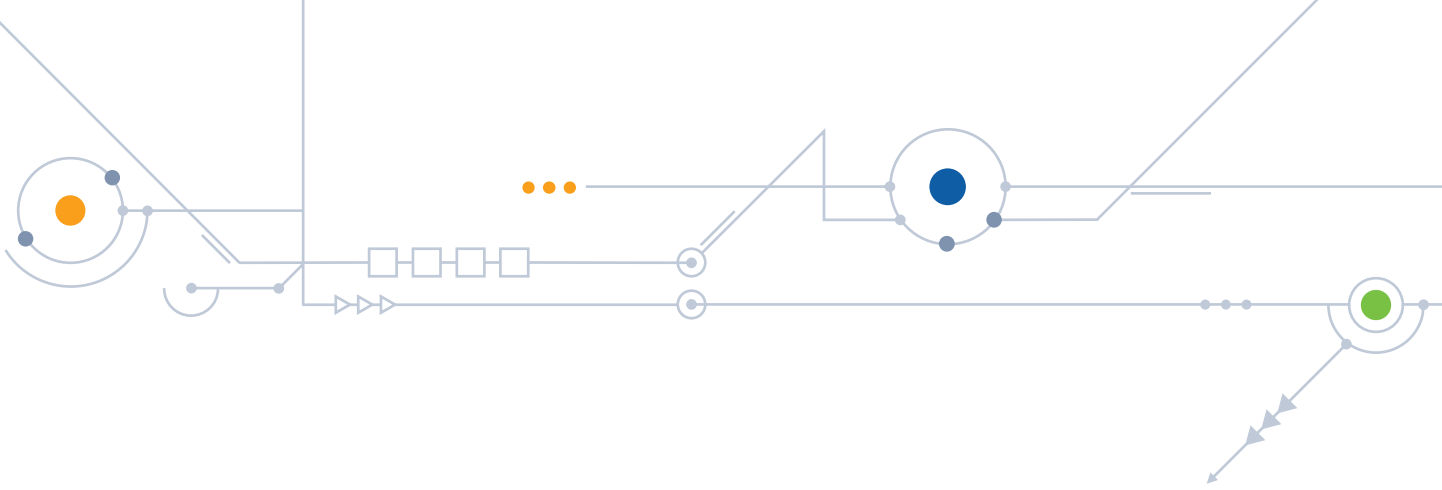
	Execution style test	Understanding instructions tests	Reading comprehension test	Verbal logic test	General thinking test	Average
Analytical Ability	0.47	0.42	0.18	0.68	0.67	0.44
Quick Thinking	0.45	0.39	0.28	0.60	0.58	0.41

Table 1: Correlations between one of the Accelium tools, which assesses analytical ability and quick thinking, and other external tests.

The findings indicate convergent validation with applied intelligence tests, systematic thinking, understanding instructions, and abstract reasoning. However, it also shows discriminant validity with tests which their main characteristic is verbal. The correlations are average. Therefore, despite the existing overlap between the skills assessed by the Accelium game-based assessment and the abilities evaluated in traditional assessments, other factors are not measured by the traditional ones. Thus, **the tool contributes to a complete diagnosis of the candidate's skills.**

Another study examined correlations between psychologists' assessments of candidates (based on different tools) and Accelium digital test. Medium and high correlations were found between Accelium tests and assessments related to analytical thinking, learning ability, judgment, and more. In contrast, a low and non-significant correlation was found between our tests and organizational capabilities. This finding is expected since Accelium assessment tools were not designed to test these capabilities.





Summary:

Adam Millo tested the validity and reliability of Accelium's game-based assessment tools. They examined several digital games as alternatives to cognitive diagnosis. They concluded from the accumulated data that the tool supports the diagnosis, and they recommend using it as part of the screening processes they conduct.

Following the data collected from studies presented here, Adam Milo decided to incorporate our game-based assessments into their solutions to recruit and sort candidates for various positions.

