

Mohammed VI Polytechnic University-Morocco

UM6P School of Collective Intelligence



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Applied Research Project

Untapped Talent in Public Administrations

How can we identify, measure, and combine talents to form the strongest project teams
within the public administration?

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Abstract

The implications of cognitive diversity were analysed in this study based on Steernberg's theory of multiple intelligence. We measured creativity, emotional intelligence, practical intelligence and practical intelligence in a sample (N=46) of individuals. The innovative capacity of individuals was identified by testing their ability to propose innovative (novel, useful and feasible) solutions to complex societal problems. Creativity and practical intelligence were identified as key attributes that promote people's innovation. Through clustering using the K-means method, we were able to determine two types of groups of people (the innovative and the less innovative) who differ in their creativity and practical intelligence style. Through this study we were also able to demonstrate that the parameters novelty, feasibility, and utility are variables that can contribute to the creation of an innovation indicator.

Introduction

We started this research work, and nobody was talking about war or invading countries yet. But now it is, and we haven't even finished with the battle against COVID. So many unexpected changes, one after the other. Each one with its effect on the daily lives of people around the world, whether they are near or far from the places of its various changes. From the point of view of human evolution, of striving to make our planet earth sustainable for every human being, we are seeing setbacks caused by these changes. According to authors P. Kinsinger and K. Walch, we live in a world in which Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) reign. But when we look at the history of humanity, we have already experienced dark moments such as the economic crisis of 2008, the two world wars, enslavement, colonialism and so on. This is to say that everything that is happening to us today is not new to the evolution of the human species. If in 2022, we still have an existing human species on earth despite difficult times: it is thanks to our capacity for innovation. The constant search for solutions to the problems we create or do not create through the interactions between humans or between humans and their environment. As human beings evolve in groups within society, it is important to think about and improve their capacity for innovation. Before being in a group, the human being is first of all an individual. More attention should also be paid to the management effects of innovation at the organisational and functional level (e.g. financial and operational performance of the company, organisational commitment and employee involvement, and ambidexterity of capabilities) than at the individual level (e.g. well-being,

creativity, purpose and agility). Effective approaches to addressing VUCA require better understanding and coordination between these two levels (Millar et al., 2018). The need for innovation in all areas is even more pressing and necessary if we consider the specific challenges of Africa. A continent with a rich history in terms of civilisation and which for the past few centuries has been facing global challenges but also specific challenges related to making its various resources useful, starting with the human resource useful for its own development. In a generic way, why is a group of people A more efficient, more innovative than another group B. Why do some countries evolve better than others? Why do companies, public administrations in one country or region perform better than others? The literature and public discourse talks about diversity of groups. Others talk about gender diversity, skin colours and background. But before all these external and easily perceptible factors, we are human. We have an organism with organs such as the heart, the brain, and so on. If we focus on the brain, we can therefore ask ourselves what diversity in terms of human cognitive ability promotes good group performance for innovation.

Cognitive innovation has not received much attention from empirical and conceptual research in the cognitive sciences (Fabry, 2017).

The need to have the right combinations has been raised by previous studies explaining human technology. Knowing that our world but especially Africa needs more than ever a high capacity for complex problem solving in both the public and private spheres, we analyse in this paper the combinations of people in terms of their cognitive capacity that improves complex problem solving and boosts the capacity for innovation in society.

Literature review

There is no doubt that there are more businesses, industries, and agencies implementing team-based systems than ever before. Organizations believe that teams, teamwork, and effective team functioning can provide a competitive edge. Teams are, after all, dispatched to tackle difficult and complex problems (Cooke et al., 2004). The need to make more use of the collective intelligence of humanity is emerging in the context of the sustainable development challenges of countries around the world.

Leimeister explained that the roots of collective intelligence are widely believed to go back to evolutionary processes and refer to intelligence in groups. Collective intelligence is not a new phenomenon and has been the subject of scientific work and research (biology, social sciences, engineering, computer science, etc.) for many years. Decomposing collective intelligence etymologically, the term “collective” describes a group of individuals who are not required to have the same attitudes or viewpoints. Different members can reveal different perspectives and

approaches, and thus leading to better explanations or solutions to a given problem. “Intelligence” refers to the ability to learn, to understand, and to adapt to an environment by using one's own knowledge (Leimeister, 2010).

Crises of various forms and moments of difficulty reveal the need for change in organisations regardless of their size or sector of activity. Following the financial crisis of 2008, Collm and Schedler pointed out that the innovativeness of public administration must be increased. Because the financial crisis mercilessly exposes the deficits of private and public organizations. Their research suggested that it will be crucial for public managers to prepare themselves and their administrations for the future and, in doing so, depart from the beaten tracks of the past (Collm & Schedler, 2012). Even more recently, the pandemic we are going through has shown the pressing need for innovation in many sectors including public health.

Digital technologies are being harnessed to support the public-health response to COVID-19 worldwide, including population surveillance, case identification, contact tracing and evaluation of interventions on the basis of mobility data and communication with the public (Budd et al., 2020).

Morocco has undertaken many reforms with the aim of successfully integrating into the world economy in general, and the African economy in particular, in order to diversify its economy and strengthen its competitive potential in terms of exports (Ilham Taouaf* & , Yassine Marzougui, Moha Arouch, 2021) . More than 20 years ago, Morocco began a process that aimed to establish a national ecosystem that favoured the development of national scientific research in general and innovation and valorization of research results in particular (MESRSFC, 1999 & 2000). Morocco, through its new development model 2021 driven by His Majesty King Mohamed VI, emphasizes the acceleration of technological transformations, particularly under the effect of the digital transition, which should lead to disruptions in production methods. According to the report (*La commission spéciale sur le modèle de développement, 2021*), these trends require countries like Morocco to place human capital training, R&D and innovation among its development priorities, and to accelerate its upgrading in terms of technological infrastructure, to strengthen its competitiveness and pursue its development. The importance of the role of human resources for both public and private organisations no longer needs to be demonstrated.

Human resources (HR) are vital to an organization’s development and sustainability, the ability to innovate is a valuable component of organizational effectiveness, efficiency, and productivity—all factors relying on an organization’s human talents. (Ronquillo et al., 2021). It is therefore essential to understand how best to find the right human resource and put them

in a group where they will be effective. In a study (Ronquillo et al., 2021) conducted on a sample of 1,220 employees in the public and non-profit sectors, researchers found that staff inflexibility has a negative effect on the climate for innovation in both the public and non-profit sectors, and the effects of other variables, such as motivation for advancement, vary by sector. How can we identify, measure, and combine talents to form the strongest project teams within the public administration? Let's assume that the implementation of an innovative project requires an innovative intelligence.

A trivial solution that may come to mind is certainly to bring intelligent people together to have groups to innovate. Is the IQ commonly known when talking about intelligence sufficient or is something else needed? The notion of intelligence is the subject of much work and debate in the literature because it is not limited to a single metric according to some psychologists. People speculate that innovation intelligence has three dimensions, based on the Triarchic Theory of Intelligence or Three Forms (Practical intelligence, Analytical intelligence, and Creative intelligence) of Intelligence by psychometrician Robert Sternberg.

An intelligence that is defined in a 3-dimensional frame of reference: The fact that these 3 forms are both indispensable for the implementation of a project, but also never uniformly present in a person, is the first characterization of the fundamentally collaborative nature of innovation.

Sternberg's definition of human intelligence is "(a) mental activity directed toward purposive adaptation to, selection and shaping of, real-world environments relevant to one's life" (Sternberg, R. J., 1997). Robert Sternberg's (1988) triarchic theory of intelligence refers to a theoretical model developed to complement the models of human intelligence developed by the psychometric approach, i.e., based solely on intelligence test scores (IQ). Robert Sternberg believed that intelligence should be conceived as helping the individual to adapt in his or her life and that in this respect, IQ tests do not capture two other important aspects of intelligence: creativity and practical intelligence. The triarchic theory of intelligence describes three fundamental aspects of intelligence: analytical (compositional aspect), creative (experiential aspect) and practical (contextual aspect) (« *Théorie triarchique de l'intelligence* », 2021). The theory is called "triarchic" because it consists of three parts. The first part relates intelligence to the internal world of the individual, specifying the mental mechanisms that lead to (more or less) intelligent behaviour. This part of the theory specifies three kinds of mental processes that are instrumental in learning how to do things, planning what things to do and how to do them, and in actually, doing the things. The second part of the theory specifies at what point in a persons' experience with tasks or situations intelligence is most critically involved in handling

those tasks or situations. In particular, this part of the theory emphasises the roles of dealing with novelty and of automatising mental processing in intelligence. The third part of the theory relates intelligence to the external world of the individual, specifying three kinds of macroprocesses — adaptation, selection and shaping — that characterise intelligent behaviour in the everyday world. This part of the theory thus emphasises the role of environmental context in determining what constitutes intelligent behaviour in a given milieu (Robert J. Sternberg, 1986). This theory of intelligence, also called successful intelligence, is a good foundation for our research work because it better captures the fundamental nature of human capabilities. According to its author (Sternberg, 1999), if this new concept is incorporated into the laboratory, schools, and the workplace, not only science will benefit, but also individuals, organisations, and society, in the short and long term. The complexity of innovation may require the use of several skills. This requires a group to be able to perform a wide variety of tasks. What (Chikersal et al., 2017) define as collective intelligence is according to them a key factor for successful collaboration. According to his researchers, group composition, in particular the diversity and social responsiveness of members, are consistent predictors of Collective Intelligence, but we have limited knowledge of the mechanisms underlying their effects.

The analysis of the composition of a group in terms of the cognitive abilities of its members for a better performance and an improvement of the collective intelligence of the group within a public administration is an unexplored field. Therefore, we want to combine Sternberg's theory of multiple intelligences with the composition of innovative groups. Our aim is to start from the individual dimension to understand the dynamics of the group. Studying the physiological dynamics of teams in the context of work teams can help to understand the possible unique relationships between physiological processes and tasks and variables that are relevant to work teams (e.g. measures of team productivity) (Kazi et al., 2021). To understand team performance and to develop team training, reliable and valid measures of team performance are necessary (Healey et al., 2004). This is not an easy task especially when we are in the field of public innovation or public problem solving. The most difficult policy problems of the modern era have been described as complex, intractable, open-ended and 'wicked' (Head, s. d.).

