ORLANDO LIMA RUA
(org.)

CREATIVITY AND BUSINESS INNOVATION

(VOLUME II)

CEOS.PP
CENTRE FOR ORGANISATIONAL AND SOCIAL STUDIES OF POLYTECHNIC OF PORTO

CREATIVITY AND BUSINESS INNOVATION

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Este trabalho é financiado por fundos nacionais através da FCT – Fundação para a Ciência e Tecnologia, I. P., no âmbito do projeto UIDB/05422/2020.

This work is financed by portuguese national funds through FCT – Fundação para a Ciência e Tecnologia, I. P., under the project UIDB/05422/2020.

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Título

CREATIVITY AND BUSINESS INNOVATION (Volume II)

Autor

CEOS Edições – Centro de Estudos Organizacionais e Sociais do Politécnico do Porto – ISCAP – Politécnico do Porto

Capa e paginação

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Revisão
Orlando Lima Rua

Edição: 2022

ISBN: 978-989-53631-3-1

URL: https://www.ceos.iscap.ipp.pt/ceoseditions/creativity-and-business-innovation-(volume-ii)

DOI: https://doi.org/10.56002/ceos.0073b

INDEX

PREFACE

The bachelor's degree in Creativity and Business Innovation is a joint study programme offered by the Polytechnic of Porto (P.PORTO), through the Porto School of Accounting and Administration (ISCAP), Vilnius Kolegija - University of Applied Sciences (VIKO), from Lithuania and the Estonian Entrepreneurship University of Applied Sciences (EUAS), from Estonia.

This is a pioneer degree in the context of Portuguese higher education, taught in English. Due to its innovative character, it responds to the new paradigms that higher education institutions (HEI) will have to face. With innovative syllabus, teaching/learning methodologies and assessment methods it develops new paths for higher education programmes.

To conclude this degree, students must develop and present a Final Thesis (Project). Thus, the present book compiles, in the form of chapters, some of the work presented by the students during the academic year of 2021/22. They have been organised in the form of volumes, being the second volume presented (Volume II).

The objectives of this book are (1) to allow students of this bachelor's degree to develop and consolidate knowledge in the various disciplinary areas of Management, (2) to support students in finalising their Final Thesis (Project), and, finally, (3) to promote the transfer of knowledge from Academia to Society.

The organizer and the authors of the chapters are grateful for the support of the entrepreneurship and innovation research line of the Center for Organisational and Social Studies of Polytechnic of Porto (CEOS.PP).

CHAPTER 1 – IMPACT OF 3D TECHNOLOGY ON MARKET INNOVATION

João Silva

Orlando Lima Rua

ABSTRACT

This study aims to analyse the most significant currently existing 3D technology, both in form of 3D printing and 3D scanning, and how it can be impactful on the innovation of markets.

A quantitative methodological approach was adopted using an online questionnaire. A survey of 47 organizations and individuals was obtained, and data analysis was performed using statistical techniques.

The results show that the majority of professionals in a wide range of markets already recognize the positive impact 3D technology can have on the various parts of their areas of activity, although they revealed only a surface level of knowledge about this technology, being heavily divided on whether they were aware of different types of 3D scanning and 3D printing technologies, and presenting very neutral results about how affordable or accessible they perceive it to be.

The main conclusions of this study are that 3D technology, as a tool that has been greatly evolving in the past years, has enormous potential to positively impact not only markets and organizations but also our everyday lives, allowing us to save resources and time to achieve the intended goals in comparison to the most traditional methods.

Keywords: Innovation, Market Innovation, 3D technology, 3D printing, 3D scanning.

INTRODUCTION

As markets become more and more competitive, organizations need to know how to innovate and adapt to the new environments and audience expectations, with the risk of becoming irrelevant in comparison to their competitors. One of the most innovative tools greatly developed in recent years is 3D technology, which can be used in a multitude of ways to achieve higher competitivity in a market, and potentially revolutionize it. To observe this phenomenon, research was done on articles about innovation, market innovation, and different forms of 3D technology.

As can be further analysed throughout this paper, innovation can be divided into 4 different types. According to Kylliäinen (2019), these types of innovation vary in terms of their impact on the market, and the newness of the technology, and consist of: incremental innovation, radical innovation, sustaining innovation, and disruptive innovation. Gregor and Hevner (2022) support this idea, by presenting their concept, putting the maturity of the application domain (problem space) against the maturity of knowledge (solution space), and describing each of the sectors in a similar way to Kylliäinen's, in which exploitation corresponds to incremental innovation; invention corresponds to radical innovation; exaptation corresponds to sustaining innovation, and advancement corresponds to disruptive innovation.

Having all these types of innovation, we can conclude that a market isn't something solid or stable, it's in constant change to fulfil the needs of the community (Kjellberg et al., 2012), and its development and innovation depend both on product and process innovation (Johne, 1999).

To achieve these forms of innovation on which market innovation depends, 3D technology – especially 3D scanning and 3D printing – has become a great tool, having many creative ways to be used.

3D scanning consists of a set of processes that creates a digital version of a physical object or space (Kumar et al., 2018; Goyanes et al., 2016), and, in this paper, five different types of scanners/methods most commonly used for different needs are addressed, these being: Laser triangulation-based 3D Scanners; Projected or Structured Light 3D Scanners; Medium and Long-Range 3D Scanners; Photogrammetry; and Contact Scanning (Kamani, 2020; Bhatti, Wahab & Sindi, 2021). 3D printing still doesn't appear to have one concise definition agreed on between experts, as the common simplistic definition can be commonly applied to consumer versions of rapid prototyping machines, rather than the great amplitude of methods (Berman, 2012). Just like 3D scanning, 3D printing can be done using different methods, out of which the 3 most commonly known and used are studied in this paper: Material extrusion; Polymerization; and Powder bed fusion.

LITERATURE REVIEW

INNOVATION CONCEPT

Overall, innovation is an umbrella term that serves to describe a wide range of concepts. It does not just engulf technological innovation, but also societal, economic, environmental, cost-driven, etc. making it so it can serve as a description for a sense of purpose in the development of humanity and can be seen as a multidimensional concept with different meanings and definitions, which depending on the perspective of the field it's being applied to, can coexist or collide with each other (Edwards-Schachter, 2018).

The United Nations separates institutional units, to which innovation can be applied, into 5 different sectors: non-financial corporations, financial corporations, general government, households, and non-profit institutions serving households (System of National Accounts, 2008, p. 65). However, the definitions used for this paper target mainly the corporate sector.

According to the Oslo Manual (OECD, 2018), innovation can be distinguished into innovation as an outcome (innovation), and the activities that originate it (innovation activities), defining innovation as "a new or improved product or process (or a combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)" and designating innovation activities as "all developmental, financial and commercial activities undertaken by a firm that is intended to result in an innovation for the firm." (p. 20).

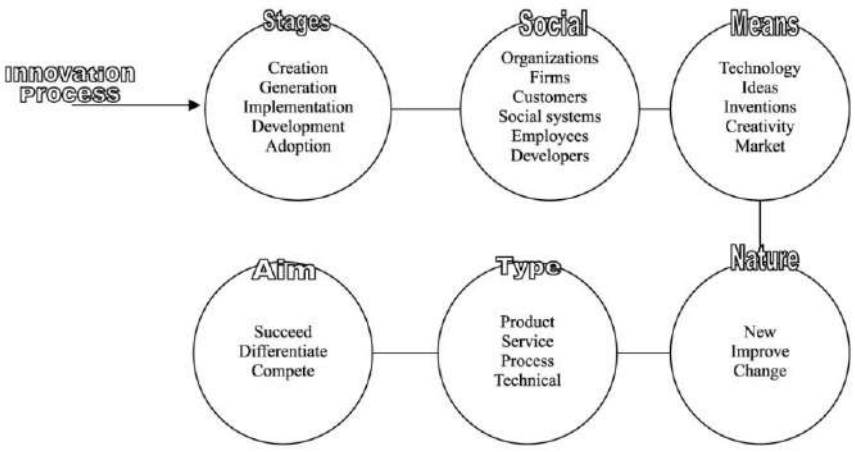

Figure 1 - Innovation process
Source: Baregheh et al. (2009).

In addition, a study that gathered and analysed 60 definitions of innovation and studied their keywords and attributes to find the most common terms and ideas applied to each, defined innovation as a multi-stage process in which organizations transform ideas into new or improved

products, services, or processes, to advance, compete, or differentiating themselves in their respective market (Baregheh et al., 2009). Along with this definition, they also proposed the following diagram so that this process could be better understood (Figure 1).

INNOVATION TYPES

Innovation can be much more complex than just a definition, as it doesn't always act the same way. In this particular case, we will be looking at the Innovation Matrix (Figure 2) putting technology newness against its impact on the market (Kylliäinen, 2019), which is a technology-oriented variation of other innovation matrixes, such as the KIM (knowledge innovation matrix) (Figure 3), which puts the maturity of the knowledge (solution) against the maturity of the application domain (problem/opportunity) (Gregor & Hevner, 2022).

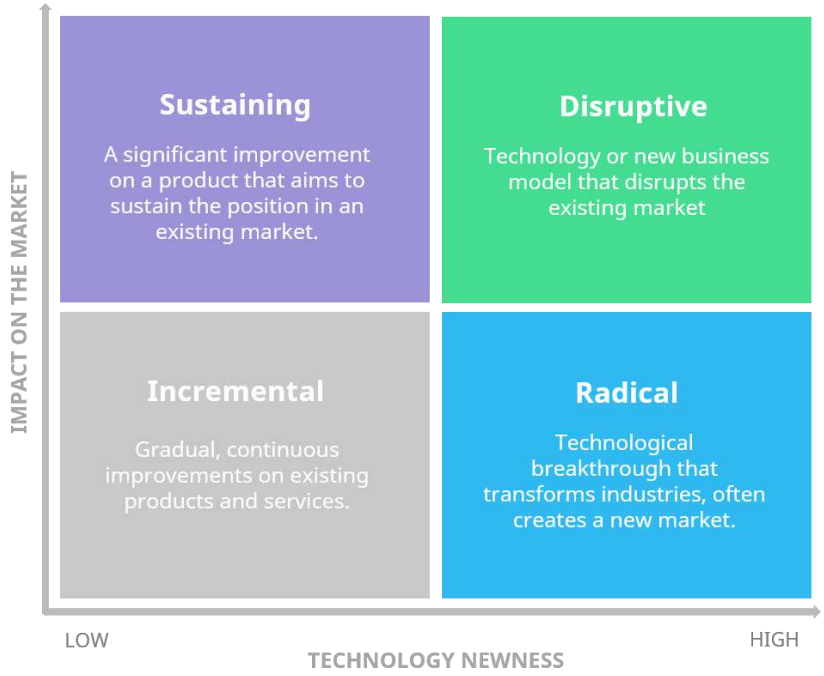

Figure 2 - Innovation matrix
Source: Kylliäinen (2019).

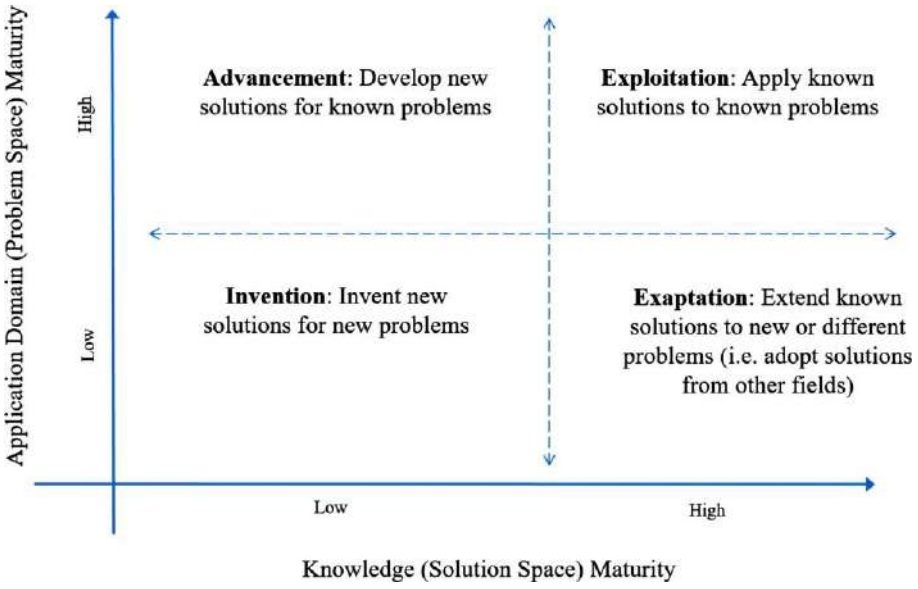

Figure 3 – Knowledge innovation matrix
Source: Gregor and Hevner (2022).

Incremental innovation

Kylliäinen (2019) says this form of innovation is often very minor and doesn't create any new markets. It consists of innovating on a smaller scale, continuously; this makes it so the product or service being provided maintains its core function and may attract higher paying customers due to how that improvement met their needs better than the predecessor. This scholar claims one of the great advantages of this type of innovation is that the improved product or service won't need to be explained, as people are already familiar with its functionality.

However, there are also a few risks to this, such as the possibility of not making much of an impact; overcomplicating by adding too many features could lead customers to choose a simpler alternative, so it should only be done if you intend on targeting a group with specific needs; and finally, this form of innovation isn't reliable long-term because the market is prone to change, and minor changes like this will make it so it can't keep up with customer needs (Kylliäinen, 2019).

This type of innovation corresponds to KIM's "Exploitation", as it consists of a non-significant form of innovation, allowing for observable growth to take place with only a minor change or customization (Gregor & Hevner, 2022). An example of this is the enterprise resource planning systems, which allow for the integration of system functionality with common business activities (financial management, the sales cycle, human resources, product design and development, etc.) to make business operations easier (Loshin, 2011).

Radical innovation

For Kylliäinen (2019), radical innovation can transform markets or even the entire economy, by solving problems and needs in unusual ways, sometimes even fulfilling needs we didn't know we had. To this scholar, this is a type of innovation that's been on the rise in recent years primarily due to such unforeseen technological advances; being such a revolutionary form of innovation, it faces the risk of resistance from the public, making it so it takes a lot more development and time to be able to be sent into the market.

The invention is the quadrant in the KIM that better applies to this form of innovation, as it consists of the recognition of a new solution to a problem/opportunity that hadn't yet been identified, which can lead to the creation of a new market (Gregor & Hevner, 2022). The most common example of this is the internet, which grew from a proposition for network packet switching (as opposed to circuit switching), as a connection wouldn't have to be established before sending packets (Xiao, 2008). The final result of this proposition wasn't resulting from a need to fulfil a gap in a market or to improve something already existing, but instead from a personal project of the inventor (Gregor & Hevner, 2022).

Sustaining innovation

The primary objective of this type of innovation is to grow and improve the markets it already exists in, by satisfying the customer's needs. Just as in incremental innovation, the changes to the product or service aren't too extreme to the point that it would change its entire purpose or functionality; however, they usually aren't as small as in incremental innovation, causing a bigger impact on the market and succeeding in meeting the most demanding customer's needs faster (Kylliäinen, 2019).

There's both a positive and a negative side to using this method in comparison to disruptive innovation, primarily when it comes to the organization's growth in the market. There's less risk and high profit in adopting this method, but it takes a longer time to achieve that optimum state, whereas disruptive innovation has a higher risk associated, but gains that same profit in less time (Kylliäinen, 2019).

For sustaining innovation, the quadrant in the KIM that better applies is Exaptation, as it consists of growing by solving a new problem/opportunity, using already known solutions, and making it so the impact is relevant, but not too extreme. A good example of this is e-books, as they take the already known concept of books, and improve on it by bringing it to a digital realm (Gregor & Hevner, 2022).

Disruptive innovation

According to Kylliäinen (2019), unlike all the others, this form of innovation aims to create a new value network by either entering or creating a new market. The author claims it's common for these innovations to appear less successful at the beginning, as it doesn't necessarily target a wider audience. Instead, the main target tends to be a more unique customer segment at this initial stage, as it commonly addresses a more peculiar problem, which many times that isn't very apparent and creates some room to integrate a wider audience in the long-term; this can cause very rapid growth at the start, positioning the organization in a perfect blue ocean, creating a lot of relevancy and profit, at a higher risk.

The main characteristic that tends to cause problems for this type of innovation is that, very often, the organization doesn't know how to adapt to new competition in the market they created, being too focused on developing and optimizing the formula that has proven to be so successful in the past, making them unwilling to change or adapt. Over time, this could lead to this first organization losing relevancy because, by the time they realize the new market has reached a wider audience, there will already be in place an alternative to their product or service that meets the customer's needs better, and they won't necessarily have the new capabilities and technology to compete (Kylliäinen, 2019).

The remaining quadrant, advancement, can serve as a representation of disruptive innovation in the sense that a new or better solution is created and developed for an already known problem/opportunity, which comes as a big risk due to the low knowledge of the solution, however, it opens the possibility to create a big advantage over the competition. A good example of this occurrence was the creation and development of tablet computers, which came as an advancement in comparison to the already existing large computers (Gregor & Hevner, 2022).

To protect an already existing organization from being disrupted, it's important to keep an eye on the new entrants to the market and analyse their behaviour. With this, it's possible to learn how to move on from the traditional formula and prepare for the future, take a risk and invest in new concepts that have the potential for growth (Kylliäinen, 2019).

MARKET INNOVATION

Concept

A market isn't something solid and stable, it's socially created to fulfil a need of the community, which makes it very malleable and subject to change by various factors. With this, it can be said that a market is something in constant development, "markets are not; they

become" (Kjellberg, Storbacka et al., 2012). Given the ever-evolving nature of markets, companies need to decide if they prefer to be a market driver or to be market-driven. For a company to be a market driver, it must have a clear and unique view of which market it wants to drive, meaning it will change the configuration of behaviour of different parts that influence that market. This course of action is also commonly called "market scripting". For a company to be market-driven, they typically only have to adapt to the course of the market over time, and don't make significant changes to the market itself (Storbackaa & Nenonen, 2015).

Additionally, according to Johne (1999), proper business development consists of the organic growth of a market through constant innovation, which is influenced primarily by two separate concepts: Product innovation and Process innovation (Figure 4).

Figure 4 - Types of innovation that impact business development
Source: Johne (1999).