As our approach is based on the triarchic theory of intelligence, we have a track of measurement of cognitive abilities that promote individual intelligence. When moving to the group level it is important to be able to find an element that facilitates group performance. Many research studies have shown the involvement of emotional intelligence in the performance of a group of

people. (Jamshed & Majeed, 2018) investigate the relationship between team culture and team performance through the mediating role of knowledge sharing and team emotional intelligence. This study demonstrates that knowledge sharing and team emotional intelligence influence team working, but also confirms the strong association between team culture and team performance through the lens of knowledge sharing and team emotional intelligence. Another experiment using the three components of Salovey and Mayer's (1990) conception of emotional intelligence: Understanding emotion, managing emotion, and identifying emotions demonstrates that understanding emotion and managing emotion positively correlated with some measures of team performance (Feyerherm & Rice, 2002). Empirically others researchers also work on the effect of emotional intelligence of the team, as calculated by the average of all team members' individual emotional intelligence measurements, on the cohesiveness of the team, and the effect of the perception of self-efficacy of the team members on the relationship between emotional intelligence and team cohesion. Results indicated that team cohesion was highest when team members demonstrated greater emotional intelligence. Self-efficacy also had a positive influence on team cohesion. High self-efficacy was found to be an important mediator of the relationship between emotional intelligence and team cohesion. High emotional intelligence promoted the development of self-efficacy, resulting in increased team cohesion. Increased team cohesion resulted in improved team performance and participation (Black et al., 2018).

In an increasingly digitised society, interest in the use of so called big (and small) data has never been greater. Data analytic techniques, of varying sophistication, are being used to understand social phenomena, evaluate policies, tailor consumer marketing, predict voting behaviour, enable precision medicine and a host of other real-world applications (Raguseo, 2018). The term 'People Analytics' (PA) has been appearing with greater frequency in executive leadership and Human Resources Management (HRM) circles (Deloitte, 2017). PA promises to help organisations understand their workforce, as departments or work groups, and as individuals, by making data about employee attributes, behaviour and performance more accessible, interpretable and actionable (Pape, 2016). This includes the use of information systems, visualisation tools and predictive analytics, underpinned by employee profiling and performance data (Tursunbayeva et al., 2018). Predictive and visualisation skills are important to measure and understand the analytical capabilities sought by organisations.

In the literature there are a variety of measures of people's creativity taking different approaches. The four major approaches to measuring creativity (process, person, product, and press) have been reviewed by Said-Metwaly et al. Their work points out commonly used

instruments as well as the advantages and weaknesses of each approach and reveal that the measurement of creativity is an unsettled issue, and that the existing instruments purporting to measure creativity suffer from serious conceptual and psychometric shortcomings. The common limitations of these instruments include the dissimilar and limited scope of measurement, conflicting evidence of validity, lack of appropriate norms and disregarding domain-relevant aspects of creativity. In addition, these instruments direct greater attention to within-individual aspects of creativity, ignoring the external context where creativity occurs (Said-Metwaly et al., 2017). The study also shows that the process approach developed by Wallach and Kogan's is adapted to all domains, it is more widespread, more reliable with a standardisation of the interpretation criteria. It is therefore the most suitable for our measurement of innovation.

Practical intelligence represents one important branch of the triarchic theory of successful intelligence. It consists of two components: one cognitive, the other behavioural. The cognitive component requires knowledge, both tacit and explicit, about how to deal most effectively with situations that come up in the context of everyday experience. Explicit knowledge is the kind acquired through formal training. Tacit knowledge, on the other hand, is the kind of knowledge that people possess even if they are not able to articulate the principles guiding their behaviour or explain where this knowledge was acquired (Stemler & Sternberg, 2006). He breaks down practical intelligence into three components: deal with self, with others and with tasks. The component of dealing with others also has 3 components according to Sternberg: dealing with supervisors, peers, and subordinates. He also demonstrated that the situational judgement tests can be used to measure practical intelligence.

Research question and hypothesis

How we compose teams can have a major impact on the success or failure of projects. Public administration across the world and especially the Moroccan one seeks to develop innovative projects but until now, they form these project teams in an 'ad hoc' way. Studies have shown the importance of cognitive diversity in teams. It is very likely that there is "untapped talent" within the public administration, i.e., profiles that individually and collectively are not used to their highest potential. If we can develop the right measures of cognitive diversity for the Moroccan public administration, we can compose project teams in a way that may significantly increase the chances of success, all within existing levels of resources and staffing. Our principal research question for this project is therefore: **How can we identify, measure, and combine talents to form the strongest project teams within the public administration?**

Collective intelligence (CI), a group's capacity to perform a wide variety of tasks, is a key factor in successful collaboration. Group composition, particularly diversity and member social perceptiveness, are consistent predictors of CI, but we have limited knowledge about the mechanisms underlying their effects (Chikersal, et al, 2017). A growing body of research suggests group composition is crucial in terms of group performance (Woolley et al., 2010) and group creativity (Amabile, 1982; Aggarwal & Woolley, 2019). However, there have been relatively few attempts to systematically investigate the relationship between group diversity, the composition of the group, and the capacity of groups to innovate. Furthermore, while there are many aspects of diversity we could focus on – ranging from primary dimensions of diversity (e.g., gender, personality, and age) as well as secondary dimensions (such as an individual's socio-economic background and religious affiliation) (see Loden & Rosener, 1991) – we will limit our focus to the composition of cognitive profiles and how the interaction between these profiles influences innovation. As all innovation must emerge and evolve in an environment, the acceptance of any innovative project by a population or a crowd of people surrounding the innovator is essential. It is therefore important to be able to assess the cognitive skills of the innovator, which, combined with several perceptions (Novelty, Feasibility, Utility) of the environment, will facilitate the emergence and sustainability of an innovative project.

In this respect, our project aims to address two specific questions:

- **What is the causal relationship between group composition, group diversity and a group's capacity to innovate?**
- **Can we discover certain group compositions that maximize innovation?**
- **What are the cognitive skills of the innovator that can influence the crowd's perception of his innovations?**

To answer these questions, we formulate three main hypotheses:

- H1: The innovative capacity of a group of people depends on the complementarity of their creative, analytical, practical, and emotional intelligence
- H2: The greater the diversity and complementarity of the groups, the greater the innovative capacity of the group
- H3: There is a combination of cognitive ability and crowd perception that influences the quality of all innovation

Method:

This study is based on the hypothesis that:

Innovation Intelligence = Analytical Intelligence + Creative Intelligence + Practical Intelligence

To move to the team dimension, we will integrate emotional intelligence to have a collective innovation intelligence. Thus, our formula becomes:

Collective Innovation Intelligence (CII) = Analytical Intelligence (AI) + Creative Intelligence (CRI) + Practical Intelligence (PI) + Emotional Intelligence (EI)

We measure each of the 4 components of collective innovation intelligence for each participant.

Cognitive profile assessment

- **Analytical Intelligence (AI)**

We are inspired by a game created by Omar Wagih (Guess the Correlation, n.d.). The aim of the game is simple: try to guess the correlation between two variables in a scatterplot. The closer the guess is to the actual correlation, the better. This game belongs to the category of games that are qualified in the literature as human-based computation game or a game with a purpose. This means, according to its author, that although it is intended to be entertaining, the guessing data is collected and used to analyse how we perceive correlations in scatterplots, so the more players there are, the more data is generated. A human computational game or game with a purpose (GWAP) is a human computational technique that involves assigning steps in a computational process to humans in a playful manner. A notion that emerged with Luis von Ahn who proposed the idea of "human algorithm games", or games with a purpose (GWAP), in order to exploit the time and energy of humans to solve problems that computers cannot yet solve alone. This type of game allows us to assess the analytical abilities of people. The advancements in the field of Human based Computation has produced many ideas for utilizing the brain power of humans to accomplish some intelligent tasks (Kaur & Kumar, 2018).

The estimated value of each participant to whom we present a real value of a scatter plot allows us to estimate the error made by individuals. An error that we use to estimate the analytical performance based on the fact that, the closer the error is to 0 the better the participant has performed.

- **Creative Intelligence (CRI)**

Creativity, which appears to be an essential element in the innovation process, can be measured through various approaches. Studies in the past have used idea generation capacity based on the assumption that the more ideas a person generates, the higher the probability of having a good and innovative idea. But with the development of Natural Language Processing methods, processes are emerging that allow us to assess the creativity of individuals based on the data they generate while writing. Scott Crossley proposes to examine creativity in writing using automatic linguistic analysis tools. For him, creativity can be approached from two different perspectives. Cognitive creativity, which he characterizes as the ability to develop original and

effective solutions to a problem, and linguistic creativity, which consists of playing with the form or meaning of language. Cognitive creativity can be studied in terms of fluency, flexibility, originality, and elaboration of ideas, while linguistic creativity focuses on three different types of figurative language: metaphor and simile, irony, satire and sarcasm, and wordplay.

Through a study on the Identification of creativity in problem solving using linguistic features (Stephen Skalicky, Scott A. Crossley, Danielle S. McNamara, Kasia Muldner, 2017) the authors remind us that creativity is typically assessed using divergent thinking tasks, which measure the fluency, flexibility, originality and elaboration of participants' output in a variety of different tasks. The results of this study suggest that features representative of linguistic definitions of creativity, such as humour and metaphor, are related to traditional measures, such as fluency and flexibility. We re-use the same method that is based on three divergent-thinking tasks from prior creativity research (Maimon & Horowitz, 1999) to measure people's creativity. Other study indicates that essays from writing rated as containing a greater number of ideas that were flexible, original, and elaborated were judged to be of higher quality. Idea generation is strongly linked to language features in essays. Specifically, the use of unique multiword units, more difficult words, semantic but not lexical similarities between paragraphs (Crossley et al., 2016).

- **Practical Intelligence (PI)**

"Practical intelligence allows us to read situations correctly and get what we want." Robert J. Sternberg. The application of this type of intelligence involves two elements: knowledge and actions. There are many examples of practical intelligence in everyday life. For example, when we think about how to get out of a crowded streetcar, when we choose the shortest route to work if we don't have enough time, when we ask for help if we feel bad in the street, etc.

We use a measurement tool (See tables A in annex) based on judgment tests that was previously used by Sternberg in his study Using situational judgment tests to measure practical intelligence (Stemler & Sternberg, 2006).