Product innovation

According to Cooper (2000) these times of technological advances, and changes to customer and market needs, competition in globalization has become more and more fierce, leading to the need for companies to innovate their products. However, for this innovation to be done correctly, it has to be applied with strategy, or else the company risks dissipating its resources across several projects or markets that are less relevant to the end goal. For these problems to be avoided, he researched 160 different companies and pointed out three major cornerstones of high-performance businesses when it comes to new product results, these being "1- Having a new product process that works - a template or tactical road map to drive new product projects to market quickly and successfully; 2- Resources – having the right resources and sufficient resources devoted to product innovation; 3- Having a new product and technology strategy for the business.". Cooper (2000) notes that the third cornerstone is the one that's most often missing in businesses, leading to the achievement of merely mediocre results.

Dangelico (2015) however, presents us with a more environmental view on product innovation, focusing her vision on Green Products, which are "products that use less resources, have lower impacts and risks to the environment and prevent waste generation already at the conception stage", and were recognized by the Commission of the European Communities

(2001, p. 3) as the driver of a "new growth paradigm and a higher quality of life through wealth creation and competitiveness".

Process innovation

Just like for product innovation, the advances in technology have had a significant impact on organizations' processes and methods of operation. This is especially relevant when it comes to integrating IT into the core of these processes as its role is becoming more and more apparent for the effective growth and management of the company's operations, while accurately monitoring the advances made over time (Anand et al., 2013).

The idea is further supported by Walker (2013), stating that the new implementations in services and service delivery methods come as a response to external occurrences. He claims that process innovation is directly related to how services are rendered, considering both the organizational and technological aspects of businesses, along with their relationships with other businesses.

To Walker (2013, p. 23), "Process innovations affect management and organization. They change relationships amongst organizational members and affect rules, roles, procedures and structures, communication and exchange among organizational members and between such members and the environment".

MARKET-LEARNING CYCLE

As we've previously noted, markets are in constant evolution, sometimes with more spontaneity, other times in a more predictable manner, but each of those evolutions tends to be influenced by new rules in economic systems. Market learning requires that an organization first unlearns key aspects of their competences, and questions assumptions about itself and the environment it's inserted into (Morgan & Berthon, 2008; Storbackaa & Nenonen, 2015).

The market learning cycle presented (Figure 5), was created to show how a company can systematically use market-learning processes to facilitate market innovation. In its development, the cycle had many iterations, but this ended up being the final version, resulting from feedback given from conference attendees, as well as work on the illustration of the concept. The cycle is composed of three separate stages, the duration of which can vary according to the degree of change necessary, and depending on the industry or network it's applied to Storbackaa and Nenonen (2015).

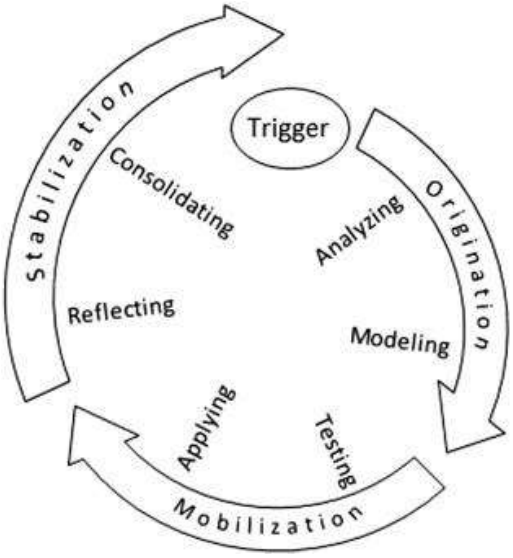

Figure 5 - Market-learning cycle
Source: Storbackaa and Nenonen (2015).

3D TECHNOLOGY

This section is dedicated in its entirety to the study of 3D technology in its current development, the understanding of its applications, and some examples of different fields in which it is being implemented, not only for entertainment but especially for societal progression. This form of technology, when applied with the goal of market innovation, can be considered either radical or disruptive innovation (Figure 2), depending on its application.

3D Scanning

3D scanning is a set of processes that consists of creating a digital version of a physical object or space. For this purpose, an image must be captured and stored as digital data, converting the surface image into coordinate points (Kumar et al., 2018).

This concept is also supported by Goyanes, et al. (2016), who claim that 3D printing is the process of generating data by capturing images and distance information of objects and transferring it to a computer.

Types and methodologies

3D scanning can be done in various ways, and each has its advantages and disadvantages. To understand these, it's better to first know what the five main methods as mentioned by Kamani (2020), and supported by Bhatti et al. (2021) consist of:

1- Laser triangulation-based 3D Scanners

These scanners use trigonometric triangulation to digitally map (collect all the coordinate points of the object) a 3D shape by pointing a laser at an object and capturing its reflection using the sensor placed at a fixed distance from the laser's source, allowing the calculations for the scanned object to be made from the angle of the light's reflection (Figure 6).

Some of its biggest benefits consist of the ability to scan irregular surfaces; it's not as sensitive to the environment; and it has a low-cost, simple design (Kamani, 2020; Bhatti, Wahab & Sindi, 2021).

According to Kolecka (2011), this type of 3D scanning enables dense surface or object sampling to provide a large amount of 3D point coordinates that describe the object.

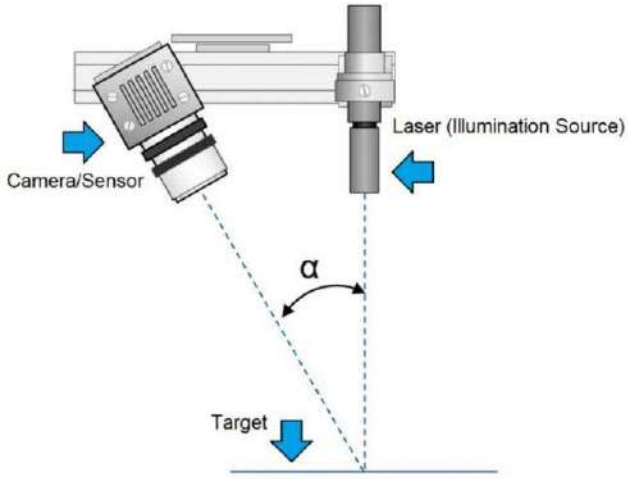

Figure 6 – Laser triangulation-based 3D scanning
Source: 3DscienceValley (2021).

2- Projected or Structured Light 3D Scanners

A projected light scanner uses LED lights (typically blue or white) to project a pattern/shape on an object, from which the sensor(s) present on the scanner will read the edges of the projected pattern/shape to digitally map the physical shape of the object (Figure 7) with the same trigonometric triangulation method as the laser triangulation-based scanners (Kamani, 2020).

A few of its great benefits are the speed at which the scan can be completed; the large area it can scan; high resolution; and high accuracy. Its price can vary greatly depending on the last 2 mentioned benefits (Kamani, 2020; Bhatti et al., 2021).

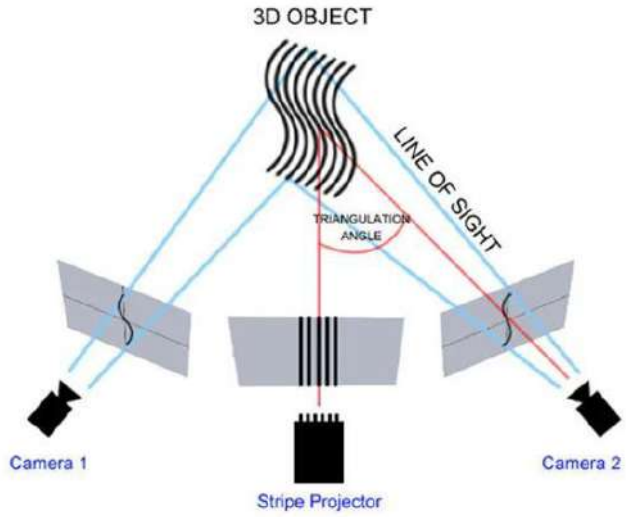

Figure 7 - Projected/Structured Light 3D scanner
Source: 3DscienceValley (2021).

3- Medium and Long-Range 3D Scanners

Longer range scanners are better suited to scan bigger objects, such as buildings or vehicles, and can be classified into two separate sub-types:

- Laser Pulse-based:

  Also known as time-of-flight scanners, these consist of measuring the distance between the scanner and the point by calculating the time light takes to travel from the scanner to the object and back to the scanner's sensor (Figure 8). By rotating the scanner around itself (usually using a mirror), it can be used to scan up to 360° around itself (Kamani, 2020; Bhatti et al., 2021).

- Laser Phase-shift:

  These are essentially the same as the pulse-based scanners, except that it modulates the intensity of the laser sent out, comparing the phases as it returns to the sensor for a more accurate image (Figure 9) (Kamani, 2020; Bhatti et al., 2021).

The primary difference between these two methods in terms of their results is that pulse-based scans are better with longer distances, being able to scan objects up to 1000m away; while phase-shift scans provide more accuracy but at a cost in distance, being only reliable for up to 300m away (Kamani, 2020).

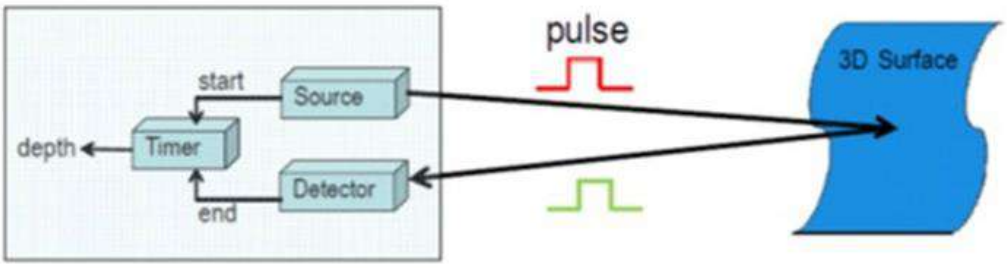

Figure 8 - Laser Pulse-based 3D scanner
Source: QMT Group (2019).

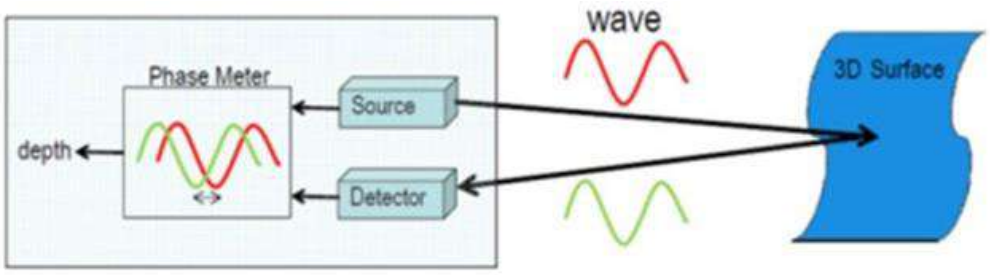

Figure 9 - Laser Phase-shift 3D scanner
Source: QMT Group (2019).

4- Photogrammetry

This type of technology works differently from the rest, as it consists of analysing already existing photographs of the object, and creating a 3D object based on the information present in those photos (lighting, shadows, etc.) as well as the conditions and settings of the camera itself (Figure 10). The great advantage of this method is that it can be done with any camera, being professional or just from a smartphone, as long as the correct settings are applied and put into the software to stitch the photos together, by finding common physical points between the pictures. However, as easy as this method is, the time consumption from the software may be high, and the results may not be as good as desired, based on the quality of the camera used for the pictures (Kamani, 2020; Bhatti et al., 2021).

This method allows for the geometric properties of objects to be determined and reconstructed either in 3D or 2D, by measuring and interpreting the images obtained (Kolecka, 2011).

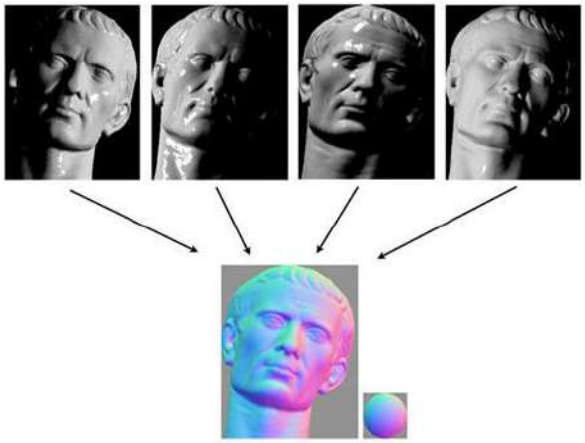

Figure 10 - Photogrammetry 3D scanning
Source: QMT Group (2019).

5- Contact Scanning

Unlike all other technologies, this does not require a visual interpretation of the object being scanned. Instead, the object must be physically scanned via direct contact from the scanner, as it is moved all around the object to collect its details (Figure 11). To get an accurate result, the scanner must have contact with multiple sections of the object, from different angles. The great advantage of this method is that it allows for the scan of transparent or reflective objects, however, it takes too much time to be more reliable than the other methods for any other application (Kamani, 2020; Bhatti et al., 2021).

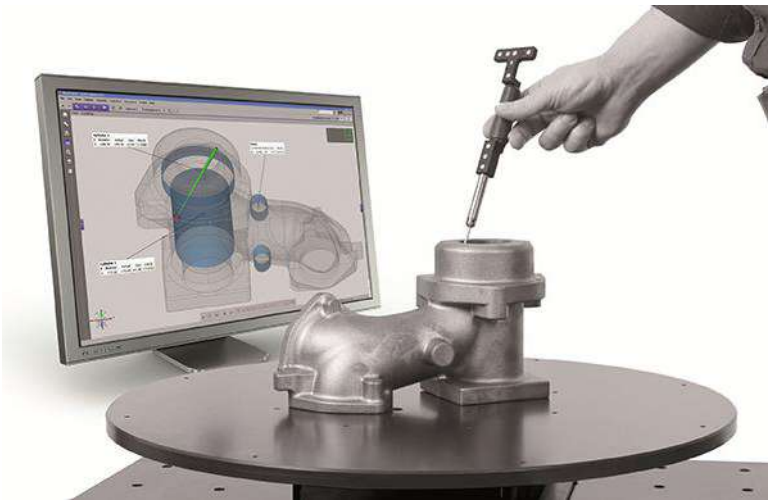

Figure 11 - Contact scanning

Source: Capture 3D (2015).

Examples

Alton Lane – 3D scanning for clothing

Alton Lane is one of the pioneers in the use of 3D scanning to manufacture clothes, more specifically formal suits. Their model consists of having the client strip down to their underwear and get inside of a human-sized scanner, in which the measurements of their body will be taken, the resulting data treated internally, and then sent to the factory, in which the suit will be manufactured according to the scanned measurements, creating a perfect fit for each client, and significantly reducing the time they have to spend in the shop taking measurements manually.

3D scanning for motion capture / virtual reality

There are many uses for 3D scanning in virtual reality/motion capture. In the realm of entertainment alone, it can be used to capture the body and facial movements of actors to create digitally realistic characters in movies and video games, as well as for the capture of movement for VR games.

A more indicated approach for societal development could be the application of VR technology already available in videogames to allow physically disabled or hospitalized people to explore virtual spaces or areas of the world otherwise out of reach for them. Such effort could work by first scanning the area or virtually recreating it, and capturing the individual's motion using scanners, thus enabling them to experience said location and amplifying their social integration.

3D Printing

According to Berman (2012)'s findings, there still isn't an exact definition of 3D printing, as some experts claim it's a process by which a 3D object is printed layer by layer using units with inkjet-based print heads, while others argue that this could be applied also to an office or consumer versions of rapid prototyping machines. However, Berman (2012) attempts to clarify this concept as "3-D printing employs an additive manufacturing process whereby products are built on a layer-by-layer basis, through a series of cross-sectional slices".

3D printing can also be understood as a process in which a 3D model or other electronic data source serves as a base to create a 3D object of any shape, in an additive process in which layers of material are laid upon each other, according to computer instructions, also referred to as computer-aided design (Gokhare et al., 2017; Awad et al., 2021).

Types and methodologies

Also commonly called additive manufacturing, this technology has evolved greatly in recent years, making it so it became necessary to standardize terminologies and classify methods for this technology. As a result, in 2015 the ISO/ASTM 52900 standard was created, distinguishing 7 different methods of additive manufacturing, which have since inspired the evolution of 3D printing technology, out of which 3 are significantly more commonly used than the others (All3DP, 2021), and these are as follows:

1- Material extrusion

Material extrusion consists of, as the name indicates, extruding material to build the desired object. To reach this goal, most commonly, a plastic filament is pushed through a heated nozzle, where it's melted so it can bind to the previous layers, allowing it to create a solid structure not only on the X and Y axes but also on the Z axis. This melted material is deposited layer by layer, following a predetermined path (Figure 12). Although the most common material used for this is plastic due to its long-term resistance and ease of use, it is possible to print a wide selection of materials, ranging from metals to chocolate. For its versatility in materials, affordability, and availability, this has become the most used method currently (All3DP, 2021).

This type of 3D printing has the advantage of being easily accessible and cheap in terms of raw materials. The typical configuration (figure for this type of printing consists of a polymer in the form of filament extruded through a heated nozzle (Huang, Chen, Jiang, Zou, Li, Liu & Yu, 2020)

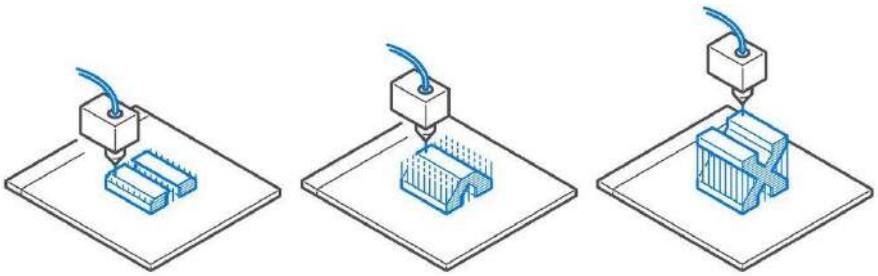

Figure 12 - Material Extrusion 3D printing
Source: All3DP (2021).

2- Polymerization

To create an object using polymerization, a light source has to selectively cure a photopolymer resin located in the base of the printer, solidifying and lifting it to create each new layer (Figure 13). The result of this process tends to present great levels of detailing and a smoother surface than other methods. As simple as this method may appear, some

variables impact the speed and quality of the print, both in terms of smoothness and detail. While some methods focus on curing the resin by crossing two separate lasers on a specific spot, others cure an entire layer at a time by flashing the desired image of each specific layer, making it a lot less time-consuming and requiring fewer calculations (All3DP, 2021). Although the application of this process to additive manufacturing has been prevented due to slow polymerization rates, this is still a valuable tool for synthesizing macromolecules with controlled topologies and diverse chemical functionalities (Zhang et al., 2019)

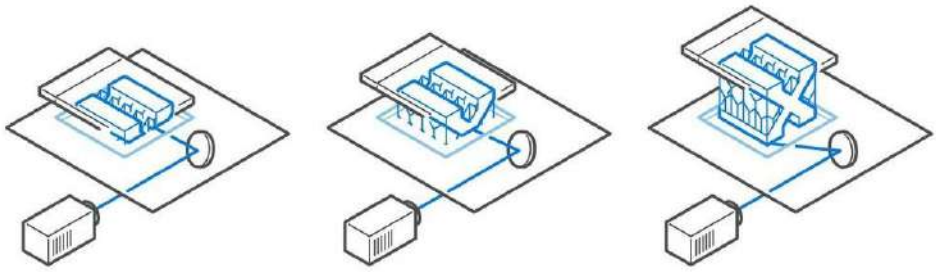

Figure 13 - Polymerization 3D printing
Source: All3DP (2021).