- **Emotional Intelligence**

For this test we use Likert scale questions and ask a series of 33 questions taken from a study (Schutte et al., 1998) about development and validation of a measure of emotional intelligence. The study is based on a series of studies describing the development of a measure of emotional intelligence based on the emotional intelligence mode developed by Salovey and Mayer. A factor analysis of the responses of 346 participants suggested the creation of a 33-item scale.

Studies have shown that the 33-item measure has good internal consistency and test-retest reliability.

Data collection

The collection of data for this study required to be able to reach a maximum of volunteers who could dedicate minutes of reflection to do the different tasks that allow us to measure the different forms of intelligence and measure individual performances. The data collection is therefore organised in two phases, each with its own survey form. The first phase, which lasted the month of July 2022, consisted of sharing the link to our studies which included the creativity, analytical, practical intelligence strategy apprehension, and emotional intelligence measurement tasks. This collection tool contains two other sections, one that collects the demographic characteristics of the participants but also allows each participant to choose a global challenge (poverty, climate change, gender inequality, conflict and war) and to propose innovative solution approaches that can address one of the chosen challenges. This task is important for our study because it allows us to measure the individual innovative capacity of our participants, which we assessed in the second collection phase of our study.

This second phase lasted two weeks, during which time the project ideas proposed in the previous phase were submitted to a large number of people who rated them according to three parameters: Novelty, Utility, Feasibility.

We used a hybrid strategy to identify and solicit participant input for the studies. The first was to use social networks (LinkedIn, WhatsApp, Twitter, Facebook, and Instagram) to share the research using short links and QR code images. We asked people available on our networks to contribute their time and share with other participants. We also organised an activity for the promotion of entrepreneurship in Africa called: 500 minutes of collective intelligence for the development of agriculture in Africa. You can see a description of this activity in the annex. This activity allowed us to recruit some of the participants and to solicit help.

Data analysis

The analysis of the data in this study consists of three main phases. The first step is the data cleaning and the creation of different variables representing creativity, analytical capacity, practical intelligence, emotional intelligence, degree of usefulness, feasibility and novelty of the innovative solution ideas provided by participants. Then we proceeded to an exploratory analysis through descriptive statistics for a first understanding of our data, then modelling to understand the interactions between variables and finally a clustering that allowed us to identify the different groups in innovation that we can identify and their characteristics.

Data cleaning

By using the full range of data collection techniques in the first phase of data collection that we presented earlier, we were able to reach 308 individuals who accessed the forms and started the experiment. We had 5 who did not give their consent, so we removed them from the sample. Looking at the data, we also realised that few people were able to complete the experiment and all the tasks in the form. As all the questions were essential for the study, we proceeded to a second cleaning consisting of selecting the individuals who had completed the cognitive ability measurement tasks and who had done the exercise consisting of proposing an innovative solution to a challenge (the fight against poverty, climate change, gender inequality and conflict) around the world. This choice is justified by the fact that these two levels of information (cognitive ability and innovation performance in the face of a complex problem-solving task) are essential for understanding the cognitive factors that can explain individuals' innovation. Because of these levels of cleaning we were able to have 46 (i.e. 14.93% of the raw observations) observations with clean data.

This can be explained by the fact that the length of the experiments, the completion of the tasks requires at least 30 minutes of reflection by the participants. Keeping the participants in a form with more than 30 minutes of reflection is not easy. This gives us ideas for improvement for a future experiment, such as redesigning the tool so that the tasks can be done in a segmented way and the participants have the possibility to do the tests one by one at different times.

Creation variables for different construct of our experiment

- **Analytical Intelligence (AI)**

We gave participants a task to predict the correlation between two variables. It is important to remember that we asked the participants to make 7 different predictions. This allows us to have a set of predictions to better judge the analytical skills of individuals. To measure the analytical performance (analytical intelligence in our research) we first calculated the percentage of prediction error. This measure was calculated using a widely used formula (Guang et al., 1995) which is the following:

percentage prediction error = ((measured value- predicted value)/measured value) * 100
or percentage prediction error = ((predicted value - measured value)/measured value) * 100

This gave us the errors of the seven predictions. As we are interested in the performance of individuals, we transformed the predictions errors into analytical performance based on the logic that the bigger the error the less the performance of the individual. So, if **AP** is the analytical performance, we have: **AP= 1- percentage prediction error.**

By determining the performance of the individuals for each of the seven predictions, we determined the analytical performance by calculating the average of the analytical performances.

Likert scaling data collection and analysis

Many of the questions in our studies are in Likert format. A question format whose major shortcoming is that it allows obtaining qualitative data. (Carl J. Chimi, David L. Russell, n.d.) points out, for example, that the use of Likert items and its derivatives generates outcome data that are qualitative and ordinal and can only be assumed to be linear.

Our approach in this study is purely quantitative, so we compensated for this shortcoming by making use of the slider questions that the Qualtrics data collection tool provides. A type of question that allows the use of sliders in a more interactive alternative. Rather than simply selecting a scale of points, respondents drag their level of preference onto a bar (qualtrics, n.d.). This allows us to collect participants' preferences on each question with the logic of Likert questions but getting continuous quantitative data. This is the approach we used for all our Likert questions.

To transform the data entries of these questions into performances we use the following formula: $\text{Performance} = (\text{Preference to Likert scale of participant} / \text{Maximum of the proposed scale}) * 100$

- **Emotional Intelligence (EI)**

The thirty-three questions contained in our emotional intelligence measurement tool include three reverse scoring questions. We used the following formula (Stats 2: Reliability, n.d.): **reverse score(x) = max(x) + 1 - x** to measure the scores of these variables. Thus, the questions can all be transformed into a performance and by calculating the average of these, we have a measure of emotional intelligence.

- **Creativity**

We used three divergent thinking tasks to measure creativity. Studies that have made use of this method generally make use of human scoring to measure the creativity of the participants' output on these kinds of tasks. However, through text-mining methods (machine learning), an emerging method of analysis based on automatic scoring of creativity has emerged in the literature. The automatic rating cannot be above the human one, but it can approach the human abilities like any algorithmic model. A psychometric comparison of methods for measuring originality of divergent thinking with human ratters and text mining models shows that, despite their inherent subjectivity, human-rated originality scores have the highest reliability, both for composite and latent factors. However, the GloVe 840B (Global Vectors for Word

Representation) text mining system was very capable of approximating human-rated scores, both in its measurement properties and in its correlations with various creativity-related criteria, including ideational fluency, elaboration, openness, intelligence, and self-reported creative activities (Dumas et al., 2021). Importantly, GloVe is an unsupervised learning algorithm for obtaining vector representations of words. Learning is performed on aggregate word-word co-occurrence statistics from a corpus, and the resulting representations exhibit interesting linear substructures of the word vector space. (Pennington et al., 2014). In a study researchers demonstrated that the GloVe (new global log-bilinear regression model for the unsupervised learning of word representations) outperforms other models on word analogy, word similarity, and named entity recognition tasks (Pennington et al., 2014).

The work of (Dumas et al., 2021) led to the development of Open Creativity Scoring (OCS) software which we used to calculate the creativity performance of the three divergent thinking tasks given to participants. Thus, we averaged the performance on the three tasks to get a measure of the creativity of each individual in our study. Open Creativity Scoring is a software that takes in an excel file with two columns (prompt, and response) and returns a measure of creativity characterized by originality of the idea and a measure of idea elaboration. The software provides a measure of creativity that can be standardised on a scale of 1 to 7. This is in line with our likert measurement method with quantitative output. We have made use of this standardisation, so that we can turn this measure of creativity into performance.

- **Practical Intelligence (PI)**

The measure of practical intelligence that we used in this study consists of giving a judgement situational task (JST) and asking seven questions that allow us to apprehend the type of practical intelligence presented as a strategy (Comply, Consult, Confer, Avoid, Delegate, Legislate or Retaliate strategy) that is dominant in each individual. We tested the participants in three different situations and tried to measure their dominant type of strategy. For each strategy, we averaged the scores of the three situations presented to the participants to determine the dominant practical intelligence of each person.

- **Innovation performance for solving a complex problem**

For the three measures (Novelty, Feasibility, Usefulness) of innovation we have aggregated the human ratters' inputs. This allows us to have a measure of three components of the indicator (to be demonstrated) we use to understand innovation.

Exploratory Analysis

Our sample of 46 people used in this study is composed of young people with an average age of 26.15 years old. A large proportion of the sample is from 18 to 25 years old (57.78%),

followed by 25 to 32 years old (28.89%), 32 to 39 years old (8.89%) and people over 39 years old (4.44%). The sample is composed of more men representing 67.39%, with 26.09% of women and 6.52% of people who preferred not to give their gender.

	mean	std	Min	25%	50%	75%	max
CRI	0.337319	0.181588	0.142857	0.219048	0.273810	0.423214	1.000000
AI	0.631674	0.189155	0.057000	0.590120	0.664203	0.777839	0.899845
EI	0.772859	0.094573	0.587879	0.716667	0.769697	0.836364	0.957576
CP	0.593168	0.215711	0.142857	0.476190	0.595238	0.714286	1.000000
CS	0.653209	0.163627	0.333333	0.523810	0.666667	0.797619	1.000000
CF	0.670807	0.177842	0.142857	0.571429	0.666667	0.761905	1.000000
AV	0.423395	0.193163	0.142857	0.285714	0.428571	0.571429	0.857143
DE	0.432712	0.190695	0.142857	0.285714	0.428571	0.571429	0.857143
LE	0.511387	0.219813	0.142857	0.345238	0.547619	0.702381	1.000000
RE	0.275362	0.182066	0.142857	0.142857	0.190476	0.321429	1.000000
Novelty	0.417759	0.177862	0.000000	0.375625	0.461000	0.523300	0.722500
Feasibility	0.430193	0.189999	0.000000	0.373325	0.480000	0.535025	0.730000
Usefulness	0.516052	0.228451	0.000000	0.440000	0.550850	0.676050	0.888000
Age	26.155556	7.286212	18.000000	22.000000	24.000000	28.000000	59.000000

Our variables associated with measuring analytical, emotional and creativity intelligence, practical intelligence and innovative idea proposal performance are based on similar scales (0

to 1), so we use boxplot to compare them using the mean of our sample, shown as a star in the figure below.

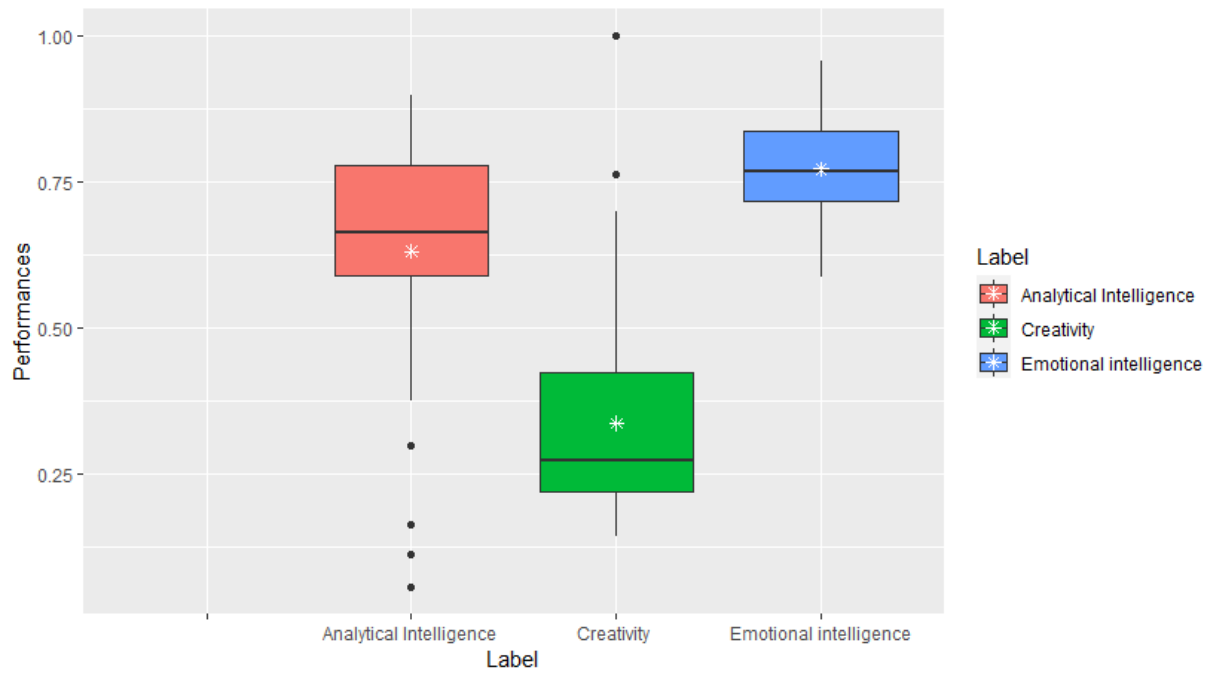


Figure 1: Distribution of values associated with participants' analytical intelligence, emotional intelligence, and creativity

In our study sample we can see that emotional intelligence is the highest ability (with an average of 0.77) followed by analytical intelligence (0.63) and creativity (0.34). The practical intelligence is defined according to seven strategies, the following figure presents the distribution of the different forms of strategy.

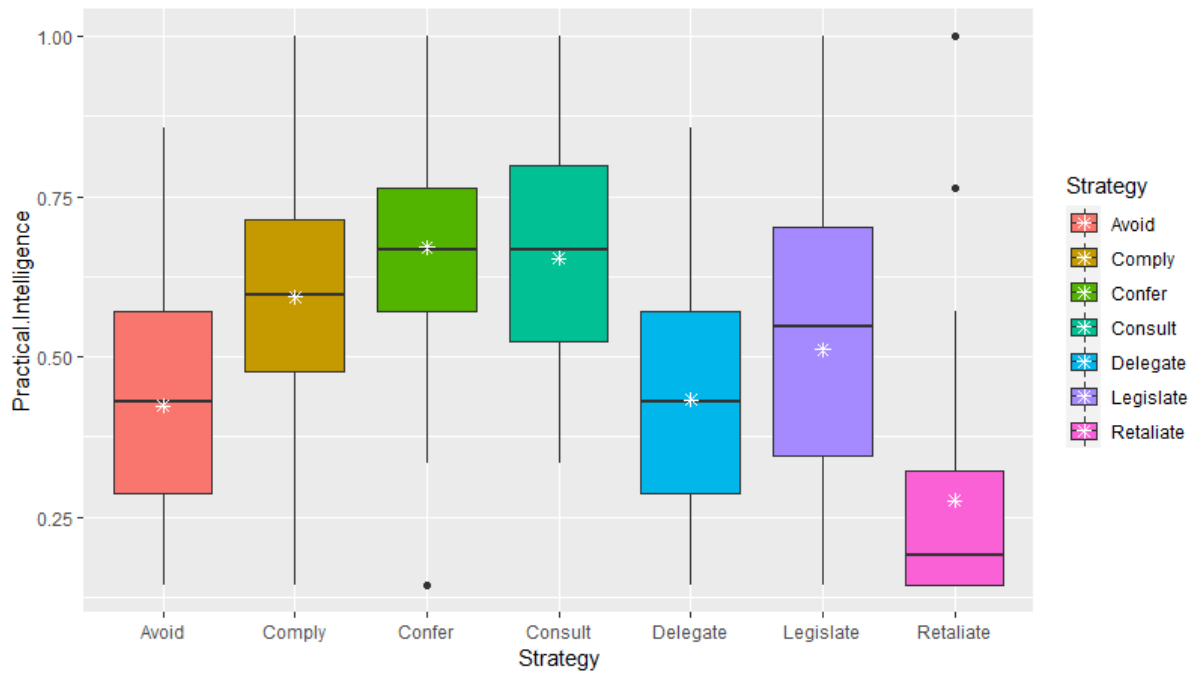


Figure 2: Distribution of values associated with the different type of practical intelligence in our sample

We can observe that the sample is characterised by people with a practical intelligence oriented towards conferring and consulting.

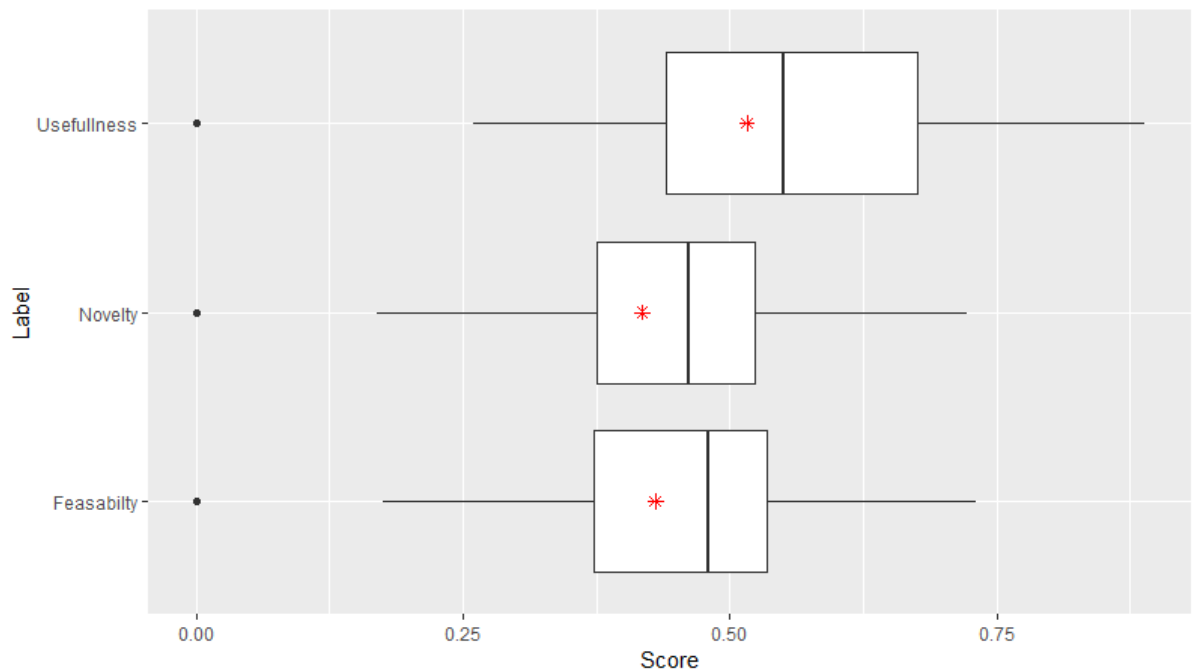


Figure 3: Distribution of values associated with the innovative idea proposal performances

The figure above shows us that usefulness is the characteristic that most describes the proposed ideas, followed by feasibility and novelty in last position. This can be explained by the fact that we are asking people to propose solutions to real problems in society. It is logical that usefulness comes first overall.

Components characterising an innovative idea

We started this experiment with the assumption from the literature that an innovative idea is defined by three main components: novelty, utility, and feasibility. This leads us to trivially assume that the innovativeness of an idea can be calculated with the following forum:

$$\text{Innovativeness of an idea} = (\text{Novelty} + \text{Utility} + \text{Feasibility})/3$$

It is important for us to verify that the three components contribute to the explanation of the same indicator which in our case is: innovativeness. To achieve this, we conducted a principal component analysis using all the variables in our study.

Principal Component Analysis

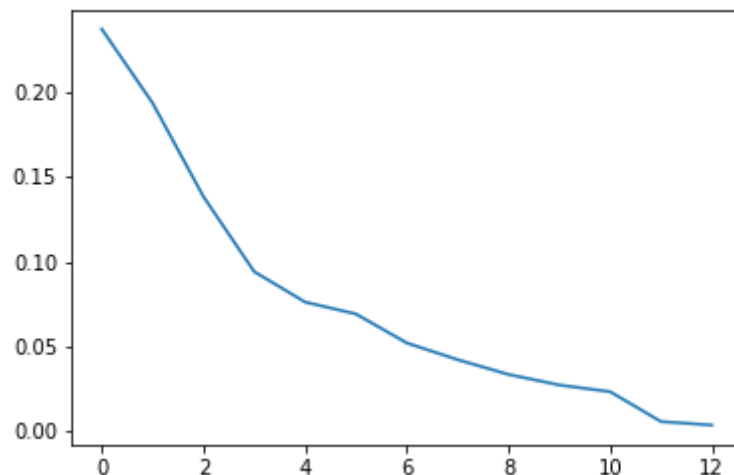


Figure 4: PCA axes information identification

The graph above shows the eigenvalues associated with each principal axis, which represents the amount of information associated with each axis. In the rest of the analysis, we could therefore limit ourselves to studying the first 2 or 3 axes.