3- Powder bed fusion

Similar to the polymerization method, powder bed fusion requires the material to already be present in the bed of the printer to be treated into forming an object. However, rather than curing the material to solidify into a shape, thermal energy selectively fuses the powder particles, which can be metals, plastics, or ceramics (Figure 14). For this to take place, a blade or wiper gradually spreads powder layer by layer into the print area to be fused, and the object is supported by the excess material being deposited but not fused. The great advantage of this method is that it allows for the production of strong, functional parts, as well as complex shapes, and eliminates the need for the use of extra material as support (All3DP, 2021).

This method of 3D printing selectively consolidates powders into 3D objects and can be done by multi-jet fusion, direct metal laser sintering, selective laser sintering/melting, and electron beam melting. The high speed and resolution of the final print allow for the fabrication of complex objects, such as medical devices and implants (Awad et al., 2021).

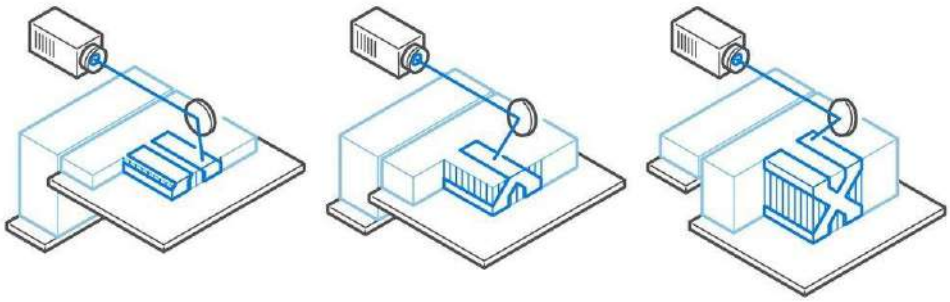

Figure 14 - Powder bed fusion 3D printing
Source: All3DP (2021).

Examples

New Story – 3D printing in construction

New story Is a non-profit organization to end homelessness, starting by building enough homes for 1 million people by 2030. For this, they're innovating by bringing 3D technology into one of the least digitized sectors in the world: construction. By using this technology, they can fully build a house with only 100.000$, generating zero waste in contrast to traditional construction, taking a lot less time to finish, and providing good thermal insulation and structural resistance. These houses are built by extruding a concrete mixture called Lavacrete in layers.

Organovo – 3D printing in medicine

Organovo is a medical laboratory and research company focused on designing and developing 3D bioprinted tissues that mimic key aspects of human biology and disease, using this technology for its innovative therapeutic applications and drug profiling capabilities.

This form of 3D printing is more peculiar than the most common practices, as it works with living tissue. To 3D print, this type of material, a study of the native tissue must first be made to identify the key architecture and composition of the target, followed by the creation of a design that can be used by a bioprinter in a laboratory environment. Then the cells must be accurately spatially dispositioned, which allows for the creation of patterns and compartments that mimic specific natural tissues. 3D bioprints show a cellular density and organization similar to the native tissue, which allows for the proper expression and localization of the cell's key functions. The ability to use a patient's diseased cells in conjunction with this technology also increases the potential to find drugs to block the progression of that disease at a cellular level (Organovo, 2020).

METHODOLOGY

METHODOLOGICAL APPROACH

As indicated in the Oslo Manual (OECD, 2018), the target of the research has to be chosen beforehand; it can be either an occurrence or the subjects responsible for it, although it's possible to mix both of them; for example, it's possible to create two separate questionnaires, one with more generic open questions focused on the subjects themselves, their opinions, and perspectives about the topic, and another more detailed focused on gathering data about the topic itself (closed questions), as well as a single questionnaire with both types of questions. It could be said that targeting an occurrence is more correlated with quantitative research methods, and targeting the subject is more correlated with qualitative research methods.

For this paper, I chose to target the occurrence (3D technology's relation to market innovation), rather than the subjects themselves, henceforth deciding to use a quantitative research method.

The quantitative research method consists of obtaining directly measurable data, as opposed to qualitative methods which gather recorded data. However, it is possible to apply quantitative methods to recorded data, for example, by counting the number of times specific words are mentioned. Although qualitative methods provide richer individual research results, they do not allow for a generalized view of the analysis (Bacon-Shone, 2021).

Quantitative research focuses on objectivity and can be used especially when there is a possibility to measure variables and occurrences in the population, for which the sample should be large and representative of it; the data is then collected objectively and systematically and analysed through statistical procedures (Queirós et al., 2017).

MEASURES

The elaboration of the research, under the concept of quantitative research methods, required the identification of variables and subdividing these into their dimensions. Table 1 represents the variables, their dimensions, and the authors they were inspired by for the construction of the questionnaire, composed of simple and precise measures, such as "yes/no" questions and scales of 1 to 5.

Table 1 - Variables and sources used on the questionnaire

Variables	Dimensions	Authors
3D Technology	Technology	Xiao (2008); Cooper (2000)
	3D scanning	Kumar, Shuaib, Tanveer, Kumar, Javaid & Haleem (2018); Goyanes, Det-Amornrat, Wanga, Basit, Gaisford (2016)

	3D printing	Goyanes, Det-Amornrat, Wanga, Basit, Gaisford (2016); Huang, Chen, Jiang, Zou, Li, Liu & Yu (2020)
	Accessibility, affordability, and limitations	Kamani (2020); Bhatti, Wahab & Sindi (2021)
Market Innovation	Type of market	United Nations (2008); Kjellberg, et al. (2012)
	Innovation	Edwards-Schachter (2018); Oslo Manual (2018); Baregheh, Rowley, & Sambrook (2009)
	Culture and community	Dangelico (2015); Walker (2013)
	Process	Loshin (2010); Anand, Wamba, Gnanzou (2013); Walker (2013)
Organization	Strategy	Cooper (2000); Anand, Wamba, Gnanzou (2013); Morgan, Berthon (2008)
	Product development	Kumar, Shuaib, Tanveer, Kumar, Javaid & Haleem (2018); Dangelico, (2015)

Source: Own elaboration.

SAMPLE

As stated in the questionnaire, all answers are anonymous, so no single person or organization will be mentioned. We have received 47 responses from medical researchers, construction companies, technology R&D companies, manufacturers, museums, archaeologists, mechanics, engineers, and research institutions.

QUESTIONNAIRE STRUCTURE

As can be observed in Appendix, the questionnaire was composed of a total of 33 questions, the first one strictly for the consent and anonymity of the participants, and the last 4 for some of their characteristics, the other 28 questions directed to the topic itself, regarding the variables listed in Table 1.

The questionnaire was done using the Google Forms online platform, which is a public tool provided by google for the creation of surveys/tests and allows those to be shared and monitored in real-time, providing graphs of both the global and individual results. This survey was available from May 31st, 2022, until June 26th, 2022.

RESULTS

PARTICIPANTS' CHARACTERISTICS

This section consists of participants' data collecting to understand their gender and age, as well as their level of studies and years of experience in their field (Table 2).

Table 2 - Participant's characteristics results

Question	Option	Number	Percentage
Gender	Male	24	51,1%
	Female	23	48,9%

	Other	0	0
Age	18-25	5	10,6%
	26-40	22	46,8%
	41-60	20	42,6%
	61+	0	0
Years of experience in your field	0-2	7	14,9%
	3-5	8	17%
	5-10	6	12,8%
	10+	26	55,3%
Level of studies	High school	8	17%
	Bachelor's degree	12	25,5%
	Masters degree	23	48,9%
	Doctorate degree	4	8,5%

Source: Own elaboration.

As seen in Table 2, the majority of participants of this survey were individuals with great experience in their fields of work and high education, presenting a balance in gender distribution and an inclination towards young and middle-aged adults. With these results, it's possible to observe that the participants were highly qualified to participate in the survey, being that they can have more unique individual views on the topic being studied than a more inexperienced audience.

RESEARCH QUESTIONS RESULTS

This section consists of 28 questions oriented toward researching the topic of this paper, and are constructed based on the variables presented in Table 1.

Table 3 indicates that the great majority of organizations the participants work in have the goal of innovating the market they're positioned in, thus increasing the chance of having some knowledge about this type of technology.

Table 3 - Question 1 results

Question	Option	Number	Percentage
1- Does your organization work with the goal of innovating the market it's in?	Yes	38	80,9%
	No	9	19,1%

Source: Own elaboration.

Table 4 indicates that all participants – more or less – recognize technology can have a high impact on innovation, making it so their willingness to do further research for Question 1 is higher.

Table 4 - Question 2 results

Question	Option	Number	Percentage	Scale
2 - How much of an impact do you believe technology can have on innovation?	1	0	0%	Low impact – High impact
	2	0	0%	
	3	0	0%	
	4	15	31,9%	
	5	32	68,1%	

Source: Own elaboration.

In Table 5, the participants appear to be divided, leaning more towards an advanced area of business, which indicates the majority believe their areas of business still have room for improvement.

Table 5 - Question 3 results

Question	Option	Number	Percentage	Scale
3 - How technologically advanced do you believe your area of business is?	1	0	0%	Not advanced – Very advanced
	2	1	2,1%	
	3	22	46,8%	
	4	16	34%	
	5	8	17%	

Source: Own elaboration.

Table 6 presents us with very divided results, as most participants appear neutral about the accessibility of 3D technology, however, there are participants at both ends of the given spectrum, indicating they may have previously researched this type of technology to draw such drastic conclusions.

Table 6 - Question 4 results

Question	Option	Number	Percentage	Scale
4 - How accessible do you believe 3D technology is?	1	2	4,3%	Not accessible – Very accessible
	2	5	10,6%	
	3	19	40,4%	
	4	17	36,2%	
	5	4	8,5%	

Source: Own elaboration.

Table 7 reinforces the data presented in Table 6, presenting a neutral majority, but also a higher inclination toward this technology not being affordable, indicating they may have already considered the use of – and researched about – 3D technology.

Table 7 - Question 5 results

Question	Option	Number	Percentage	Scale
5 - How affordable do you believe the implementation of 3D technology is?	1	2	4,3%	Not affordable – Very affordable
	2	10	21,3%	
	3	17	36,2%	
	4	15	31,9%	
	5	3	6,4%	

Source: Own elaboration.

Although Table 8 presents few results for low limitations, this indicates most participants believe the implementation of this type of technology is still quite limited to be feasible.

Table 8 - Question 6 results

Question	Option	Number	Percentage	Scale
6 - How would you rate the limitations of implementing 3D technology in your area of business?	1	2	4,3%	Low limitations – High limitations
	2	6	12,8%	
	3	23	48,9%	
	4	10	21,3%	
	5	6	12,8%	

Source: Own elaboration.

As opposed to the hesitant results towards this type of technology in the previous 3 tables, Table 9 indicates that the great majority of participants recognize the benefits of this type of technology for their organization's long-term growth.

Table 9 - Question 7 results

Question	Option	Number	Percentage
7 - Do you believe using 3D technology can be profitable for your organization in the long-term?	Yes	43	91,5
	No	4	8,5

Source: Own elaboration.

The results presented in Table 10 indicate that the majority of participants involved in this study believe that their organization's processes are only moderately to slightly optimized, leaving some room for improvement.

Table 10 - Question 8 results

Question	Option	Number	Percentage	Scale
8 - How optimized do you believe your organization's processes are?	1	0	0%	Not optimized – Very optimized
	2	7	14,9%	
	3	24	51,1%	
	4	15	31,9%	
	5	1	2,1%	

Source: Own elaboration.

Table 11 indicates that, as seen in Table 9, the participants recognize great benefits to the organization by implementing 3D technology, especially when it comes to optimizing their processes.

Table 11 - Question 9 results

Question	Option	Number	Percentage	Scale
9 - How beneficial do you believe 3D technology can be for the optimization of your organization's processes?	1	0	0%	Not beneficial – Very beneficial
	2	2	6,4%	
	3	17	36,2%	
	4	13	27,7%	
	5	14	29,8%	

Source: Own elaboration.

As seen in Table 12, most participants believe the implementation of 3D technology in their processes would be well received by their target audience, however, there is still some observable hesitation.

Table 12 - Question 10 results

Question	Option	Number	Percentage	Scale
10 - How do you think your organization's target audience would adapt to the implementation of 3D technology in your processes?	1	1	2,1%	Poor adaptation – Excellent adaptation
	2	5	10,6%	
	3	10	21,3%	
	4	23	48,9%	
	5	8	17%	

Source: Own elaboration.

Table 13 shows that, just like in Table 9, the participants believe the implementation of 3D technology can be very beneficial for the market their organization is part of.

Table 13 - Question 11 results

Question	Option	Number	Percentage
11 - Do you believe 3D technology would be beneficial to innovating the market your organization is part of?	Yes	43	91,5
	No	4	8,5

Source: Own elaboration.

The participants appear to be more divided in Table 14, indicating that the majority see the community's culture and beliefs about product quality as an inhibitor to the implementation of 3D technology, however, a great number of participants also believe the opposite to be true, which indicates great diversity between markets.

Table 14 - Question 12 results

Question	Option	Number	Percentage
12 - Do you believe the community's culture and inherent beliefs about product quality inhibit your ability to implement 3D technology in your organization?	Yes	29	61,7%
	No	18	38,3%

Source: Own elaboration.

To appease the concerns shown in Table 14, Table 15 indicates most participants see a need to educate the community for the implementation of this technology to be feasible.

Table 15 - Question 13 results

Question	Option	Number	Percentage
13 - Do you believe the community would have to be educated about this type of technology for its implementation to be feasible?	Yes	41	87,2%
	No	6	12,8%

Source: Own elaboration.

Table 16 shows that the participants are unsure whether this type of technology would change their target demographics, which may indicate a great rift between different types of markets.

Table 16 - Question 14 results

Question	Option	Number	Percentage
14 - Do you believe 3D technology would change your organization's target demographics?	Yes	27	57,4%
	No	20	42,6%

Source: Own elaboration.

The question presented in Table 17 indicates that, regardless of the market, 3D technology is seen as a useful tool for product development.

Table 17 - Question 15 results

Question	Option	Number	Percentage
15 - Do you believe 3D technology can be a useful tool for product development?	Yes	47	100%
	No	0	0%

Source: Own elaboration.

According to Table 18, the great majority of participants envision their products/services being improved by this technology, meaning that it is recognized as a good tool for progress.

Table 18 - Question 16 results

Question	Option	Number	Percentage
16 - Do you envision your products/services being improved by the implementation of 3D technology?	Yes	38	80,9%
	No	9	19,1%

Source: Own elaboration.

Being that, in Table 19, the great majority of participants answered between 3 (neutral) and 5 (high), it is believed that, for most industries, 3D technology can have a great impact on an organization’s supply capacity.

Table 19 - Question 17 results

Question	Option	Number	Percentage	Scale
17 - How much impact do you believe 3D technology can have on your supply capacity?	1	0	0%	Low – High
	2	5	10,6%	
	3	18	38,3%	
	4	17	36,2%	
	5	7	14,9%	

Source: Own elaboration.

According to the results in Table 20, the great majority of participants see a positive correlation between 3D technology and the evolution of their business strategy.

Table 20 - Question 18 results

Question	Option	Number	Percentage
18- Do you believe 3D technology can positively impact your business strategy?	Yes	37	78,7%
	No	10	21,3%

Source: Own elaboration.

Table 21 indicates that, although the participants may know what 3D scanning consists of, they are not aware of the different types of 3D scanning that can be used, which may have influenced their views in Tables 6 and 7.

Table 21 - Question 19 results

Question	Option	Number	Percentage
19 - Do you have knowledge about different types of 3D scanning?	Yes	25	53,2%
	No	22	46,8%

Source: Own elaboration.

In Table 22 we can observe that the overwhelming majority of participants recognize 3D scanning as a highly beneficial tool for product development.

Table 22 - Question 20 results

Question	Option	Number	Percentage
20 - Do you believe 3D scanning can improve product development?	Yes	46	97,9%
	No	1	2,1%

Source: Own elaboration.

Table 23 indicates that the majority of participants understand how the implementation and usage of 3D scanning technology could have a positive social impact.

Table 23 - Question 21 results

Question	Option	Number	Percentage
21 - Do you believe 3D scanning can have a positive social impact?	Yes	43	91,5
	No	4	8,5

Source: Own elaboration.

As seen in Table 24, the great majority of participants believe 3D scanning technology would be of average to high impact on the innovation of their market.

Table 24 - Question 22 results

Question	Option	Number	Percentage	Scale
22 - How impactful do you believe 3D scanning could be for the innovation of your market?	1	0	0%	Not impactful – Very impactful
	2	1	2,1%	
	3	16	34%	
	4	15	31,9%	
	5	15	31,9%	

Source: Own elaboration.

In Table 25, the majority of participants appear to believe and understand how 3D technology can revolutionize/simplify processes on a greater scale.

Table 25 - Question 23 results

Question	Option	Number	Percentage
23 - Do you believe 3D scanning can revolutionize/simplify processes in an entire market?	Yes	37	78,7%
	No	10	21,3%

Source: Own elaboration.

Just like Table 21, Table 26 shows how many of the participants are unaware of different types of 3D printing technology, which could have impacted the results in Tables 6 and 7.

Table 26 - Question 24 results

Question	Option	Number	Percentage
24- Do you have knowledge about different types of 3D printing?	Yes	29	61,7%
	No	18	38,3%

Source: Own elaboration.

Table 27 shows how the overwhelming majority of participants believe 3D printing can improve product development.

Table 27 - Question 25 results

Question	Option	Number	Percentage
25 - Do you believe 3D printing can improve product development?	Yes	46	97,9%
	No	1	2,1%

Source: Own elaboration.

The great majority of participants show, in Table 28, that they believe manufacturing with 3D printing technology could be more environmentally friendly than traditional methods.

Table 28 - Question 26 results

Question	Option	Number	Percentage
26- Do you believe 3D printing can be more environmentally friendly than traditional manufacturing?	Yes	39	83%
	No	8	17%

Source: Own elaboration.