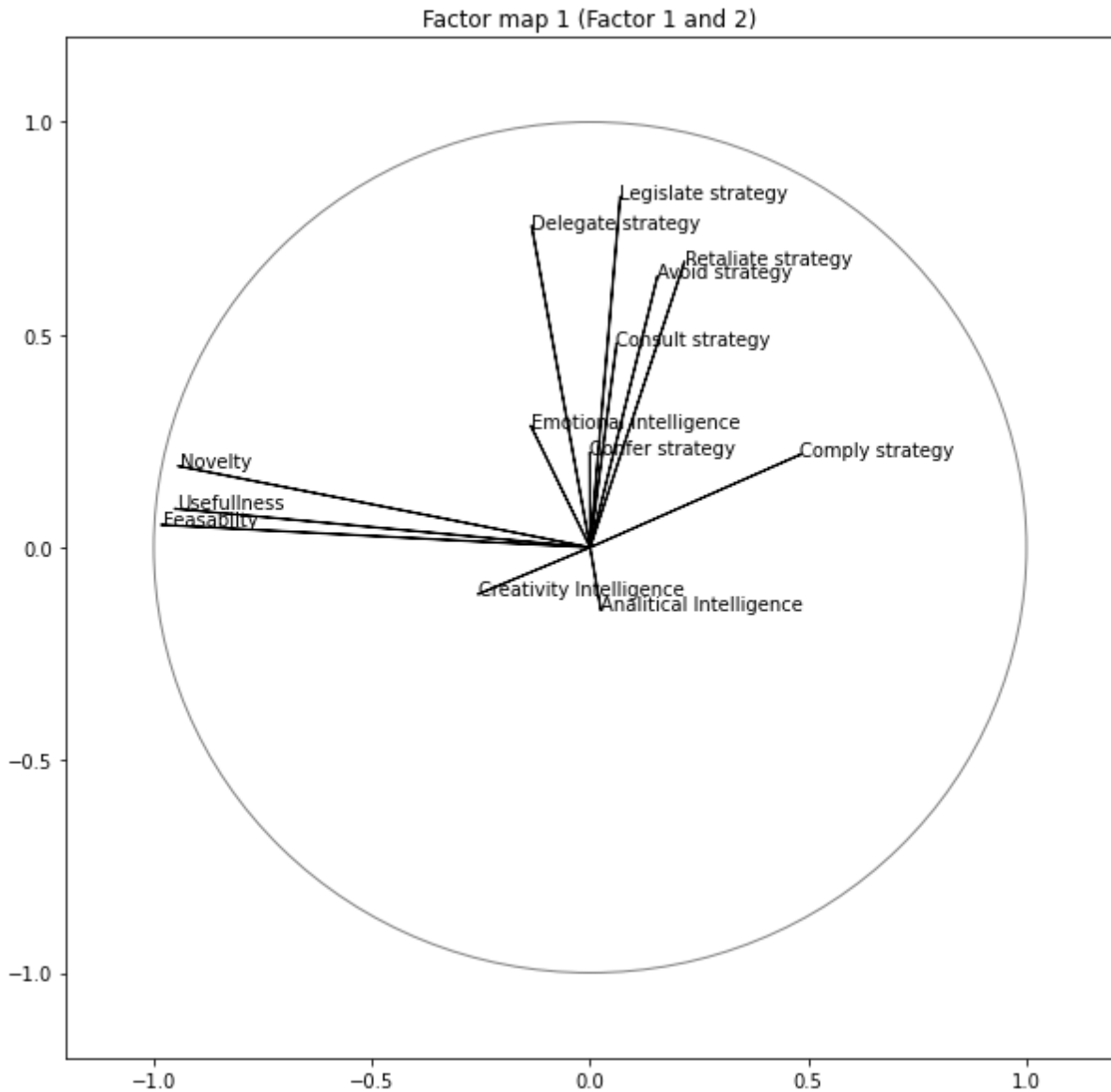


Figure 5: PCA factor analysis

Why use principal component analysis here? PCA is the statistical method adapted to explore the data set of our study composed of several variables (those related to cognitive performance and performance in proposing an innovative idea). PCA summarises this information (all our variables) into only a few new variables called principal components. These new variables correspond to a linear combination of the original variables. Our main goal in doing the PCA is to be able to determine whether the variables novelty, feasibility and utility will form one principal component. If this is the case, we can then use them to build the innovativeness variable in a general way. The analysis of the first factorial plan reveals that the best represented variables are Feasibility, Usefulness/Utility, Novelty, and other variable about the practical intelligence (Delegate Strategy, Legislate Strategy, Retaliate Strategy) However, the variables Feasibility, Usefulness, Novelty are the ones that characterize the first main axis and

in the same propensity. The variables novelty, feasibility and utility form the first principal component of our PCA. It can also be noted that apart from the variables characterising the innovation axis, no other variables are well represented in this plan. One could characterise this axis as the axis representing "innovation" by referring to the literature. We will use them to create our variable innovativeness by computing the average of these three variables. On the other hand, the second axis could be a little more similar to the axis representing the practical intelligence. Using the exploration of the data from this PCA, we can see the relevance of different forms of practical strategy to describe the same thing as practical intelligence.

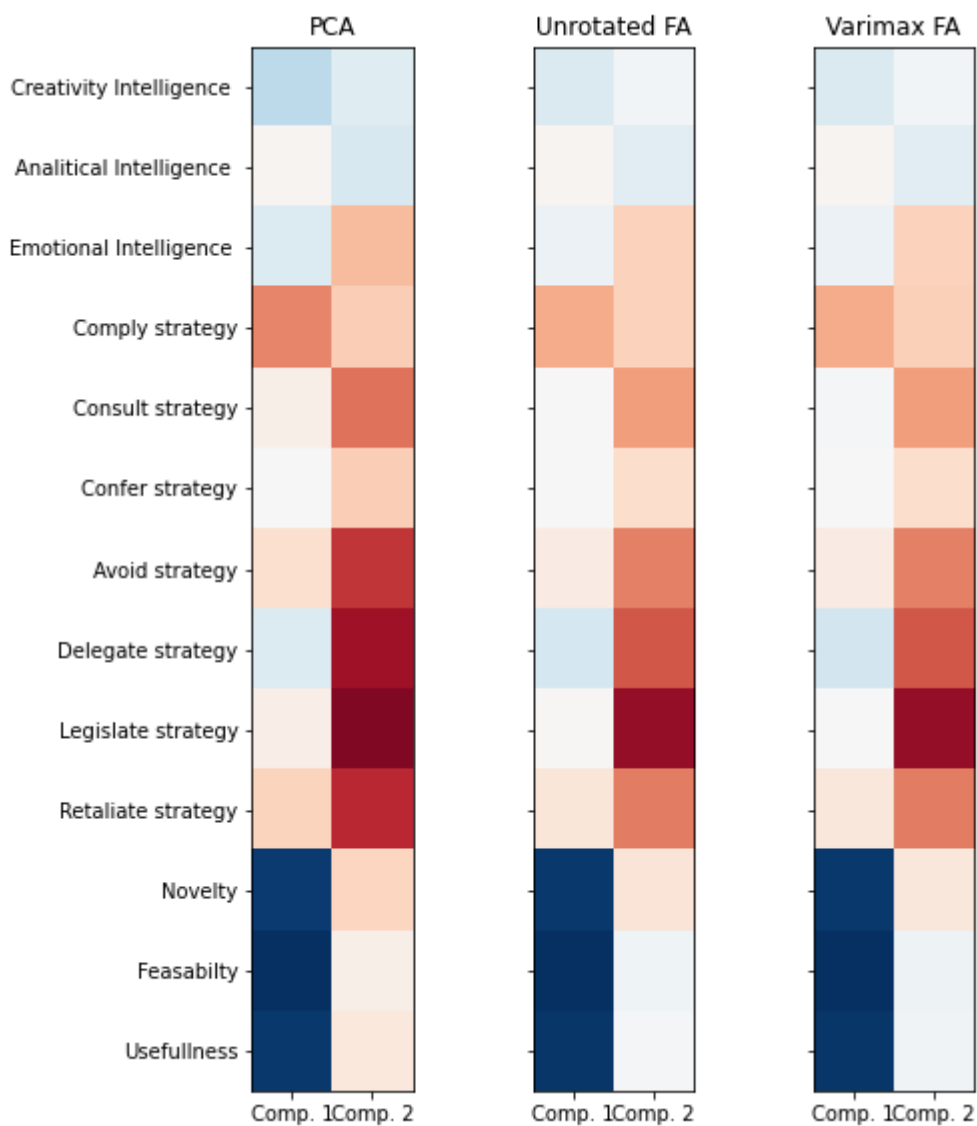


Figure 5: Variable contributions to axes in the PCA

We have been able to identify the contribution of the three variables to a single principal component. It is important to be able to identify the interdependence between this group of variables, to see how they relate to each other. For example, the psychologist John Carroll used factor analysis to develop his three-stratum theory (Carroll, 2005). A theory of cognitive ability based on a Factor analysis (which we use here) of the correlation of individual difference variables from data such as psychological tests, school grades and skill assessments from over 460 data sets.

The figure above presents the axis analysis highlighting the contribution of the variables to the main axes. It could be noticed that a quantitative analysis of the contribution of Feasibility, Usefulness, Novelty indicates that these three variables almost sensibly contribute in the same proportion to the axis of innovation with respectively the coordinates of -5.29, -5.51, -5.34. The other methods of factor analysis used (the Varimax and the Unrotated Factor method) reveal the same information. This justifies the use of the mean of these 3 variables to create the indicator measuring the innovativeness at the individual level.