Although there seems to be some level of uncertainty, Table 29 indicates that a majority of participants see 3D printed products as mostly reliable.

Table 29 - Question 27 results

Question	Option	Number	Percentage	Scale
27 - How reliable do you perceive 3D printed products to be in comparison to traditional manufacturing methods?	1	0	0%	Not reliable – Very reliable
	2	5	10,6%	
	3	20	42,6%	
	4	13	27,7%	
	5	9	19,1%	

Source: Own elaboration.

The overwhelming majority of participants, as seen in Table 30, view 3D technology as beneficial for less technological markets such as construction.

Table 30 - Question 28 results

Question	Option	Number	Percentage
28 - Do you believe more knowledge on this type of technology can be beneficial for less technological markets? (e.g. construction)	Yes	45	95,7%
	No	2	4,3%

Source: Own elaboration.

CONCLUSIONS

3D technology has been advancing and getting public attention more and more rapidly over the past years showing great potential for applications in the most varied markets, as was exemplified in the 3D technology section of the literature review of this paper.

This study shows that many factors go into innovating, and various types of innovation, all of which can impact entire markets if the two primary variables of the market are impacted: product and process. 3D technology has presented itself as an outstanding tool to impact these two variables and innovate the overall market, in particular the two types addressed in this paper: 3D scanning and 3D printing, which can serve as a gateway to further develop an

organization beyond its competition and the overall market it's located in, serving as a pioneer for a new era of development in their market.

As shown by some examples given in the literature review part of this paper, this technology can have a heavy impact on our future, both within organizations and in our everyday lives. For organizations, it can serve as an online marketing tool, for example, showcasing a scanned 3D model of a product to a potential client, or even allowing the consumer to customize a product before making a purchase; it can also act as a research and development tool, by printing prototypes to have a better perception of the final product, or running scanned versions of the product through digital simulations to better understand its properties, for example, in the car industry, it's customary to build a life-size clay version of a model car, to have a better view of its design under real-life conditions and make any necessary alterations – this process takes a long time and a lot of workers to complete, and could be done by a 3D printer in a shorter amount of time, to then be viewed and altered as necessary, and scanned back into a digital format so it can be run through the necessary simulations. In regards to everyday uses, 3D technology can also be very useful, as a consumer-grade 3D printer can provide the user with a range of options as far as their imagination and effort can go, and potentially lowering expenses in the long-term, for example, any user can print rulers, pencil holders, boxes, cable binders, coat hangers, vases, statues, etc. This technology is also beneficial for professionals in architecture, as it allows them to print a model of their structures and designs, as well as for professors from kindergarten up to universities, as it allows them to create physical representations of what they intend to teach the students if necessary.

The results from the study realized for this paper concluded that 3D technology is already recognized as a very useful tool for the innovation of markets, being that it has very high potential to improve greatly on the methods already being used, however, besides the general notion that this technology can be very positive for the growth of almost any market, there's still a lot of hesitation and lack of information about it, as participants revealed to be somewhat uninformed about different forms of each type of 3D technology, and very divided on how easily it could be implemented in terms of being accessible, affordable, and how small or severe the limitations of this technology are. Despite this lack of crucial information, the fact that the public already shows interest and recognizes how positive the implementation of this rapidly growing form of technology can be reveals that the implementation of this technology in a great variety of markets on a larger scale is a future to be heavily considered.

The topic of this paper doesn't appear to have many limitations in terms of research, as there is a lot of helpful information and guides available to be studied online, however, the biggest limitations with this work came from the research, because, even though the results

presented came from a wide variety of markets and multiple nationalities, there was a low number of responses, which may have led to a result that's not as reflective of the wider population's notions on this topic as it could have been.

This paper could be further improved in the future by including studies on digital 3D modeling of spaces and objects, which is directly linked to both forms of 3D technology presented in this paper; studies on 3D display and projection technologies; a more detailed study on 3D scanning oriented towards motion capture, both in VR and for animation films; different methods of additive manufacturing such as rotational molding; and a study on the different materials used in 3D printing, such as PLA (polylactic acid).

REFERENCES

All3DP. (2021). The Types of 3D Printing Technology in 2022. https://all3dp.com/1/types-of-3d-printers-3d-printing-technology/

Anand, A., Wamba, S. F., & Gnanzou, D. (2013, January 1). A Literature Review on Business Process Management, Business Process Reengineering, and Business Process Innovation. Enterprise and Organizational Modeling and Simulation, EOMAS 2013. *Lecture Notes in Business Information Processing*, *153*, 1-23. https://doi.org/10.1007/978-3-642-41638-5_1

Awad, A., Fina, F., Goyanes, A., Gaisford, S., & Basit, A. W. (2021, July). Advances in powder bed fusion 3D printing in drug delivery and healthcare. *Advanced Drug Delivery Reviews*, *174*, 406-424. https://doi.org/10.1016/j.addr.2021.04.025

Baregheh, A., Rowley, J., & Sambrook, S. (2009, September 4). Towards a multidisciplinary definition of innovation. *Management Decision*, *47*(8), 1323-1339. https://doi.org/10.1108/00251740910984578

Bacon-Shone, J. (2021). *Introduction to Quantitative Research Methods*. https://edshare.gcu.ac.uk/9449/1/IQRM_book_2021-04-21.pdf

Berman, B. (2012). 3-D printing: The new industrial revolution. *Business Horizons*, *55*(2), 155-162. https://doi.org/10.1016/j.bushor.2011.11.003.

Bhatti, A. Q., Wahab, A., & Sindi, W. (2021). An overview of 3D laser scanning techniques and application on digitization of historical structures. *Innovative Infrastructure Solutions*, *6*(2). https://doi.org/10.1007/s41062-021-00550-9

Cooper, R. G. (2000) Product Innovation and Technology Strategy. *Research-Technology Managemen*t, *43*(1), 38-41, https://doi.org/10.1080/08956308.2000.11671329

Dangelico, R. M. (2015). Green Product Innovation: Where we are and Where we are going. *Business Strategy and the Environment*, *25*(8), 560-576. https://doi.org/10.1002/bse.1886

Edwards-Schachter, M. (2018, June). The nature and variety of innovation. *International Journal of Innovation Studies*, *2*(2), 65-79. https://doi.org/10.1016/j.ijis.2018.08.004

Gokhare, V. G., Raut, D. N., & Shinde, D. K. (2017). A Review paper on 3D-Printing Aspects and Various Processes Used in the 3D-Printing. *International Journal of Engineering and Technical Research*, *6*(6), 953-958. https://www.researchgate.net/publication/350374850_A_Review_paper_on_3D-Printing_Aspects_and_Various_Processes_Used_in_the_3D-Printing

Goyanes, A., Det-Amornrat, U., Wang, J., Basit, A. W., & Gaisford, S. (2016). 3D scanning and 3D printing as innovative technologies for fabricating personalized topical drug delivery systems. *Journal of Controlled Release*, *234*, 41-48. https://doi.org/10.1016/j.jconrel.2016.05.034

Hevner, A., & Gregor, S. (2022). Envisioning entrepreneurship and digital innovation through a design science research lens: A matrix approach. *Information & Management*, *59*(3). https://doi.org/10.1016/j.im.2020.103350

Huang, J., Chen, Q., Jiang, H., Zou, B., Li, L., Liu, J., & Yu, H. (2020, January 14) A survey of design methods for material extrusion polymer 3D printing. *Virtual and Physical Prototyping*, *15*(2), 148-162. https://doi.org/10.1080/17452759.2019.1708027

Johne, A. (1999). Successful Market Innovation. *European Journal of Innovation Management*, 2(1), 6-11. https://doi.org/10.1108/14601069910248838

Kamani, K. (2020). *Types of 3D Scanning Technologies and 3D Scanners*. LinkedIn. https://www.linkedin.com/pulse/types-3d-scanning-technologies-scanners-karan-kamani/

Kim, C. (2015, June). *3D Metrology Newsletter - A faster way to quantify and make decisions. Capture3D*. https://www.capture3d.com/Newsletters/2015_06.html

Kjellberg, H., et al. (2012) Market futures/future markets: Research directions in the study of markets. *Marketing Theory*, *12*(2), 219-223. https://doi.org/10.1177/1470593112444382

Kolecka, N. (2012). Photo-based 3D Scanning Vs. Laser scanning - Competitive data acquisition methods for digital terrain modelling of steep mountain slopes. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *38*(4), 203-208. http://dx.doi.org/10.5194/isprsarchives-XXXVIII-4-W19-203-2011

Kumar, L., Shuaib, M., Tanveer, Q., Kumar, V., Javaid, M., & Haleem, A. (2018). 3D scanner integration with product development. *International Journal of Engineering & Technology*, *7*(2.13), 220-225. https://doi.org/10.14419/ijet.v7i2.13.11690

Kylliäinen, J. (2019, October 4). Types of Innovation – The Ultimate Guide with Definitions and Examples. Viima Solutions. https://www.viima.com/blog/types-of-innovation

Loshin, D. (2011). Enterprise Initiative Integration. *MK Series on Business Intelligence. The Practitioner's Guide to Data Quality Improvement*, 53-66. https://doi.org/10.1016/B978-0-12-373717-5.00021-X

Morgan, R. E.; Berthon, P. (2008). Market Orientation, Generative Learning, Innovation Strategy and Business Performance Inter-Relationships in Bioscience Firms. *Journal of Management Studies*, *45*(8), 1329-1353. https://doi.org/10.1111/j.1467-6486.2008.00778.x

OECD (2018, October 22). Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4. https://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm

United Nations. (2008). Institutional units and sectors. In System of National Accounts 2008, p.65. https://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf

Organovo (2020). 3D Technology Platform. Organovo, Inc. https://organovo.com/technology-platform/

QMT Group (2019). 3D Imaging. https://www.qmt-group.com/event/317/technologies/3d-imaging/

Queirós, A., Faria, D., & Almeida, F. (2017). Strengths and Limitations of Qualitative and Quantitative research methods. *European Journal of Education Studies*, *3*(9). http://dx.doi.org/10.5281/zenodo.887089

Storbacka, K., & Nenonen, S. (2015). Learning with the market: Facilitating market innovation. *Industrial Marketing Management*, *44*, 73-82. https://doi.org/10.1016/j.indmarman.2014.10.009

Walker, R. M. (2014) Internal and External Antecedents of Process Innovation: A review and extension. *Public Management Review*, *16*(1), 21-44. https://doi.org/10.1080/14719037.2013.771698

Xiao, X. P. (2008). Technical Challenges. In The Morgan Kaufmann Series in Networking. Technical, Commercial and Regulatory Challenges of QoS, 113-136. https://doi.org/10.1016/B978-0-12-373693-2.00008-2

Zhang, Z., Corrigan, N., Bagheri, A., Jin, J., & Boyer, C. (2019). A Versatile 3D and 4D Printing System through Photocontrolled RAFT Polymerization. *Angewandte Chemie International Edition*, *58*(50), 17954-17963. https://doi.org/10.1002/anie.201912608

3DScienceValley (2021). 3D Scanning Evolves To Offer Broad Application Possibilities. http://en.51shape.com/?p=3424

Appendix: Questionnaire

Impact of 3D Technology on Market Innovation

My name is João Gonçalves and I'm conducting this research questionnaire on the topic of "Impact of 3D Technology on Market Innovation" for the final thesis on a bachelor's degree in Creativity and Business Innovation at ISCAP.

3D technology should be understood in both the form of 3D scanning (including motion capture and virtual reality) and 3D printing.

The purpose of this questionnaire is to collect data from experts in various fields to understand the impact of 3D technology in different markets.

*Obrigatório

1. Your answers are completely voluntary and anonymous, and will only be used for the purpose of this research. Do you agree? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

Research

This section of the questionnaire is intended to gather data on the participant's opinion and knowledge on the areas being studied.

2. 1- Does your organization work with the goal of innovating the market it's in? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

3. 2- How much of an impact do you believe technology can have in innovation? *

Marcar apenas uma oval.

	1	2	3	4	5	
Low impact	◯	◯	◯	◯	◯	High impact

4. 3- How technologically advanced do you believe your area of business is? *

Marcar apenas uma oval.

	1	2	3	4	5	
Not advanced	◯	◯	◯	◯	◯	Very advanced

5. 4- How accessible do you believe 3D technology is? *

Marcar apenas uma oval.

	1	2	3	4	5	
Not accessible	◯	◯	◯	◯	◯	Very accessible

6. 5- How affordable do you believe the implementation of 3D technology is? *

Marcar apenas uma oval.

	1	2	3	4	5	
Not affordable	◯	◯	◯	◯	◯	Very affordable

7. 6- How would you rate the limitations of implementing 3D technology in your area of business? *

Marcar apenas uma oval.

	1	2	3	4	5	
Low limitations	◯	◯	◯	◯	◯	High limitations

8. 7- Do you believe using 3D technology can be profitable for your organization in the long-term? *

Marcar apenas uma oval.

- Yes
- No

9. 8- How optimized do you believe your organization's processes are? *

Marcar apenas uma oval.

	1	2	3	4	5	
Not optimized						Very optimized

10. 9- How benefitial do you believe 3D technology can be for the optimization of your organization's processes? *

Marcar apenas uma oval.

	1	2	3	4	5	
Not beneficial						Very beneficial

11. 10- How do you think your organization's target audience would adapt to the implementation of 3D technology in your processes? *

Marcar apenas uma oval.

	1	2	3	4	5	
Poor adaptation						Excelent adaptation

12. 11- Do you believe 3D technology would be beneficial to innovating the market your organization is part of? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

13. 12- Do you believe the comunity's culture and inherent beliefs about product quality inhibits your ability to implement 3D technology in your organization? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

14. 13- Do you believe the comunity would have to be educated about this type of technology for its implementation to be feasable? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

15. 14- Do you believe 3D technology would change your organization's target demographics? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

16. 15- Do you believe 3D technology can be a useful tool for product development? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

17. 16- Do you envision your products/services being improved by the implementation of 3D technology? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

18. 17- How much impact do you believe 3D technology can have in your supply capacity? *

Marcar apenas uma oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

19. 18- Do you believe 3D technology can positively impact your business strategy? *

Marcar apenas uma oval.

- ◯ Yes
- ◯ No

20. 19- Do you have knowledge about different types of 3D scanning? *

Marcar apenas uma oval.

- Yes
- No

21. 20- Do you believe 3D scanning can improve product development? *

Marcar apenas uma oval.

- Yes
- No

22. 21- Do you believe 3D scanning can have a positive social impact? *

Marcar apenas uma oval.

- Yes
- No

23. 22- How impactful do you believe 3D scanning could be for the innovation of your market? *

Marcar apenas uma oval.

	1	2	3	4	5	
Not impactful						Very impactful

24. 23- Do you believe 3D scanning can revolutionize/simplify processes in an entire market? *

Marcar apenas uma oval.

- Yes
- No

25. 24- Do you have knowledge about different types of 3D printing? *

Marcar apenas uma oval.

- Yes
- No

26. 25- Do you believe 3D printing can improve product development? *

Marcar apenas uma oval.

- Yes
- No

27. 26- Do you believe 3D printing can be more environmentally friendly than traditional manufacturing? *

Marcar apenas uma oval.

- Yes
- No

28. 27- How reliable do you perceive 3D printed products to be in comparison to traditional manufacturing methods? *

Marcar apenas uma oval.

	1	2	3	4	5	
Not reliable						Very reliable

CHAPTER 2 – HOW LO-FI MUSIC IMPACTS STUDENTS' CREATIVE THINKING AND PERFORMANCE

Pedro Chaves

Orlando Lima Rua

ABSTRACT

Lo-fi music is a study companion for thousands of students globally. The purpose of this paper is to understand how listening to lo-fi music affects students' creative thinking and academic performance.

To achieve this goal, an online questionnaire was created (quantitative research), which gathered a total of 131 answers from students from all around the world who regularly listen to lo-fi music.

The results indicate that listening to lo-fi has a positive impact on students' creative thinking and performance. These findings could also reveal that lo-fi may bring benefits on factors including stress relieving and productivity, traits that may be related to a better creative and learning environment.

It is hoped that this study may open doors for further academic and scientific studies in specialized fields such as neurobiology and music education, to further understand how lo-fi provides these improvements on students' creative thinking and performance, as well as how one may be able to take full advantage of lo-fi's properties to further develop creative and cognitive capabilities.

Keywords: Lo-fi, Music, Creativity, Students, Performance.

INTRODUCTION

Creativity is the driving force behind scientific, technological and cultural innovation, and it can be considered one of the key competencies of the 21st century (Ritter, 2017). Besides, this scholar defends that the problems one faces in our complex and the fast-changing world more than ever demand creative thinking. Music has been recognized to have an impact on one's emotions, moods and behaviour (Hallam & Godwin, 2015), and various studies have been made throughout the years: Regarding music education and formal music training, Simpson (1969) concluded that high-school music students performed better on various elements of Guilford's Test of Divergent Thinking, compared to non-music students. Hamman et al. (1990) found that undergraduate music majors scored higher in Guilford's tests compared to non-music majors. In contrast, regarding music listening, although research shows music does improve cognitive performance (Cockerton et al., 1997), some studies portray specific genres of music as a distracting factor in cognitive tasks. Furnham and Bradley (1997) concluded that listening to pop music worsens cognitive performance on various tasks, such as memorization and information retention.

Mainly because of the COVID-19 pandemic and its consequent, almost global shifting of schooling methods from presential to virtual, lo-fi music has burst in popularity among students from various age groups. Being fully distributed online, especially via video and music streaming sites such as YouTube and SoundCloud, lo-fi has been drawing attention for being a suited studying and relaxing companion.

Therefore, the objective of this paper is to explore a connection between the lo-fi genre and the stimulus of creativity among students. As lo-fi listening is of incredibly easy access, assuming that one has internet access and an internet-capable device such as a smartphone or a computer, this study aims to answer the following question:

Is lo-fi a potential creativity and performance booster?

Finding lo-fi music to be beneficial for creative thinking and students' performance can be of significant importance for the subject of creativity. Having a free and easily accessible source of endless creativity-stimulating audible content, that has been maintaining a strong liking among students of our current generation since its increase in popularity, may be a promising method in helping struggling students with the stimulus of creative thinking and cognitive performance.

LITERATURE REVIEW

LO-FI MUSIC

Concept and evolution

Lo-fi (also known as “lo fidelity”, “low-fi” and “lofi”) can be defined as a recording that sounds as if it were produced in a non-professional setting. Certain sonic imperfections are characteristic of lo-fi tracks, happening both during media recording (such as tape hiss, abrupt cuts, clicks and distortion) and in performance (amateurish mistakes, poor intonation). These production defects, while appearing to be amateur modes of mediation, are interpreted with an aesthetic emphasis. Jones argues that lo-fi revolves around a perceptual duality, connecting its aural emphasis on its mediation to the fact that it paradoxically conveys a sharp sense of reality, intimacy and immediacy, ultimately pursuing an unrealistic co-existence between the real and the artificial (Jones, 2014). Harper portrays lo-fi as ‘a positive appreciation of what is perceived and/or considered normatively interpreted as recording imperfections, with particular emphasis on imperfections in the recording technology itself’ (Harper, 2014).

The term lo-fi can be traced back to the 1950s, a time in which it was used to refer to the recording quality and production of an album. During early rock & roll history, tracks were recorded in a cheap, swift manner, often using inferior audio equipment. Following this line of thought, 1960s garage rock records and 1970s punk rock can be labelled as lo-fi (Allmusic). Recognizable names such as The Beach Boys, Bob Dylan and the Beatles have released albums that may be considered lo-fi regarding their literal connotation: Smiley Smile (1967), John Wesley Harding (1967) and the White Album (1968), respectively. In 1977, Schafer gave a negative connotation to lo-fi, defining it as an unfavourable signal-to-noise ratio and adding that, when applied to soundscape studies, a lo-fi environment is one in which signals are overcrowded, resulting in masking or lack of clarity (Schafer, 1977).

In the early 1990s, as it began to be adopted by indie rock bands such as Sebadoh and Pavement, and consequently pushed into success by Liz Phair and Beck, lo-fi earned its relevance around the alternative rock community and came to be established as a niche musical genre, in addition to its descriptive term meaning. Expectedly, as a direct effect of being consolidated into recognition, lo-fi received its fair share of critics, with some reducing it to something of questionable, trivial value. In 1994, lo-fi reached major acknowledgement by media such as the *New York Times, Musician,* and *Option*, and in the following year, *Times* portrayed lo-fi as the latest “industry buzzword” (Jones, 2014).

With the 21st century technological revolution, in the 2000s lo-fi disrupted a technological division between professional and amateur artists, due to the rise of modern digital audio workstations (DAWs) (Bell, 2018). Many then-lo-fi artists had opted for superior, professional standards, and in contrast, amateur artists gained interested in old, vintage equipment trying to reproduce lo-fi aesthetics. A notable breakthrough in lo-fi aesthetics was the release of Ariel Pink's debut album, *The Doldrums*. Pink's music agglomerated several qualities characteristic of lo-fi, such as distortion and the lack of clarity and higher frequencies. As the music resurrected then-obsolete 1990s styles, Pink succeeded in introducing the factor of nostalgia to lo-fi – a new trait of lo-fi that has since prevailed (Harper, 2014).

Lo-fi hip hop

From the mid-2010s on, lo-fi has turned into a worldwide phenomenon with the rise of a subgenre known as "lo-fi hip hop" or "lo-fi chill beats" among the current young generation (Wang, 2020). It's distributed entirely online, in particular via major video and music streaming platforms such as YouTube and SoundCloud (Wang, 2020; Winston & Saywood, 2019).

Lo-fi hip hop is heavily inspired by 1990s vintage hip hop instrumental producers J Dilla and Nujabes, while combining other genres' elements that fit in the relaxing and "chill" theme, such as jazz and R&B (Wang, 2020). The factor of nostalgia, vital on lo-fi hip hop tracks, is reached by incorporating many of the sonic imperfections that are part of lo-fi aesthetics.

The success of lo-fi hip hop took place especially on YouTube, as one has easy and abundant access to 24/7 live streams of lo-fi tracks, as well as curated compilations and mixes (Winston & Saywood, 2019). The most prominent lo-fi hip hop streaming channel, named Lofi Girl (formerly ChilledCow), has more than ten million subscribers and surpasses one billion total views, as of June 2022. As in most other lo-fi streaming channels, Lofi Girl's non-stopping live streams are accompanied by a Japanese-inspired looped animation of a girl studying or relaxing. Other common looped animations in lo-fi hip-hop videos include scenes from the late 90s and early 2000s animes, portraying modern Japanese culture's impact on the genre (Wang, 2020). *Vice* writer Luke Winkie describes Lofi Girl as " the person who first featured a studious anime girl as his calling card, which set up the aesthetic framework for the rest of the people operating in the genre" (Winkie, 2018).

The COVID-19 pandemic and its consequent extended period of quarantine had an obvious impact on people turning to digital platforms, says Luke Pritchard to *The Verge*, member of the duo behind College Music – also one of the most popular lo-fi channels on YouTube (Alexander, 2020). Interviewed by this reporter, Nick Stafford, owner of lo-fi channel Nickolaas, too claims his channel has seen a significant rise in views since the start of the pandemic. Figure

1 shows that interest in lo-fi regarding YouTube searches has been continuously growing since late 2016, with a substantial rise in interest starting around late 2020.

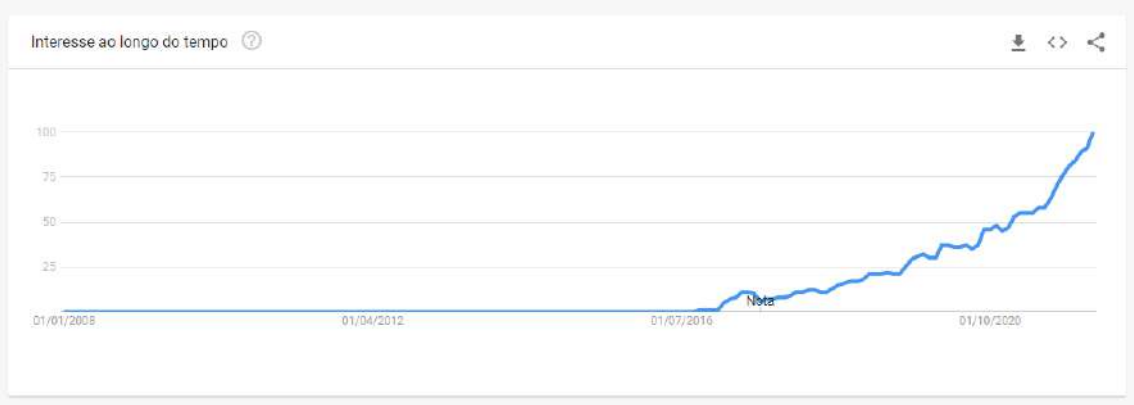

Figure 1 - Interest in "lofi" over time in Youtube.
Source: Google Trends (January 2008 - March 2022).

Lo-fi and mental health

According to a survey made by the Student Experience in the Research University (SERU) Consortium, the COVID-19 pandemic has had an alarming impact on both undergraduate and graduate students' mental health. In addition, it was concluded that the prevalence of major depression-related disorders among professional and graduate students doubled in 2020 compared to the previous year, while anxiety-related disorders grew 1.5 times in the same period (Chirikov et al., 2020).

This survey evaluated data from 30,725 undergraduate students and 15,346 graduate and professional students, among nine public research universities. The scales used to support the scholars' research were the Patient Health Questionnaire-2 (PHQ-2), to screen for depression symptoms, and Generalized Anxiety Disorder-2, to screen for anxiety symptoms. The PHQ-2 contains two questions related to the frequency of depressive moods over one's previous two weeks and GAD-2 contains two questions related to the frequency of anxiety over the previous two weeks. All questions are scaled from 0 (not at all) to +3 (nearly every day). Major depressive or anxiety disorders, respectively, are to be expected if each test's results score 3 or higher (Chirikov et al., 2020).

The following figures show the overall results for these questionnaires (PHQ-2 shown in green and GAD-2 shown in blue).

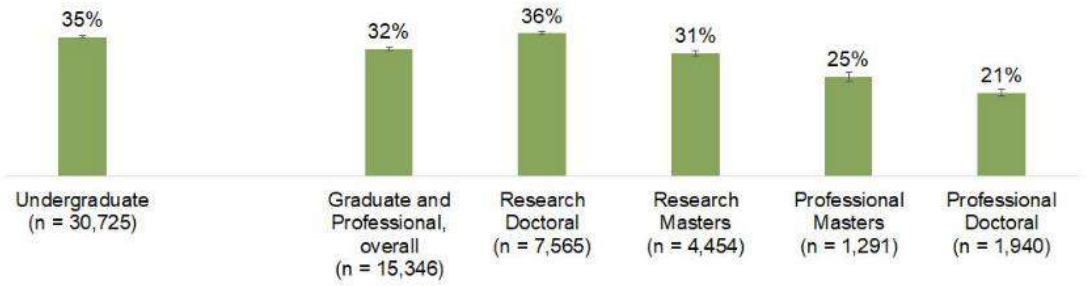

Figure 2 - Prevalence of major depressive disorder among tested students.
Source: SERU (2020)

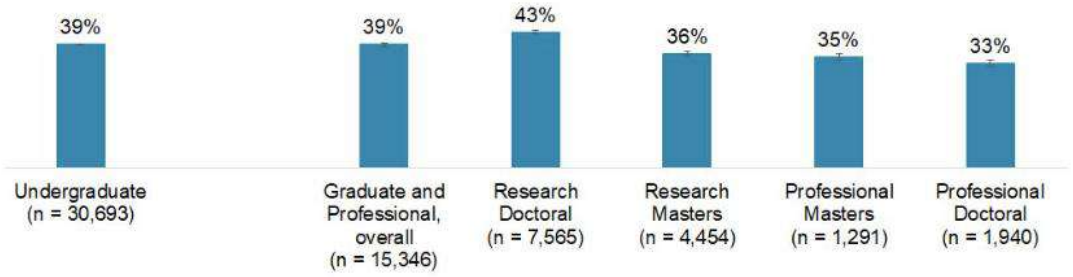

Figure 3 - Prevalence of generalized anxiety disorder among tested students.
Source: SERU (2020).

As shown in Figure 2, 35% of undergraduate applicants and 32% of graduate and professional applicants tested positive for major depressive disorders, while figure 3 shows 39% of undergraduate, graduate and professional applicants reported positive for generalized anxiety disorders, with research doctoral students even reaching a higher 43%.

At a time of struggle with mental health issues between students who sough for ways to focus and relieve stress, while adapting to a new work-from-home environment, Lo-fi music offers melodies that create a proper ambience for a more stress-free productive atmosphere (Coulibaly, 2020).

Interviewed by *Engadget* writer Tim Seppala, Brain.FM science director Dr Kevin Woods, who holds a PhD in auditory neuroscience, said “good focus music has no vocals, no strong melodies, 'dark' spectrum, dense texture, minimal salient events, heavy spatialization, a steady pulse, sub-30-200Hz modulation and above 10-20Hz modulation” (Seppala, 2018), mentioning many characteristics present in lo-fi aesthetics.

Regarding mental health, there are some studies correlating the kind of music one is listening to, and the arousal state one is in (Coulibaly, 2020). There is evidence of low arousal songs benefiting regions of the brain in charge of memory and task completion, while high arousal music was found to be more distracting (Nguyen & Grahn, 2017).

Although there are some studies concerning the effects of music on one's arousal state in a broader way, the effect of lo-fi music specific on mental health remains vastly unexamined academically. Still, the capability of lo-fi music to create a calmer and more relaxed atmosphere, which is something that may positively impact one's mental health through the study, work and regular tasks, seems unquestionable, as it is put in practice by many thousands of students around the world (Coulibaly, 2020).

CREATIVITY

The concept of creativity has been a subject of extensive and continuous discussion (Yanhua et al. 2021), and is defined and studied differently by several authors throughout the times:

Bohm (1998, p. 1) views creativity as something impossible to define in words, separating it from talent, as "there are a tremendous number of highly talented people who remain mediocre". To Bohm, creativity consists of going beyond one's mechanical reactions, conditioned by society and ordinary ways of thinking, which pushes individuals to an "unpleasant state of dissatisfaction and conflict". This scholar also states that is not at all easy to awaken the creative state of mind. On the contrary, it is one of the most difficult things that could be attempted (Bohm, 1998).

Reid and Petocz (2004) mention the different ways creativity is seen in different fields: in education, it is called "innovation"; in business, it is "entrepreneurship"; in mathematics, it is often associated with "problem-solving" and in music, it is "performance" or "composition". To Reid and Petocz, a creative product in different domains is measured against the norms of that domain, with its own rules, approaches and conceptions of creativity (Reid & Petocz, 2004).

Swede argues that "creativity is a process that results in some sort of outcome that possesses at least two qualities: it must be unique, and it must have value" (Swede, 1993). This goes in concordance with Csikszentmihalyi's suggestion that, in many fields, creativity is the ability not to solve a problem, but to be able to discover a problem (Csikszentmihalyi, 1990), in the sense of disregarding the definition of creativity as being a mere response to a certain situation.

Howard Cannatella emphasizes the importance of creativity, stating there is evidence to suggest that the need for creativity is biologically, physically, and psychologically an essential part of human nature, necessary for human reproduction, growth and cultural striving (Cannatella, 2004).

Creativity involves divergent thinking and convergent thinking: While divergent thinking consists in the developing of various answers from accessible information by making unexpected

combinations or transforming it into unanticipated forms, such as idea generation, convergent thinking is the cognitive process of deriving the best possible single solution to a problem of question. Convergent thinking should not be labelled as uncreative for having its basis on accuracy, logic, conventional search and decision-making strategies, as it still requires creativity, for example, to relate outwardly unrelated concepts (Ritter, 2017).

CREATIVE THINKING

According to Weisberg (1993), creative thinking requires a deliberate production of novelty. As so, one cannot be creative by producing something one knows already exists. On the other hand, if an individual produces something which is a novelty for himself but has, unknowingly, been produced in the past by someone else, it still counts as creativity (Weisberg, 1986).

Creative thinking can be nurtured and accomplished in all school subjects and curriculum areas. Even subject-specific content that might appear trivial has the potential to nurture creativity in students, on the assumption that the pedagogical approach allows so. Motivation plays a big role in the pursuit of creativity and learning, as intrinsically motivated individuals tend to be more willing to spend their time and energy to be creative, compared to individuals who are driven by pressure or inducements. Students are likelier to articulate their creative potential when involved in demanding tasks fitting their interests and skills (Kampylis & Berki, 2014).

A key component of creative thinking is the ability to 'play' with ideas, including currently existing and newly-generated ones. It's vital to the process of creative thinking to be able to consciously consider ideas from different perspectives and to think creatively within the constraints of a task (Ramalingam et al., 2020)

Creative thinking and critical thinking

A form of thought commonly linked and compared to creative thinking is critical thinking, and many studies have been conducted to better comprehend the conceptual complexities involved in creativity and critical thinking (Hoon et al., 2021). These two concepts are commonly misunderstood as opposites (Paul & Elder, 2008), as at first glance, it may appear there is not much of a connection between them (Rai, 2011). Paul & Elder (2008) note this happens for several reasons, one being cultural, consequent of media's representation of creative and critical individuals.

Paul and Elder (2008) point out that these concepts are closely related, as meaningful thinking includes both creative and critical thinking. The capabilities of producing original ideas, characteristic of creativity, are needed for meaningful thinking. However, meaningful thinking

also demands judgement, planning and evaluation of factors, and attributes present in criticality. As so, great thinking involves both elements of imagination and intellectuality (Paul & Elder, 2008).

Creativity and mental health

The relationship between creativity and mental health is rather complex and one of psychology's oldest topics, going back as far as 380 B.C., when Plato stated that Gods speak through poets, setting them aside from ordinary people (Cropley, 1990; Gillam, 2013).

Stress, for example, has been proved to have a negative impact on the creativity-related process, such as task switching and cognitive flexibility, even though the negative impact is not universal (Vartanian et al., 2020). These authors mention Byron et al's analysis of 76 studies aimed at examining the impact of stress on creativity. Byron et al's (2010) meta-analysis results concluded that it is an oversimplification to say stress has a positive or negative effect on creativity, stating this effect depends on how stress-inducing the stressor is. Normally, low-stress-inducing situations triggered an increase in creative performance, while high-stress-inducing situations triggered a decrease in creative performance. The presence of anxiety was found to be pivotal in these researchers' findings, as participants with all levels of anxiety had a worse creative performance, while those with low levels of anxiety performed better (Byron et al., 2010).

In a study performed by Yanhua et. al (2021), it was revealed that depression is positively correlated with creativity, demonstrating that depression does not just generate negative effects but also has the potential to motivate one to be more creative. As depression affects an individual's ability to cope with life events, it consequently affects daily creativity. In the same way that anxiety was an influencing factor in Byron et al's study, psychological resilience can act as an intermediary in the link between depression and creativity (Yanhua et al., 2021), meaning that individuals with higher resilience are more likely to take advantage of their emotional resources when facing obstacles (Debbane et al. 2017). As so, theoretically, the results of this study suggest that by strengthening their psychological resilience, students suffering from depression may be able to better react to challenges and adversities, allowing them to express their creative potential in their daily lives or fields of interest. However, the authors mention that the mechanisms and cognitive processes of depression and its impact on creativity are still debated (Yanhua et al., 2021).

STUDENTS' PERFORMANCE

The definition of academic success varies from researcher to researcher. Ellis & Worthington (1994) and Scheuerman (2000) defined academic success as the term regarding successful students capable of managing the demand of university efficiently, both in society and academically, as well as striving for success and to be considered socially proficient, intrinsically motivated and goal-oriented. Commonly, academic success can be described as student self-motivation, self-efficiency and one's power to cope with the study environment, solely to reach notable academic performance (UKEssays, 2021).

Many practical studies are carried out to investigate factors affecting college students' performance (Mushtaq & Khan, 2012). For example, Khan et al. (2013) performed a study to explore the effect of stress on students' performance, and the results showed stress can lessen academic performance. Steinmayr et al. (2019) researched the importance of motivation in students' academic success, finding strong evidence that believing in one's competencies is advantageous regarding academic achievement. Additional factors mentioned by other scholars include socio-economic status (Black et al., 2014), teaching and learning processes (Chickering & Gamson, 1999), university and school infrastructures (Schneider, 2002), family influence (Ali et al., 2009), study habits, personality traits and peers influence (Singh et al., 2017).

COVID-19 confinement and students' performance

In spring 2020, the COVID-19 outbreak disrupted life around the world and, as in many other sectors, its resultant confinement affected education in many ways, such as the closure of schools for several weeks or months. Even though school closures are considered to be very efficient measures to curb the spread of the virus, many researchers and educators showed concerns about the consequences closures may bring on student academic achievement and performance inequalities (Hammerstein et al., 2021).