Analysis of the cognitive factors explaining innovation

Between creative, emotional, analytical, or practical intelligence, what best explains the innovation potential of individuals? What is the interaction of the four with the innovation capacity? We therefore ran a multiple linear regression using as dependent variable (the innovativeness) and as independent variables creative intelligence (CRI), analytical intelligence (AI), emotional intelligence (EI) and the seven practical intelligence strategies (Complain, Consult, Confer, Avoid, Delegate, legitate, Reitate) .The regression model is as follows:

innovativeness ~ CRI+AI+EI+CP+CS+CF+AV+DE+LE+RE

Summary of the regression

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.790322	0.375434	2.105	0.0425 *
CRI	0.072291	0.194895	0.371	0.7129
AI	-0.177965	0.175692	-1.013	0.3180
EI	-0.185714	0.383153	-0.485	0.6309
CP	-0.373860	0.158282	-2.362	0.0239 *
CS	-0.007624	0.207232	-0.037	0.9709
CF	0.081956	0.188211	0.435	0.6659
AV	-0.008006	0.194427	-0.041	0.9674
DE	0.272056	0.186826	1.456	0.1542
LE	-0.020100	0.183213	-0.110	0.9133
RE	-0.132121	0.192709	-0.686	0.4975

Signif. codes:

0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.194 on 35 degrees of freedom
Multiple R-squared: 0.2125, Adjusted R-squared: -0.01247
F-statistic: 0.9446 on 10 and 35 DF, p-value: 0.5063

The above results show that the p-values are greater than 0.05, we accept the null hypothesis that there is no significant statistical correlation between the independent variables and the dependent variable. The R-squared is 0.25 and the adjusted R-squared is so low. This shows us that the model does not explain the data. Despite the statistical insignificance of the model overall, when we look at the coefficients associated with the variables in the results, we can see that only creativity and the practical intelligence scores (confer and delegate) contribute positively to the model. This statistical insignificance could be explained by the size of our sample (n=46) which cannot reflect the reality of a whole population. We will therefore continue our analysis by focusing on the results reflecting the reality of our sample without any pretensions of statistical inference.

Non-parametric statistical correlation

We perform a Spearman correlation test on our variables. This allows us to find a correlation coefficient, not between the values taken by the dependent variable and each of the independent variables, but between the ranks of these values.

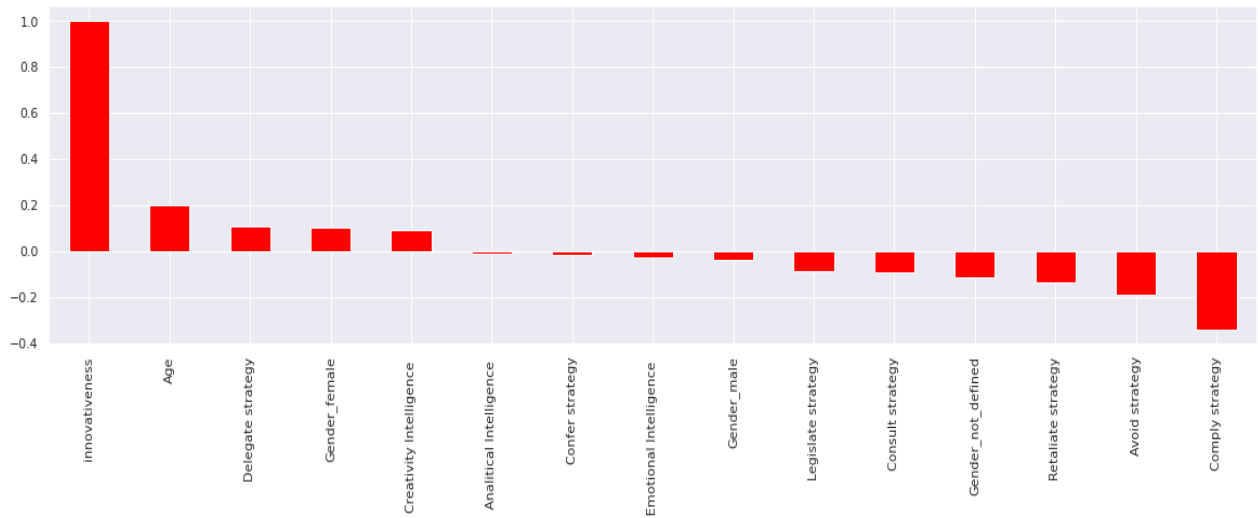
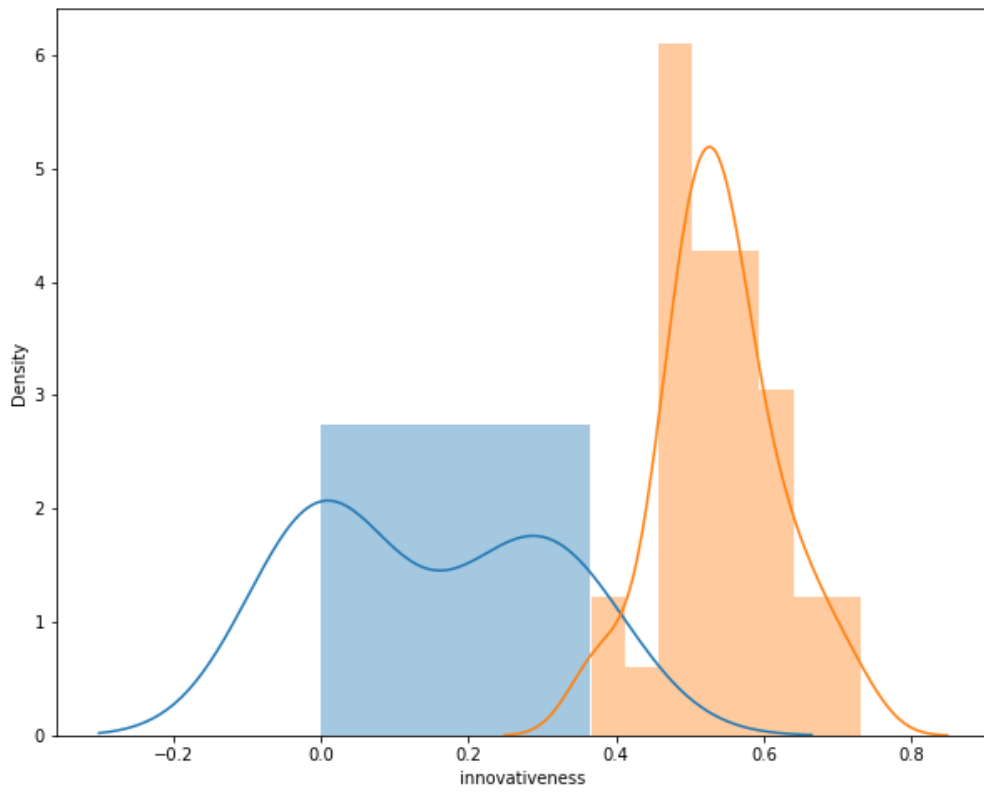
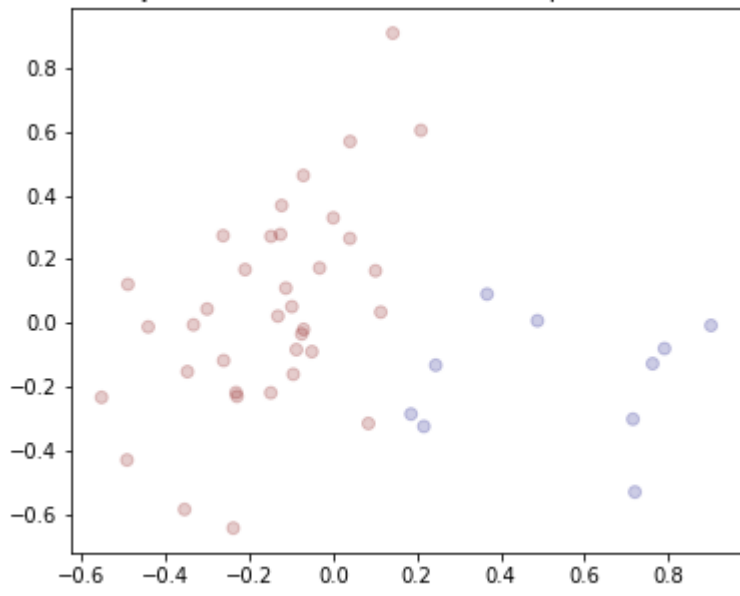


Figure 6 : Non parametric correlation analysis

Through the figure we can read that there is a positive magnitude interaction between people's innovativeness and creativity, practical intelligence (delegate style) and female gender. Practical intelligence styles such as comply and avoid have a negative relationship with innovation. Regarding analytical intelligence, we cannot observe a clear interaction between it and innovation considering this graph.

Clustering analysis

We use the k-means clustering method, an unsupervised machine learning technique to identify clusters of data objects in our dataset.



The application of clustering allowed us to identify the best cluster that best fit our sample and this was the formation of two clusters, one characterising individuals with good performance in terms of innovation capacity and the other characterising individuals with low innovation capacity.

ANOVA test on both clusters obtained

We are running an analysis of variance (ANOVA) to test for an overall difference between all the groups (from the previous clustering), i.e. test that one group is statistically different from the other.

Variables	F-statitics	P values
Analytical Intelligence	0.000564631950008005	0.9811499016858969
Emotional Intelligence	0.09768398009070053	0.7561033719263861
Comply strategy	5.11540603176448	0.028707223388745606
Consult strategy	0.10685388593763778	0.7453047798239896
Confer strategy	0.08795602198900532	0.7681873725129876
Avoid strategy	0.4806332744794001	0.4917792044083328
Delegate strategy	4.4905590778778315	0.03976273320351372
Legislate strategy	0.3226739612567943	0.5728926941941037
Retaliate strategy	0.1254709727594362	0.7248668611808522
Novelty	96.24642400943692	1.2012150515048626e-12
Feasibility	107.53168283413638	2.1544096121526594e-13
Utility	89.02672408377585	3.8878212710483e-12

Having obtained two clusters, it is important to be able to analyse the significance of the difference between the groups according to our different research variables. This allows us to prove the statistical significance of the differences between the group of high and low performers in innovation.

The realization of an ANOVA test then allowing to highlight the existence of a relation between the classes obtained following the clustering and the various variables of our study indicates us that only the variables "Comply strategy", "Delegate strategy" (both a practical intelligence style) , "Novelty", "Feasibility" and "Usefulness" present a significant relation at a threshold of 5% with the variable obtained following the clustering. This indicates that only these last ones have a discriminating power and really allow us to characterize our different classes obtained following the clustering.