While the negative impacts of school closures due to summer vacations or natural disasters are already acknowledged in the literature, there is a lack of academic research, comparatively, regarding the impact of COVID-19-related school closures on student performance (Hammerstein et al., 2021). A year into the pandemic, these scholars presented a work aiming to provide a systematic overview of studies on the effects of COVID-19 confinement and school closures on student achievement in primary and secondary education. The following figure shows the process of study gathering and screening, from a total of 601 studies on the matter.

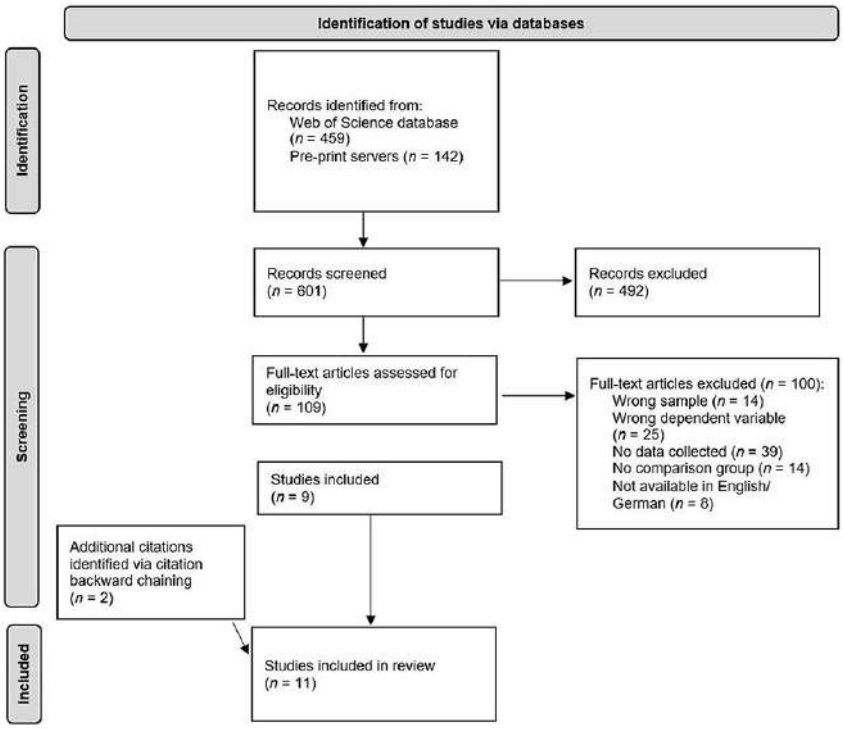

Figure 4 - PRISMA flowchart of the literature search and screening process.
Source: Hammerstein et al. (2021).

This work reported that there is clear evidence for a negative effect of COVID-19-caused school closures on student achievement and performance, comparable in size to results regarding summer school closure losses. Results were reportedly more significant in younger students, as well as students from families with low socioeconomic status. Also, even though online learning was implemented, the effects achieved by it were similar to those achieved when no teaching activities were implemented at all during summer vacation (Hammerstein et al., 2021).

MOZART EFFECT

Rauscher et al. (1993), motivated by predictions of a structured neuronal model of the cortex and with the intent of demonstrating a causal relationship between music cognition and cognitions about abstract operations, studied the effect of listening to Mozart on spatial-temporal reasoning in college students (Rauscher, 1993)

In this experiment, 36 students were each given three sets of QI spatial reasoning tasks, and each task was headed by 10 minutes of the following conditions:

- Listening to Mozart's sonata for two pianos in D major, K488;
- Listening to a relaxation tape;
- Silence.

Reportedly, the performance had seen an improvement for the given tasks immediately following the first conditions, while compared to the remaining two. The enhancing effect of Mozart's music is temporal, not exceeding the 15-minute mark during the engagement in each spatial task (Rauscher, 1993).

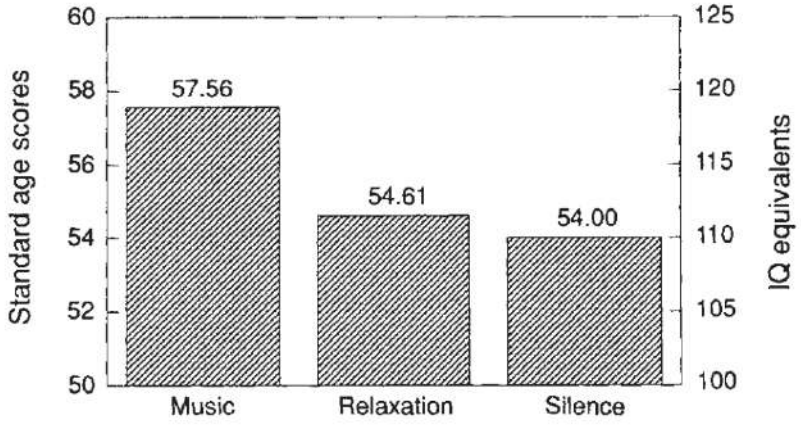

Figure 5 - Standard age scores for each of the three listening conditions
Source: Rauscher (1993).

While Rauscher (1993) stressed in her research that she only measured a specific kind of spatial intelligence, stating that "it's very important to note that we did not find effects for general intelligent, just for this one aspect of intelligent. It's a small gain and it doesn't last very long", the popular press came to distort and strongly exaggerate the research's findings. Soon after Rauscher's paper was published by Nature and printed by Associated Press, headlines about it were less subtle than Rauscher's findings, as the general idea became "Mozart makes you smart". Rauscher was wildly misquoted on multiple aspects of her paper, such as the generalization of the research's results to children, which escalated to the point of Georgia's then Governor Zell Miller proposing a budget to provide every child with a classical music CD, followed by the state of Tennessee. Worth remembering the research was done on 36 college students (Spiegel, 2010).

Rauscher still stands by her original finding, however saying later research proved that it's not really about Mozart, but any music or artist that one finds engaging, as the brain finds it stimulating compared to, for example, silence (Spiegel, 2010). "The key to it is that you have to enjoy the music, […] If you hate Mozart, you're not going to find a Mozart Effect. If you love Pearl Jam, you're going to find a Pearl Jam effect." – Rauscher.

Supporting Rauscher's beforementioned quote, some studies, such as Ilie and Thompson's (2011), concluded that manipulations of rate, pitch height, and intensity in music

influenced, between other factors, two types of cognitive functioning: speed of processing and creative problem solving (Ilie & Thomson, 2011).

METHODOLOGY

METHODOLOGICAL APPROACH

This study aims to better understand the effect of lo-fi music listening on students' creative thinking and performance. Two distinct methodological approaches were available as a means of research regarding the current topic: quantitative studies and qualitative studies. As their name indicates, quantitative studies rely on quantitative information such as numbers and figures, while qualitative studies are based on qualitative information such as words, sentences and narratives (Cooper & Schindler, 2014).

These scholars mention that one cannot decide whether qualitative or quantitative studies are better or more useful. Additionally, in various social sciences, such as management studies, sociology, psychology, and others, no clear predominance of qualitative or quantitative research methods is verified (Cooper & Schindler, 2014).

As so, taking into consideration all accessible resources and means of performing each one of the available methodological approaches, it was concluded that the quantitative study is the best suited as the method of research for this dissertation.

Statistical methods have proved extremely useful in analyzing all kinds of data both in social and behavioural sciences. Statistical analysis can find relationships and trends too subtle to be seen otherwise. One of the greatest advantages of quantitative research is its ability to question not only whether there is overall support for a hypothesis, but also whether the extent of support differs along with the attributes of the studies (Green & Hall, 1984).

Quantitative research methods are appropriate when factual data are needed to answer the research question, when general or probability information is taken on opinions, attitudes, views, beliefs or preferences and when the question or problem is known and clear (Hammarberg et al., 2016).

Lo-fi music's presence and distribution are entirely online and via mostly free-to-use video and music streaming sites of easy access to everyone. As so, there are several lo-fi communities among the main instant messaging social platforms, such as Discord, Reddit or even YouTube's chat function on lo-fi streams. At the time of writing, Lofi Girl's official Discord server has a total of 694.410 members, while its official subreddit (a Reddit forum dedicated to a specific topic) has more than 30.000 participants. This gives the quantitative research method a considerable

advantage over the qualitative method, as an online questionnaire is expected to be of an easy spread between the genre's fans and listeners among the various lo-fi communities across the internet. Comparing this to the qualitative method of research, in which a more practical, time-consuming and individual experiment would be put together, including structured interviews, focus groups and observation (Tenny et al., 2021), the quantitative research method is concluded to have the potential of obtaining a considerably larger number of responses, which is crucial for this research. Also, an online questionnaire breaks any geographical, age and cultural restraint, as it will be accessible for any lo-fi enjoyer around the world to participate.

QUESTIONNAIRE

As a means of support for the current study, an online questionnaire was created using Google Forms. The platform's easy-to-use interface and advantages such as unlimited surveys and being 100% free to use have consolidated it as a popular product in online survey research (Vasantha & Harinarayana, 2016).

The Internet and its attending technologies provide a great platform for researchers to obtain data (Gordon & McNew, 2008). Online data gathering has the potential of accessing a large and geographically distributed population, as well as being time and cost-efficient for the researcher (Lefever et al., 2007).

The online questionnaire was designed to measure the impact of lo-fi music listening on a student's creative thinking and performance. Its goal is to drive respondents to perform a self-evaluation regarding the impact of lo-fi music on their creative exercising capabilities. No demographic barriers are necessary for the questionnaire, as so, it was distributed internationally. The only requirement for the participant to be able to answer the entirety of the questionnaire is to be a student who listens to lo-fi music, and this was enforced by creating a one-question section which only allowed the respondent to proceed to answer the quiz in its entirety if confirmed it is a student that listens to this genre.

The questionnaire was written in English, corresponding to the main spoken language of lo-fi communities, chats and servers, on which the quiz will be divulgated.

Matching this study's title, the survey is named "Impact of lo-fi music on students' creative thinking and performance" and its structure is divided into three separate sections:

Section 1, as previously stated, serves as reinforcement to make sure only students who listen to lo-fi music – the survey's target audience – get to answer the questions. As so, only one question, being it mandatory, is included in this section: "Are you a student who listens to lo-fi music?". Answering "no" automatically ends the questionnaire.

Section 2 contains the first part of the questionnaire, and it's called Part 1. This section collects information such as age, and gender and includes miscellaneous questions to understand the way one listens to lo-fi, such as how much time a day one spends listening to the genre, at what volume and what activity one usually does while listening to it. A total of six questions constitute this section.

Section 3 – denominated Part 2 in the questionnaire – includes all crucial questions, directly pertinent to the goal of this final thesis. It was designed in a way to gradually increase the "intensity" and objectivity of the questions as the participant goes further into the survey. This section contains a total of nine questions. The first four questions refer solely to the way the student feels when listening to lo-fi music and its effects on his creativity, productivity and state of mind. The fifth question introduces a transition to more objective and direct questions, by asking if the student's studying performance is effectively better when listening to lo-fi. The four following questions address actual performance gains obtained by lo-fi listening and the uniqueness of the genre in providing these effects.

In essence, the questionnaire consists of sixteen questions, fifteen of which are relevant to the analysis (see Appendix).

RESULTS

The questionnaire was open to answers from June 19 to June 24. Throughout six days, a total of 131 answers were obtained.

As previously noted, the first section consisted of just one question. By directly asking if the respondent was a student who listened to lo-fi music, and only being able to proceed if answered positively, this question only allowed the survey's target audience to continue and complete the questionnaire.

From 131 participants, 94,7% (n=124) were students who listen to lo-fi. As so, 124 students were able to proceed with the questionnaire (Table 1).

Table 1 - Survey Introduction

	Are you a student who listens to lo-fi music?	**Frequency**	**Percentage**	**Cumulative Percentage**
Valid	Yes	124	94,7	94,7
	No (end of the questionnaire)	7	5,3	100
	Total	**131**	**100**	

Source: Own elaboration.

This section contains miscellaneous information about the respondents and the way they listen to lo-fi music.

In the first question, which regards the participants' age, it can be analyzed a larger concentration of participants between 20 and 21 years (34,7%) and between 22 and 23 years old (27,4%), followed by students whose age is between 18 and 19 (20,2%). 9,7% of participants are 16 or 17 years old, and 6,5% are 24 or older. Just 1,6% of respondents are 15 or younger (Table 2).

Table 2 - Age

	How old are you?	Frequency	Percentage	Cumulative Percentage
Valid	15 or younger	2	1,6	1,6
	16 – 17	12	9,7	11,3
	18 – 19	25	20,2	31,5
	20 – 21	43	34,7	66,2
	22 – 23	34	27,4	93,6
	24 or older	8	6,5	100
	Total	**124**	**100**	

Source: Own elaboration.

Regarding gender, from a total of 124 students, the majority are male (67%), followed by 39,5% female students. 6,5% of respondents identify as other genders or preferred not to disclose (Table 3).

Table 3 - Gender

	I identify myself as a:	Frequency	Percentage	Cumulative Percentage
Valid	Male	67	54	54
	Female	49	39,5	93,5
	Other/Prefer not to say	8	6,5	100
	Total	**124**	**100**	

Source: Own elaboration.

Concerning the methods of choice for lo-fi listening, a considerable number of participants (45,2%) usually choose to listen to lo-fi via 24/7 live streams, while 29,8% prefer to manually pick their favourite mixes and track compilations. The remaining students prefer to listen to some lo-fi songs in particular (14,5%) or have their playlists (10,5%). Table 4 displays the results.

Table 4 - Lo-fi listening methods of choice

	When listening to lo-fi, do you more often pick:	Frequency	Percentage	Cumulative Percentage
Valid	24/7 live streams	56	45,2	45,2
	Lo-fi mixes (track compilations)	37	29,8	75
	Specific lo-fi songs	18	14,5	89,5
	Your own playlist	13	10,5	100
	Total	**124**	**100**	

Source: Own elaboration.

The question "How do you listen to lo-fi music?" was the only one which allowed participants to pick multiple answers, as this made sense given the question's context. It can be confirmed that the vast majority of participants listen to lo-fi as a study or work companion

(71,8%), as well as an instrument to help relax (62,9%). 29,8% of students listen to lo-fi while playing games, 23,4% use lo-fi as a means to help them fall asleep and 18,5% listen to lo-fi at the gym or practising a sport (Figure 6).

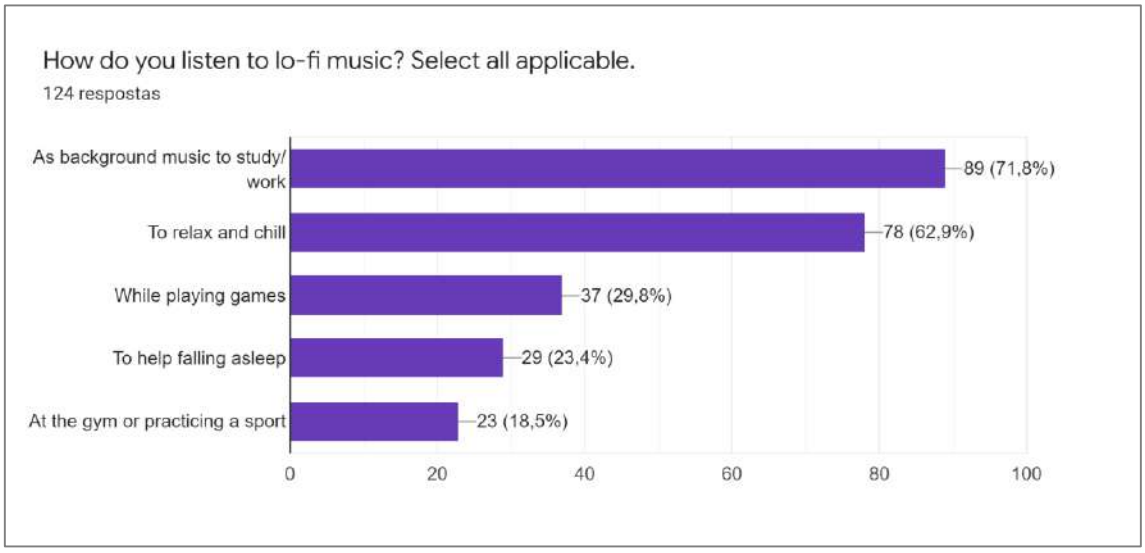

Figure 6 - Activities done when listening to lo-fi
Source: Own elaboration.

Table 5 refers to how much time a day students typically spend listening to lo-fi music. It can be examined the amount of time spent listening to the genre varies considerably from student to student. 26,6% of students spent between 1 and 2 hours listening to lo-fi, immediately followed by 25,8% who spent from 2 to 3 hours. This percentage is not much higher than the one of students who spend from 30 minutes to an hour (20,2%), which is then followed by 12,1% of respondents who usually spend less than 30 minutes and 11,3% who enjoy lo-fi from 3 to 4 hours a day. 4% of students participating in the questionnaire listen to lo-fi music for 4 hours or more per day.

Table 5 - Time spent per day listening to lo-fi

	Usually, how much time a day do you spend listening to lo-fi?	**Frequency**	**Percentage**	**Cumulative Percentage**
Valid	30 minutes or less	15	12,1	12,1
	30 minutes – 1 hour	25	20,2	32,3
	1 – 2 hours	33	26,6	58,9
	2 – 3 hours	32	25,8	84,7
	3 – 4 hours	14	11,3	96
	4 hours or more	5	4	100
	Total	**124**	**100**	

Source: Own elaboration.

The next question, portrayed in Table 6, regards the volume one usually sets when listening to lo-fi. Near half of the participants (48,4%) set a normal volume, followed by 33,9% who prefer a lower volume and 17,7% who opt for a louder listening experience.

Table 6 - Usual listening volume

	At which volume do you typically enjoy your lo-fi music?	Frequency	Percentage	Cumulative Percentage
Valid	Low volume	42	33,9	33,9
	Normal volume	60	48,4	82,3
	Loud volume	22	17,7	100
	Total	**124**	**100**	

Source: Own elaboration.

In this section, every question was shaped as a statement and students had to answer from 1 to 5 regarding how much they related to it, being 1 – Totally disagree, 3 – Neutral or not applicable and 5 – Totally agree. Only one number could be picked per statement.

Figure 7 shows more than half of the inquired students (52,4%) feel more capable of solving problems when listening to lo-fi, and 33,9% (n=42) mostly agree with the statement. 12,1% responded neutrally and 2 students disagree to some extent. No student completely disagreed.