Analysis of comply strategy after clustering

Clusters	N	Mean	SD	SE	95% Conf.	Interval
0	10	0.7238	0.1707	0.0540	0.6017	0.8459
1	36	0.5569	0.2147	0.0358	0.4842	0.6295

The analysis of the variable "Comply strategy" shows that individuals with low innovation capacity are generally characterised by a higher value in terms of comply strategy (a higher average) compared to individuals with high innovation capacity.

Analysis of delegate strategy after clustering

Clusters	N	Mean	SD	SE	95% Conf.	Interval
0	10	0.3238	0.1552	0.0491	0.2128	0.4348
1	36	0.4630	0.1903	0.0317	0.3986	0.5274

Regarding the variable "delegate strategy", we notice that the group of people with a high capacity for innovation is characterised by a higher average, which indicates that they are more

inclined to have a high value for this indicator compared to the individual with a low capacity for innovation.

Discussion

From the different cognitive and emotional abilities, we measured, we found that emotional intelligence is the highest ability in the population with an average of 0.77 out of 1. It should be kept in mind that this study was based on a sample of 97.83% Africans. A study of a sample of 2067 individuals in nine countries explored the influence of cultural dimensions on emotional intelligence. The results of this study show that collectivism, uncertainty avoidance and long-term orientation have a positive influence on different dimensions of emotional intelligence (Gunkel et al., 2014). Eaton & Louw (2000) reminds us of an important point made by researchers on African cultures, which are considered collectivist (H. C. Triandis, 1989). This may well explain the strong presence of high average emotional intelligence. The high analytical skills in our results can also be explained by the fact that the majority of our participants were students in the science and technology field at the university.

The results of our work allowed us to reveal the different forms of practical intelligence that dominate our study sample, namely consultative and conferring intelligence. The "delegate" style of practical intelligence was able to be indicative of the capacity for innovation, unlike the "comply" style, which has a negative interaction on the capacity for innovation of individuals. The analysis of the relationship between Analytical, Practical and Emotional Intelligence and line manager competences indicated that practical intelligence largely explains the level of competence used in managerial work (Baczyńska, 2015). This shows the importance of being able to understand the implications of this form of intelligence in improving performance within organisations.

The goal of our experiment is about understanding the causal relationship between group composition, group diversity and a group's capacity to innovate. A very important objective for the continuous change that organisations need. Organizations that are committed to systemic innovation require leaders who can design groups that promote creativity and effectively manage group process paradoxes and losses. Organization needs to attract, select, develop, and retain members with creative potential. Critical cultural assumptions include the belief that individuals are the source of good ideas and most productive when given autonomy in how work is accomplished. An important belief about group performance is that the best

solutions are found when diverse perspectives are considered and ideas debated (Matthew & Sternberg, 2006).

We have noticed that the different abilities tested are not on average all present in large proportions in the population. Analytical intelligence averages 0.63 while creativity averages 0.33 and the different styles of practical intelligence vary in different proportions within our population. This shows us once again that Sternberg's theory of success intelligence is a solid basis for the analysis of cognitive diversity and performance of individuals. This theory states that intelligence involves creative skills to generate new ideas, analytical skills to assess whether ideas are good, practical skills to put ideas into practice and convince others of the value of those ideas, and wisdom-based skills to confirm that one is using one's knowledge and skills to serve a common good (Sternberg, 2015). Successful intelligent people know what their strengths and weaknesses are, and then they build on their strengths and correct or compensate for their weaknesses (Sternberg, 2020). Our results allow us to first identify weaknesses that can be improved by individuals to make them more successful. This study focuses on the individual abilities of people by observing their interactions with performance on innovative problem-solving tasks. Such an approach allows us to identify at the individual level the characteristics that favour innovation and to infer on group behaviour. The study allowed us to first reveal a significant relationship of two practical intelligence styles with innovation. Firstly, the delegate style, which defines a person with the character and behaviour of implicitly or explicitly delegating responsibility for his or her action to someone else. He/she also disclaims responsibility for his/her action. The appropriate use of a person's potential with this form of practical intelligence lies in his or her ability to recognise his or her own lack of expertise in dealing with a situation. An inappropriate use of this potential is that the actor is able to cope with the situation himself. The form of practical intelligence that diminishes the capacity for innovation is comply. People with this type of dominant intelligence are people who do whatever is asked of them, regardless of who is asking, and take actions that can be interpreted as an active approval of others' behaviour in a situation. The appropriate benefits lie in the fact that they agree with what they are being asked to do. Short-term compliance has long-term benefits and such a person wants to benefit from the expertise of others. The disadvantage or inappropriate use of a potential practical intelligence tell is that people with this style fear the emotional consequences of non-compliance, short-term compliance has negative long-term consequences, such a person will be perceived as unable to solve their own problems (Stemler & Sternberg, 2006).

The analysis of one's own capabilities at the individual level is a first step towards analysing the implications at the group level. For group performance is above all an aggregation of individual performance. A framework for linking individual and organisational intelligence to innovation argues that organisational intelligence is a social outcome and is linked to individual intelligence through mechanisms of aggregation, transfer between levels and distribution (Glynn, 1996). Innovation is often assumed to be the work of a talented few, whose products are passed on to the masses (our societies and social networks) (Muthukrishna & Henrich, 2016).

Clustering allowed us to identify two groups, the first group of innovation performers characterised by the practical intelligence "delegate strategy" and the second group of less performing people characterised by the style "comply strategy". The above characterisation is the one resulting from the analysis of the relationships using parametric tests and which have statistical significance. Using non-parametric tests, we were able to identify a positive interaction between the innovation of individuals (indirectly describing the cluster of performers) and the creativeness of age and gender.

Creativity is the production of new and useful ideas in any field. Innovation is the successful implementation of a creative idea within an organisation (Amabile, T. M., 1996). The ability of women to innovate is increasingly demonstrated by studies on women's innovation. A study in Liberia on the availability of migrant labour and new techniques for growing rice in flooded terrain resulted in a marked increase in the cultivation of additional personal rice fields, particularly by women (Currens, 2008). Another study on the motivation of innovation capacity of smallholder farmers, both men and women, in Africa, Asia and Latin America shows that women have innovation potential (Badstue et al., 2018). These studies confirm the premise of the hypothesis we found in this study in relation to the propensity of the female gender to perform better in terms of innovative capacity.

The three parameters (utility, feasibility, novelty) proved to be variables that could well define the innovation of an idea. The utility and feasibility of ideas was the most dominant factor in people's ratings. This shows us that a good innovator must be able to provide useful and feasible ideas to persuade the perception of the crowd. Psychologists agree that being creative means generating relatively new, useful/adapted, high quality ideas or products that are accepted by society (Matthew & Sternberg, 2006).

Conclusion

Through this study we have extensively tested Sternberg's triarchic theory of intelligence. A theory that allows us to broaden the scope of analysis of human intelligence. The study allowed us to measure the cognitive and emotional abilities that drive an individual's ability to solve a complex societal problem with an innovative solution. Creativity and practical intelligence have proven to be important factors in fostering innovation. This allows us to have hypotheses to test the collective intelligence of innovation within groups.

Limitation

The first limitation of our study is related to the data collection which was totally online and which pushed us to do all the tasks on the individual aspect. The sample size of the data is small and does not allow for a generalization of the majority of the results to the population as a whole. Measuring analytical intelligence with a single activity may not be able to capture a person's analytical ability. It would be interesting to diversify and test several measures of analytical intelligence. To carry out the collection with a more structured technique and which would not allow to lose a great quantity of information due to the abandonment of the participants.

Appendix

Table A

N°	Questions/Tasks	Purpose/Types
Creativity assessment		
1	To the best of your ability, please write down all the original and creative uses for a brick. Certainly, there are common, unoriginal ways to use a brick; for this task, try to think of and then write down all of the unusual, creative, and uncommon uses of a brick. You'll have three minutes.	First question for the divergent thinking task

2	To the best of your ability, please write down all of the original and creative instances of things that are round. Certainly there are some obvious things that are round; for this task, try to think of and then write down all of the unusual, creative, and uncommon instances of things that are round. You'll have three minutes.	Second question for the divergent thinking task
3	Imagine that people no longer needed to sleep. What would happen as a consequence? Write down all of the original, creative consequences of people no longer needing to sleep. You'll have three minutes.	Third question for the divergent thinking task
4	What are the two most creative responses you provide for the previous task.	Idea filtering task to think about the most creative answer previously provide
Analytical Intelligence assessment		
5	Your estimation 1	Participants first Guess
6	Your estimation 2	Participants second Guess
7	Your estimation 3	Participants third Guess
8	Your estimation 4	Participants Fourth Guess
9	Your estimation 5	Participants Fifth Guess
10	Your estimation 6	Participants sixth Guess
11	Your estimation 7	Participants seventh Guess
Practical Intelligence Assessment		
12	Given the situation, please indicate in the box below what would be your primary concern in dealing with the situation.	

13	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly disagree; 4 = neutral; 7 = strongly agree. - By tomorrow morning, Mrs. Fatima should write back to Chabi saying how much she appreciated his note.	First Situational judgement tests, question 1
14	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly disagree; 4 = neutral; 7 = strongly agree. - Mrs. Fatima should speak to another teacher who knows Chabi and get his/her advice on how to respond	First Situational judgement tests, question 2
15	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly disagree; 4 = neutral; 7 = strongly agree. - Mrs. Fatima should take aside and thank him privately rights after she reads the note	First Situational judgement tests, question 3
16	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly disagree; 4 = neutral; 7 = strongly agree. - Mrs. Fatima should do nothing; just ignore the note	First Situational judgement tests, question 4
17	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly disagree; 4 = neutral; 7 = strongly agree. - Mrs. Fatima should ask the school psychologist to talk to Mike	First Situational judgement tests, question 5

18	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly disagree; 4 = neutral; 7 = strongly agree. - Mrs. Fatima should announce to the class that any letters that she gets from students will be kept private.	First Situational judgement tests, question 6
19	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly disagree; 4 = neutral; 7 = strongly agree. - In the presence of the whole class, Mrs. Fatima should tell Mike that writing love letters to the teacher is not appropriate behavior.	First Situational judgement tests, question 7
20	Given the situation, please indicate in the box below what would be your primary concern in dealing with the situation.	
21	Given the situation, please rate the quality of the following statements. It is important to note that 1 is for strongly Disagree, 4 for Neutral and 7 for Strongly Agree. - Mr. Jackson should try to put more effort into future projects.	Second Situational judgement tests, question 1
22	Given the situation, please rate the quality of the following statements. It is important to note that 1 is for strongly Disagree, 4 for Neutral and 7 for Strongly Agree. - Mr. Jackson should talk to a few trusted colleagues about how angry he feels and ask them for their advice	Second Situational judgement tests, question 2

23	Given the situation, please rate the quality of the following statements. It is important to note that 1 is for strongly Disagree, 4 for Neutral and 7 for Strongly Agree. - Mr. Jackson should talk to the department chair privately about his concerns.	Second Situational judgement tests, question 3
24	Given the situation, please rate the quality of the following statements. It is important to note that 1 is for strongly Disagree, 4 for Neutral and 7 for Strongly Agree. - Mr. Jackson should not make an issue out of it.	Second Situational judgement tests, question 4
25	Given the situation, please rate the quality of the following statements. It is important to note that 1 is for strongly Disagree, 4 for Neutral and 7 for Strongly Agree. - Mr. Jackson should ask a colleague to advocate for him.	Second Situational judgement tests, question 5
26	Given the situation, please rate the quality of the following statements. It is important to note that 1 is for strongly Disagree, 4 for Neutral and 7 for Strongly Agree. - Mr. Jackson should decide that from now on, he will simply ignore any future remarks on his portfolio, good or bad, from the department chair	Second Situational judgement tests, question 6
27	Given the situation, please rate the quality of the following statements. It is important to note that 1 is for strongly Disagree, 4 for Neutral and 7 for Strongly Agree. - Mr. Jackson should persuade his colleagues to oppose any other extra	Second Situational judgement tests, question 7
28	Given the situation, please indicate in the	

	box below what would be your primary concern in dealing with the situation.	
28	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly Disagree, 4 =Neutral and 7 = Strongly Agree. - Mr. Thompson should reiterate his opinion about the curriculum but state that he is willing to go along with the group	Third Situational judgement tests, question 1
30	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly Disagree, 4 =Neutral and 7 = Strongly Agree. - After the meeting, Mr. Thompson should ask one of the other teachers how he or she thinks he should deal with his colleagues comments	Third Situational judgement tests, question 2
31	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly Disagree, 4 =Neutral and 7 = Strongly Agree. - Mr. Thompson should talk privately with his colleague and say that he felt the personal attack was inappropriate and out of line	Third Situational judgement tests, question 3
32	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly Disagree, 4 =Neutral and 7 = Strongly Agree. - Mr. Thompson should ignore the attack and continue his discussion with another teacher.	Third Situational judgement tests, question 4

33	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly Disagree, 4 =Neutral and 7 = Strongly Agree. - Mr. Thompson should ask the principal speak to the colleague about his behavior	Third Situational judgement tests, question 5
34	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly Disagree, 4 =Neutral and 7 = Strongly Agree. - Mr. Thompson should propose the establishment of format rules of order for faculty meetings	Third Situational judgement tests, question 6
35	Given the situation, please rate the quality of the following statements. It is important to note that 1 = strongly Disagree, 4 =Neutral and 7 = Strongly Agree. - Mr. Thompson should state that he is not interested in responding to petty	Third Situational judgement tests, question 7
Emotional Intelligence Assessment		
36	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I know when to speak about my personal problems to others	Emotional Intelligence Assessment question 1
37	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - When I am faced with obstacles, I remember times I faced similar obstacles and overcame them	Emotional Intelligence Assessment question 2
38	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I expect that I will do well on most things I try	Emotional Intelligence Assessment question 3

39	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - Other people find it easy to confide in me	Emotional Intelligence Assessment question 4
40	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I find it hard to understand the non-verbal messages of other people	Emotional Intelligence Assessment question 5
41	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - Some of the major events of my life have led me to re-evaluate what is important and not important	Emotional Intelligence Assessment question 6
42	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - When my mood changes, I see new possibilities	Emotional Intelligence Assessment question 7
43	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - Emotions are one of the things that make my life worth living	Emotional Intelligence Assessment question 8
44	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I am aware of my emotions as I experience them	Emotional Intelligence Assessment question 9
45	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I expect good things to happen	Emotional Intelligence Assessment question 10
46	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I like to share my emotions with others	Emotional Intelligence Assessment question 11
47	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - When I experience a positive emotion, I know how	Emotional Intelligence Assessment question 12

	to make it last	
48	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I arrange events others enjoy	Emotional Intelligence Assessment question 13
49	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I seek out activities that make me happy	Emotional Intelligence Assessment question 14
50	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I am aware of the non-verbal messages I send to others	Emotional Intelligence Assessment question 15
51	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I present myself in a way that makes a good impression on others	Emotional Intelligence Assessment question 16
52	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - When I am in a positive mood, solving problems is easy for me	Emotional Intelligence Assessment question 17
53	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - By looking at their facial expressions, I recognize the emotions people are experiencing	Emotional Intelligence Assessment question 18
54	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I know why my emotions change	Emotional Intelligence Assessment question 19
55	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - When I am in a positive mood, I am able to come up with new ideas	Emotional Intelligence Assessment question 20

56	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I have control over my emotions	Emotional Intelligence Assessment question 21
57	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I easily recognize my emotions as I experience them	Emotional Intelligence Assessment question 22
58	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I motivate myself by imagining a good outcome to tasks I take on	Emotional Intelligence Assessment question 23
59	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I compliment others when they have done something well	Emotional Intelligence Assessment question 24
60	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I am aware of the non-verbal messages other people send	Emotional Intelligence Assessment question 25
61	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - When another person tells me about an important event in his or her life, I almost feel as though I have experienced this event myself	Emotional Intelligence Assessment question 26
62	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - When I feel a change in emotions, I tend to come up with new ideas	Emotional Intelligence Assessment question 27
63	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - When I am faced with a challenge, I give up because I believe I will fail	Emotional Intelligence Assessment question 28

64	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I know what other people are feeling just by looking at them	Emotional Intelligence Assessment question 29
65	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I help other people feel better when they are down	Emotional Intelligence Assessment question 30
66	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I use good moods to help myself keep trying in the face of obstacles	Emotional Intelligence Assessment question 31
67	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - I can tell how people are feeling by listening to the tone of their voice	Emotional Intelligence Assessment question 32
68	Use the scale (1= Strongly disagree to 5= agree) to describe yourself - It is difficult for me to understand why people feel the way they do	Emotional Intelligence Assessment question 33
Innovation Task		
69	Which of this global issue you care about and want to solve ?	Participants choose one world challenge they want to work on
70	Name of your innovative project	Provide a name to the project
71	Description of your innovation in 250 words maximum	Describe the solution they are providing to solve the challenge
72	Gender	Participant Gender
73	Age	Participant Age
74	Region	The continent of each participant
75	Profession	The profession of the participant

Five hundred minutes of collective intelligence for the development of agriculture in Africa

The aim of this activity was to build multidisciplinary teams in STARTUP mode in order to find and propose solutions to the challenges of agriculture in Africa. This activity called "500 Minutes of Collective Intelligence for Agriculture in Africa" brought together students from UM6P and other Moroccan universities for 500 intense minutes of collective reflection in order to come up with teams and innovative projects that could be incubated within the different entrepreneurship entities of UM6P. For the participants, this was an opportunity to experience an entrepreneurial immersion in "collective intelligence". This helped to sharpen their problem-solving skills as a team. Today, a new company is generally driven by a collective: "several brains are better than one". The growing complexity of our world brings people with very different expertise around the same table. More ideas, shared risks, more investment capacity investment capacity, wider network, etc. However, the number of people does not guarantee success. We must be careful that numbers do not become a counter-productive element. Collective intelligence provides participants with some elements to make the number of people a lever for success in entrepreneurship.

Based on the Nesta collective intelligence playbook (*Collective Intelligence Design Playbook (Beta)*, s. d.) we have designed the activity with this main step:

1. **Issues map:** An activity that aims to help participants clearly define the challenge. It allowed them to look at the problem from different angles and to define a broader context. This way they could capture, compare and discuss different points of view before focusing on a clear challenge on which to base the rest of the collective intelligence project.
2. **Solution brief:** Participants clearly articulated the requirements of the solution(s) to be designed.
3. **Finding solutions:** participants use a matrix to explore different methods of finding solutions, depending on the type of solution needed and the audience to be involved in developing the solution.
4. **Unique perspectives:** As it is easy to get stuck consulting the same small group of experts or professional representatives of certain groups. This activity pushes participants to look beyond the usual suspects and consider who might bring new views, ideas or perspectives. or fresh perspectives.

5. **Personas:** The participants therefore tried to develop the client/collaborator persona of the solutions they work on.
6. **Challenge call to action:** During this activity, the working groups prepared a pitch in the form of a call to action to convince other people to join them in the development of their entrepreneurial project with impact for agriculture.
7. **Technical prototyping:** With the solution ideas well defined, the participants worked on technical prototyping of the solutions they had thought of. This was to get a start on developing a solution.
8. **Collaboration agreement:** This exercise allows participants to develop a collaborative agreement. This helps to initiate strong partnerships between team members. It minimises the risks of working with new people. It allows for the establishment of trusting relationships and the development and piloting of the project-based, time-bound proposal. It helps to define rewards, risks and responsibilities and development stages for both parties involved.

The participants worked on the following challenges:

1. Increasing agricultural production in Africa
2. Professionalisation of agriculture in sub-Saharan Africa
3. Agro-industry development
4. Facilitating the adoption of and access to agricultural inputs
5. Deterioration of livestock transhumance systems
6. Introduction and dissemination of new technologies in agriculture in Africa
7. Irrigation and agricultural development in Africa
8. Intra-African food trade
9. Agriculture 4.0 for a technological leap in Africa
10. The food system and environmental footprint
11. Credit to agriculture
12. Improving farmers' self-sufficiency through the information and training service
13. Enhancing the value of crops, transforming them into products that can be consumed on the continent: the made in Africa.

This activity attracted 57 participants, of whom we were able to have 14 participate in our experiment. The organisation of this activity required the mobilisation of 80 T-shirts, 80 Badges, a Roll up, the use of the entrepreneurship campus (Start Gate) of the UM6P and a budget of 8200 DH.

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