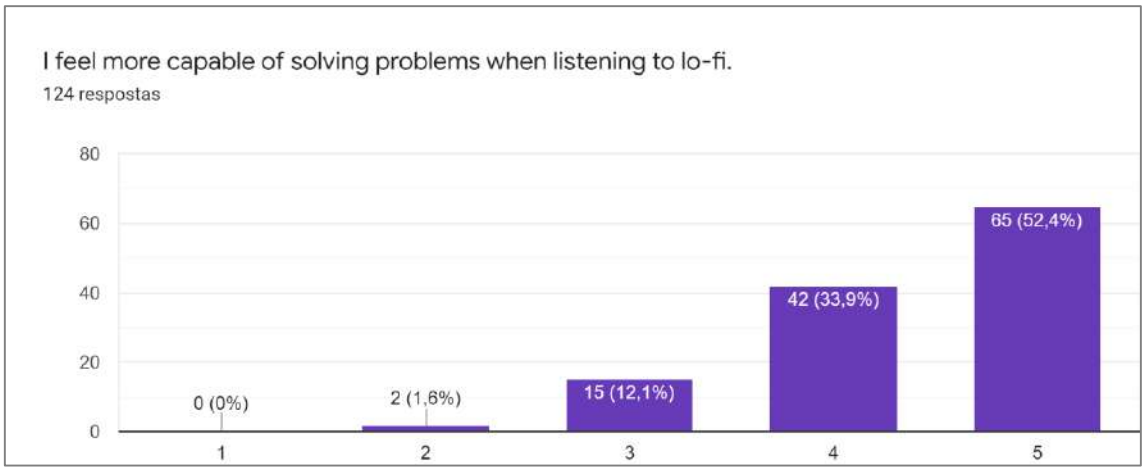

Figure 7 - Problem-solving
Source: Own elaboration.

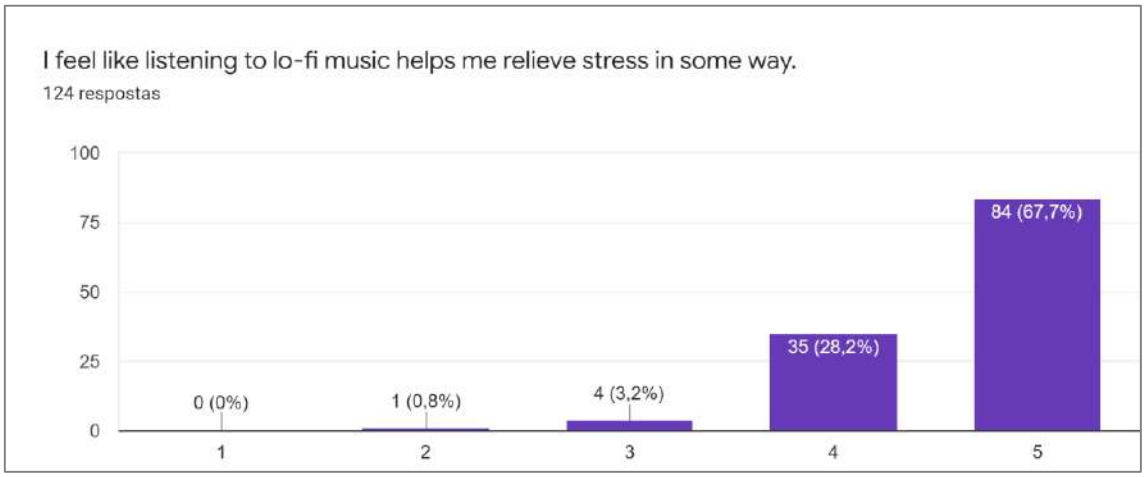

Figure 8 - Stress relieving
Source: Own elaboration.

The next statement, regarding the help of lo-fi music in relieving stress, was the most positively agreed on among all nine statements from this section (Figure 8). From a total of 124 students, 84 (67,7%) acknowledge with confidence that lo-fi is a reliable help in relieving stress, while 35 (28,2%) mostly agree, totalling 96% of students who agree with the statement. Only 4% of students are neutral or partly disagree (3,2% and 0,8%, respectively). Figure 9 shows52,4% of inquired students feel more productive when listening to lo-fi, and 40,3% agree to an extent. The remaining 7,3% are neutral or do not have an established opinion on the matter. No student partly or completely disagreed.

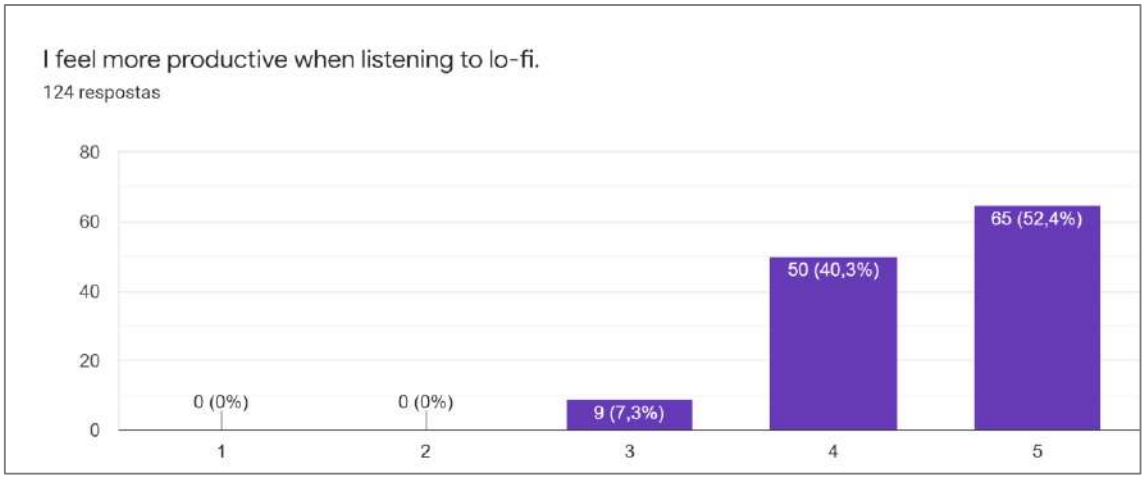

Figure 9 - Productivity
Source: Own elaboration.

Figure 10 indicates that 47,6% of surveyed students feel more creative when listening to lo-fi, fully agreeing with the statement given. 38,7% somewhat agree lo-fi has a positive effect on their creativity, while 11,3% are neutral on this subject. The remaining 3 students (2,4%) do not feel lo-fi brings any benefit to their creative thinking.

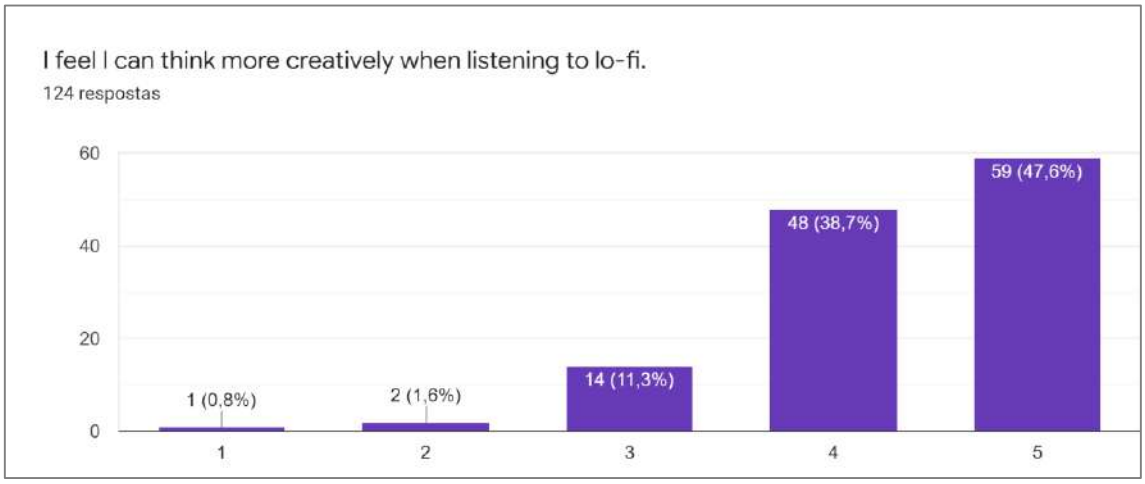

Figure 10 - Creativity
Source: Own elaboration.

The next question marks a shift from concerning only the participants' personal views and feelings to more direct statements, fact-based and with tangible results (Figure 11). 46% of questioned students truly agree lo-fi effectively improve their studying performance, while 41,1% agree with the statement to some extent. 12 students (9,7%), from a total of 124, feel neutral on this subject, and 3 (2,4%) disagree. 1 student strongly disagrees.

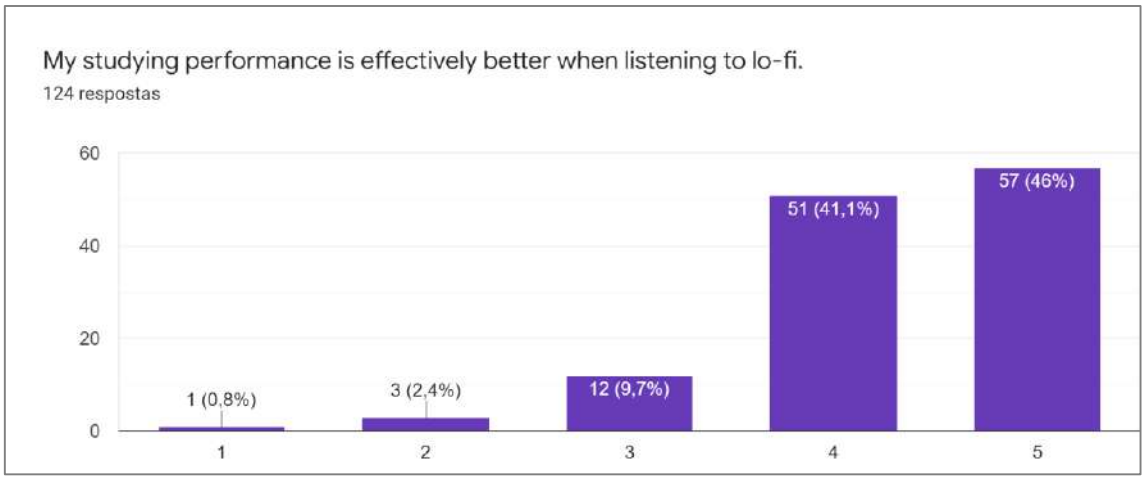

Figure 11 - Studying performance
Source: Own elaboration.

In the question shown in Figure 12, while answers are still mostly positive, it is possible to recognize the impact of more fact-based questions on the answers provided, when compared to the previous graphs. Based on actual academic results, lo-fi music reportedly improves the academic performance of 70,2% of students, from which 37,1% fully agree and 33,1% partially agree. 23,4% answered neutrally, being the largest neutrality percentage of any statement in this section. 6,4% of students disagree that lo-fi has improved their academic performance.

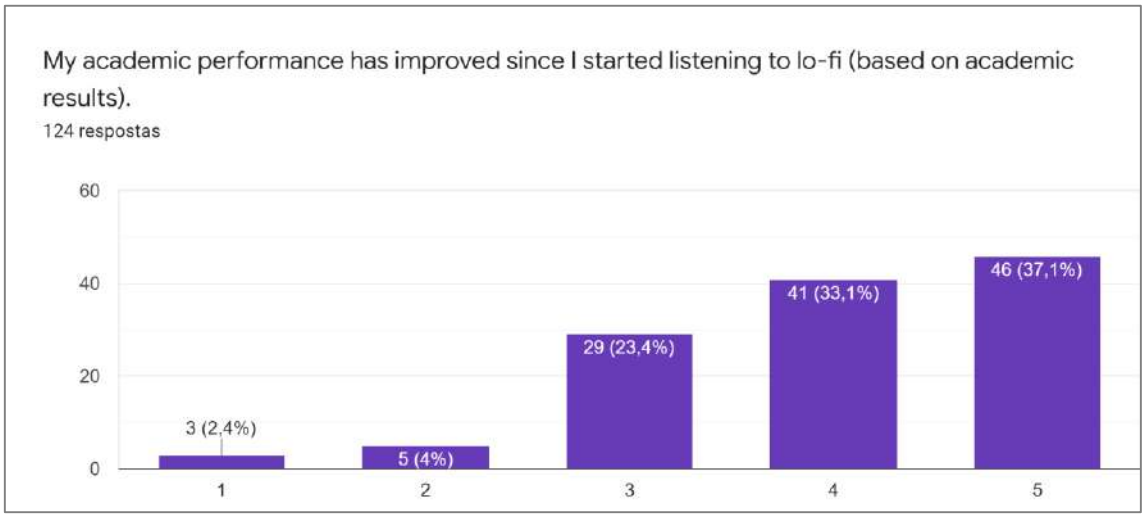

Figure 12 - Academic performance
Source: Own elaboration.

The question presented in Figure 13 had the goal of stretching lo-fi's performance influence to a wider picture. This was achieved successfully, as a substantial percentage of students (45,2%) truly agree on lo-fi helps them have better performance on whichever task they are doing at that given moment, while 39,5% agree to some point. 13,7% answered neutrally, while 2 students (1,6%) somewhat disagree.

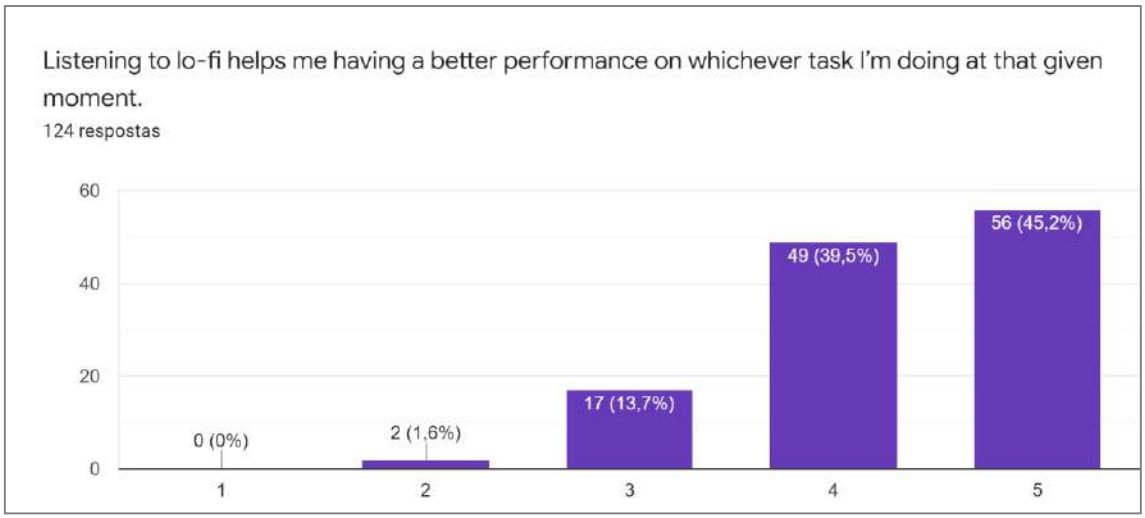

Figure 13 - Global performance
Source: Own elaboration.

Figure 14 provides a statement comparing the contributions of lo-fi on students' productivity to other music genres. Once again, over half of examined participants strongly agree on lo-fi's uniqueness in contributing to their productivity, followed by 26,6% partially agreeing on students and 11,3% maintaining neutrality on the topic. 4 students (3,2%) partially disagree with the statement, while the remaining 2 (1,6%) strongly disagree, suggesting that other music genres might have a better impact on their productivity.

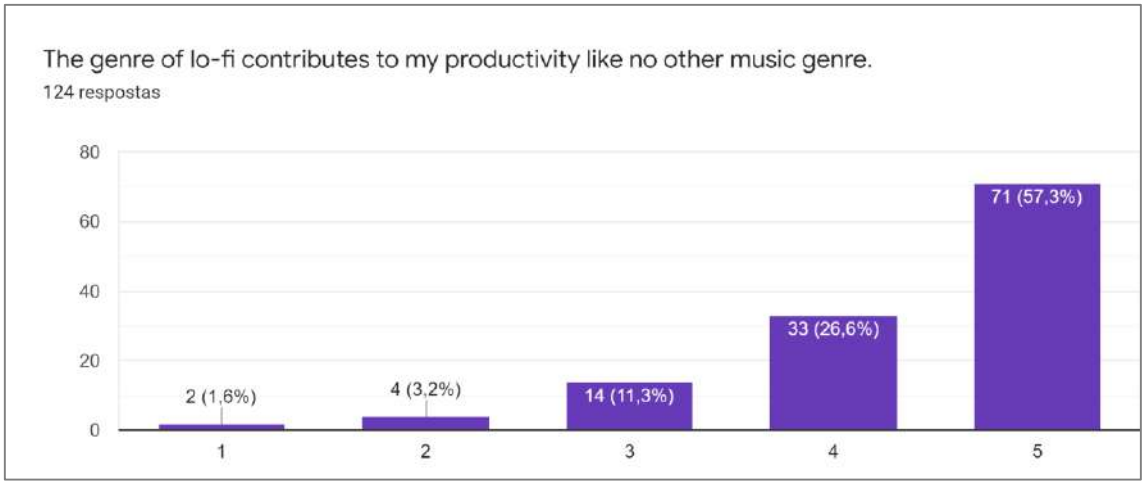

Figure 14 - Productivity compared to other genres
Source: Own elaboration.

The questionnaire ends with a statement similar to the previous one, this one referring to the distinctiveness of lo-fi in contributing to a student's creative capabilities. Comparing Figures 14 and 15, it can be noted that answers are equally similar: 55,6% of 124 students fully agree on lo-fi being unique in contributing to their creative capabilities, 28,2% somewhat agree and 12,1% are neutral. 3,2% of students disagree to an extent, and 1 student (0,8%) strongly disagrees. As so, it is implied that 4% of students found another music genre to have better contributions to their creative capabilities.

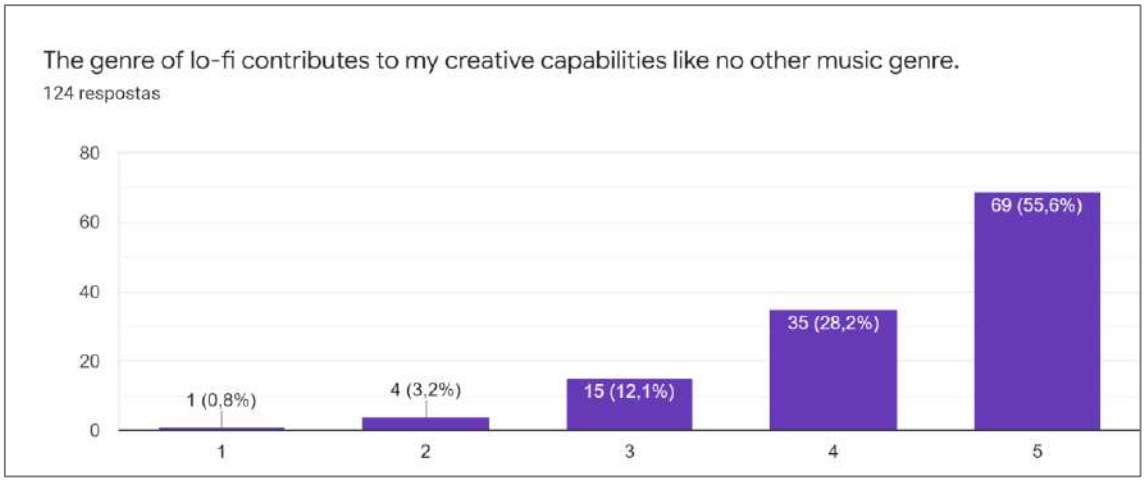

Figure 15 - Creativity compared to other genres
Source: Own elaboration.

DISCUSSION AND CONCLUSIONS

Further analysis of all collected answers from the questionnaire and given discussions and conclusions will be presented in this chapter.

Section 2, being the first part of the questionnaire, showed no clear discrepancies between exogenous factors including age and gender, as students from all age groups and genders participated in the survey. It can be further examined in this section that participating students each have their lo-fi listening habits which do not seem to have a direct influence on section 3's answers, which are the ones of most direct importance to the findings of the present report.

Some of the answers' results were expected by the author, including 24/7 live streams being the most often picked method of listening to lo-fi, as it was with these live streams lo-fi earned its current popularity among students in the first place. Also, lo-fi being used as background music to study/work, as well as to relax and chill, were too anticipated results given the fact only students who listen to lo-fi were able to answer the questionnaire, as well as lo-fi's calming properties, respectively.

The amount of time one listens to lo-fi does not seem to make a noticeable difference in section 3's results, as the results are well distributed. Most students also prefer not to listen to lo-fi at loud volumes.

Analyzing the first four answers from this section, all solely questioning the way participants feel when listening to lo-fi music, indicates students unmistakably do feel more capable of solving problems, more productive, stress relieved, and ultimately more creative.

The second question, from which one can understand by analyzing the answers that lo-fi music is of great help in stress relieving, goes in concordance with Byron et al's (2010) findings. Again, these researchers stated low stress-inducing situations can lead to an improvement in creative performance, while high stress-inducing situations can lead to a decline in one's creative capabilities (Byron et al., 2010). As lo-fi music influences a student's state of mind to be less stressful, it ultimately leads to an increase in creative thinking capabilities, verified in the fourth question's results, in which students strongly agreed on feeling capable of thinking more creatively when listening to lo-fi.

The fifth question, acting as a bridge between emotion-based and more direct, fact-based questions, did not see a shift in student agreement rate compared to the first four. Students generally agree their studying performance is effectively better when listening to lo-fi music, lining in with the genre's popularity and appraisal as a studying companion. This shift, however, is quite noticeable when students were asked if their academic performance, based on actual results, had improved since they started listening to lo-fi. While answers were positive, this question had the lowest agreement rate (70,2%) of all questions, considerably below the average of all nine answers (85,65%), while also having the highest neutrality percentage (23,4%).

This shift was reversed when participants were asked if listening to lo-fi helps them have a better performance on whichever task they're doing at that given moment, receiving overwhelmingly positive answers. The last two questions related to the uniqueness of lo-fi in helping improve productivity and creativity, are also crucial for the basis of this thesis. If answered negatively, it would be recommended further, deeper research on other genres' effects on these subjects. Responses were also tremendously possible on both matters, averaging an 83,85% positivity rate.

This study doesn't come without its limitations, as several complexities were identified in the making of this questionnaire.

This being a report using a quantitative method of research, unless there are multiple open questions – which, in this case, there are none – there is virtually no room for respondents to give their point of view on the concerned subjects. Also, even though the questionnaire was

carefully planned and grammatically reviewed multiple times before publishing, the researcher can't clarify the confusion caused by a given question that may have been unclear for the respondent (Marshall, 2005).

Being distributed entirely online and easily accessible by anyone receiving the survey's access link, there is always a chance of a certain percentage of results being biased, especially considering there is no age restriction. This can happen intentionally, driven by malicious intent of adulterating one's work, or merely out of support for the lo-fi movement and a desire for the genre to get more widespread acceptance and appreciation.

Further, the current topic falls within the fields of specialized branches such as neurobiology and music education, much outside the author's scope of expertise. As so, scientific research by experts in these respective areas may obtain more accurate results and go into deeper grounds. Still, this study aims to incentive further and deeper research on the matter.

CONCLUSIONS

The present paper studied the impact of lo-fi on students' creative thinking and performance. Based on the results of the quantitative research completed to support this paper, it can be concluded that lo-fi has a positive impact on a student's creativity and performance. With these results, it could be discovered that lo-fi also has a beneficial impact on factors such as stress relieving and productivity, which can be directly linked to a better studying and creative environment.

With the theoretical framework, it was presented an overview of lo-fi as a concept and as a genre, as well as creativity, creative thinking and students' performance. Also, it was studied the connection between both main subjects of matter – lo-fi music and creativity – to mental health, as a means of better understanding how lo-fi achieves this positive impact.

Lo-fi music stands as both a study and relaxing companion for thousands of students from all around the world. The existence and popularity of online communities, servers and chats dedicated to lo-fi, some with over half a million participants, prove students and lo-fi enjoyers are willing to go a long way in worshipping the genre. This was an inspiration for the development of this study, as lo-fi has the potential to enhance the creative capabilities of a massive number of lo-fi listeners and supporters globally.

With this in consideration, and due to concerns on the aforementioned limitations, the author recommends this study to be followed by proper scientific evaluations, studies and

experiments, to further discover technical sources on how lo-fi achieves this, and how can one take the best possible advantage of the genre's properties to reach a creative pinnacle.

REFERENCES

Alexander, J. (2020) Lo-fi beats to quarantine to are booming on YouTube, The Verge

Allmusic, Lo-Fi Music Genre Overview. Retrieved from https://www.allmusic.com/style/lo-fi-ma0000002701?1656279986051

Arora, Nisha & Singh, Neetu. (2017). Factors Affecting the Academic Performance of College Students. i-manager's Journal of Educational Technology. 14. 47.

Bell, A. P. (2018). Dawn of the DAW: The Studio As Musical Instrument. Oxford University Press. p. 29.

Black, S. E., Lincove, J. A., Cullinane, J., Veron, R. (2015) Can You Leave High School Behind?, Economics of Education Review

Bohm, A. (1998). On Creativity. New York: Harper and Row, Publishers.

Byron, K., Khazanchi, S., & Nazarian, D. (2010). The relationship between stressors and creativity: A meta-analysis examining competing theoretical models. Journal of Applied Psychology, 95(1), 201–212.

Chickering, A. W., & Gamson, Z. F. (1999). Development and adaptations of the seven principles for good practice in undergraduate education. New Directions for Teaching and Learning, 80, 75-81.

Chirikov, I., Soria, K. M, Horgos, B., & Jones-White, D. (2020). Undergraduate and Graduate Students' Mental Health During the COVID-19 Pandemic. UC Berkeley: Center for Studies in Higher Education.

Cockerton, T., Moore, S., & Norman, D. (1997). Cognitive Test Performance and Background Music. Perceptual and Motor Skills, 85(3_suppl), 1435–1438.

Cooper, D. & Schindler, P. (2014). Business Research Methods. McGraw Hill, 148

Cropley, A. J. (1990). Creativity and mental health in everyday life. Creativity Research Journal, 3(3), 167–178.

Csikszentmihalyi, M. (1990) The domain of creativity, in M. Runco and R. Albert, eds., Theories of Creativity, Sage Publications, London.

Debbane, M., Badoud, D., Sander, D., Eliez, S., Luyten, P., and Vrticka, P. (2017). Brain activity underlying negative self- and other-perception in adolescents: The role of attachment-derived self-representations.

Dolegui, A. S. (2013). The Impact of Listening to Music on Cognitive Performance. Vol. 5 No. 09

Furnham, A., & Bradley, A. (1997). Music while you work: the differential distraction of background music on the cognitive test performance of introverts and extraverts. Applied Cognitive Psychology, 11(5), 445–455.

Gillam, T. (2013). Creativity and mental health care. Mental Health Practice, 16(9), 24–30.

Gordon, J. S., & McNew, R. (2008). Developing the Online Survey. Nursing Clinics of North America, 43(4), 605–619.

Green, B. F., & Hall, J. A. (1984). Quantitative Methods for Literature Reviews. Annual Review of Psychology, 35(1), 37–54.

Hallam, S & Godwin, C. (2015) Actual and perceived effects of background music on creative writing in the primary classroom, Psychology of Education Review, 39(2), 3.

Hallam, S. (2010). The power of music: Its impact on the intellectual, social and personal development of children and young people. International Journal of Music Education, 28(3), 269–289.

Hammarberg, K., Kirkman, M., & de Lacey, S. (2016). Qualitative research methods: when to use them and how to judge them. Human Reproduction, 31(3), 498–501.

Hammerstein, S., König C., Dreisörner T. & Frey A. (2021) Effects of COVID-19-Related School Closures on Student Achievement-A Systematic Review, Vol. 12, Frontiers in Psychology ISSN=1664-1078

Harper, A. (2014). Lo-Fi Aesthetics in Popular Music Discourse, 2, 9-10

Hoon P. J., Weihua N., Li C. & Heavon A. (2021) Fostering Creativity and Critical Thinking in College: A Cross-Cultural Investigation. Frontiers in Psychology, 12

Howard Cannatella (2004). Embedding Creativity in Teaching and Learning. Journal of Aesthetic Education, 60

Ilie, G., & Thompson, W. F. (2011). Experiential and Cognitive Changes Following Seven Minutes Exposure to Music and Speech. Music Perception: An Interdisciplinary Journal, 28(3), 247–264.

Jones, B. (2014) Signifying DIY: Process-oriented Aesthetics In 1990s Alternative Rock and Hip-Hop. Chapel Hill, NC: University of North Carolina at Chapel Hill Graduate School

Kampylis, P., & Berki, E. (2014). Nurturing creative thinking. International Academy of Education, 6, 88.

Khan, M. J., Altaf, S., Kausar, H. (2013) FWU Journal of Social Sciences, Winter 2013, Vol. 7, No. 2, 146-151

Koulibaly, N. (2020) LoFi music, mental health, and its beautiful impact on its listeners, KultureHub

Lai, E. R. (2011) Critical Thinking: A Literature Review. Pearson

Lefever, S., Dal, M., & Matthíasdóttir, Á. (2007). Online data collection in academic research: advantages and limitations. British Journal of Educational Technology, 38(4), 574–582.

Lewis, S. (2015). Qualitative Inquiry and Research Design: Choosing Among Five Approaches. Health Promotion Practice, 16(4), 473–475.

Marshall, G. (2005). The purpose, design and administration of a questionnaire for data collection. Radiography, 11(2), 131–136.

Mushtaq, I., Khan, S. N. (2012) Factors Affecting Students' Academic Performance, Global Journal of Management and Business Research, Volume 12 Issue 9 Version 1.0

Nguyen, T. & Grahn, Jessica A. (2017) Mind Your Music: The Effects of Music-Induced Mood and Arousal Across Different Memory Tasks

Norhidayah, Ali & Jusoff, Kamaruzaman & Ali, Syukriah & Najah, Mokhtar & Salamat, Azni. (2009). The Factors Influencing Students' Performance at Universiti Teknologi MARA Kedah, Malaysia. Management Science and Engineering.

Paul, R. & Elder, L. (2008) The Thinker's Guide to The Nature and Functions of Critical & Creative Thinking, The Foundation for Critical Thinking Press.

Ramalingam, D., Anderson, P., Duckworth, D., Scoular, C., & Heard, J. (2020). Creative thinking: Definition and structure. Australian Council for Educational Research.

Rauscher, F. H., Shaw, G. L., & Ky, C. N. (1993). Music and spatial task performance. Nature, 365(6447), 611–611.

Rauscher, F. H., Shaw, G. L., & Ky, K. N. (1995). Listening to Mozart enhances spatial-temporal reasoning: towards a neurophysiological basis. Neuroscience Letters, 185(1), 44–47.

Reid, A.; Petocz, P. (2004). Learning domains and the process of creativity

Ritter, S. M., & Ferguson, S. (2017). Happy creativity: Listening to happy music facilitates divergent thinking. PLOS ONE, 12(9), e0182210.

Running, D. J. (2008). Creativity Research in Music Education. Update: Applications of Research in Music Education, 27(1), 41–48.

Schafer, R. M. (1977). The Tuning of the World, 272

Schneider, M. (2002) Do School Facilities Affect Academic Outcomes?, National Clearinghouse for Educational Facilities

Seppala, T. (2018) The science behind the 'beats to study to' craze, Engadget

Spiegel, A. (2010) 'Mozart Effect' Was Just What We Wanted To Hear, NPR

Steinmayr, R., Weidinger, A. F., Schwinger, M., & Spinath, B. (2019). The Importance of Students' Motivation for Their Academic Achievement – Replicating and Extending Previous Findings. Frontiers in Psychology, 10.

Swede, G. (1993) Creativity: A New Psychology, Wall & Emerson, Toronto

Tenny S, Brannan GD, Brannan JM, et al. (2021) Qualitative Study. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing.

UKEssays. (November 2018). Reasons why Academic Success is Important. Retrieved from https://www.ukessays.com/essays/education/why-is-academic-success-important-education-essay.php?vref=1

Vartanian, O., Saint, S. A., Herz, N., & Suedfeld, P. (2020). The Creative Brain Under Stress: Considerations for Performance in Extreme Environments. Frontiers in Psychology, 11.

Vasantha Raju N., & Harinarayana, N.S. (2016, January). Online survey tools: A case study of Google Forms. Paper presented at the National Conference on "Scientific, Computational & Information Research Trends in Engineering, GSSS-IETW, Mysore.

Wang, Justin (2020). Lofi Hip-Hop Radio: Beats to Relax/Study To, 1, 13, 21

Weisberg, R. W. (1986). Creativity: Genius and other myths. New York: Freeman.

Weisberg, R. W. (1993). Creativity: Beyond the myth of genius. New York: Freeman

Winkie, L. (2018). How 'Lofi Hip Hop Radio to Relax/Study to' Became a YouTube Phenomenon, Vice

Winston, E., Saywood, L. (2019). Beats to Relax/Study To: Contradiction and Paradox in Lofi Hip Hop. Journal of the International Association for the Study of Popular Music, 40

Yanhua, X., Jinlian, S., Wei, Z., Xingrou, W., Dongtao, H., Yuqing, Z. & Jiamin, W. (2021) Depression and Creativity During COVID-19: Psychological Resilience as a Mediator and Deliberate Rumination as a Moderator. Frontiers in Psychology, 12.

Appendix: Questionnaire

Impact of lo-fi music on students' creative thinking and performance

This questionnaire was made in the scope of the Final Project curricular unit, part of the course of Creativity and Business Innovation at ISCAP, in Portugal. It will serve as research support for the conclusion of the final thesis "How lo-fi music impacts students' creative thinking and performance".

The questionnaire is fully anonymous, and all data will be used solely for the intent of the present research. Thank you for participating!

1st section:

1. Are you a student who listens to lo-fi music?

□ Yes

□ No (end of questionnaire)

2nd section:

Part 1

2. How old are you?

□ 15 or younger

□ 16 - 17

□ 18 - 19

□ 20 - 21

□ 22 - 23

□ 24 or older

3. I identify myself as a:

□ Male

□ Female

□ Other/Prefer not to say

4. When listening to lo-fi, do you more often pick:

□ 24/7 live streams

□ Lo-fi mixes (track compilations)

□ Specific lo-fi songs

□ Your own playlist

5. How do you listen to lo-fi music? Select all applicable.

□ As background music to study/work

□ To relax and chill

□ While playing games

□ To help falling asleep

□ At the gym or practicing a sport

6. Usually, how much time a day do you spend listening to lo-fi?

□ 30 minutes or less

□ 30 minutes - 1 hour

□ 1 - 2 hours

□ 2 - 3 hours

□ 3 - 4 hours

□ 4 hours or more

7. At which volume do you typically enjoy your lo-fi music?

□ Low volume

□ Normal volume

□ Loud volume

3rd section:

Part 2

Select a number between 1 and 5, where:

1 – Totally disagree; 3 – Neutral or not applicable; 5 – Totally agree

	1	**2**	**3**	**4**	**5**
I feel more capable of solving problems when listening to lo-fi.					
I feel like listening to lo-fi music helps me relieve stress in some way.					
I feel more productive when listening to lo-fi.					
I feel I can think more creatively when listening to lo-fi.					
My studying performance is effectively better when listening to lo-fi.					
My academic performance has improved since I discovered lo-fi (based on academic results).					
Listening to lo-fi helps me have better performance on whichever task I'm doing at that given moment.					
The genre of lo-fi contributes to my productivity like no other music genre.					
The genre of lo-fi contributes to my creative capabilities like no other music genre.					

CHAPTER 3 – IMPACT OF CREATIVITY TECHNIQUES ON FIRM PERFORMANCE

João Magalhães

Orlando Lima Rua

ABSTRACT

This research aims to recognize creativity techniques' impact on firm performance. Consequently, this study aims to understand the impact of these techniques on a Small and Medium Enterprise - Unify.

A qualitative methodology was developed, and the single case study method was used to analyze Unify. The research instrument used was the semi-structured interview with Unify's employees.

The results show that the most used technique in the company was Brainstorming. The main barrier to using this technique was that they were not all in the same space at the same time and, finally, that the use of creativity techniques impacts the firm's performance. The main conclusions obtained show that creativity techniques have a positive impact on firm performance.

Keywords: Creativity, Creative techniques, Firm-performance, SMEs.

INTRODUCTION

Creativity has been around since the beginning of humanity. The concept of creativity in the pre-Christian era was related to an expression of divine grace and the capacity of a genius making creativity a concept of secrecy that society had no idea of how to explain (Tschimmel, 2019). The creative techniques of problem-solving that promote the learning of creativity have been increasing, and many are already taught in schools and universities (Bertoncelli, Mayer & Lynass, 2016). The same scholar believes that the goal is to think outside the box to obtain and create new solutions. For Mumford et al. (2002), applying creativity techniques is a vital strategy to stimulate creativity.

Evans and Russell (1989) emphasize that the creative behaviour of the organization's members represents the key factor in response to changes and opens space for the organization to promote innovations. This study aims to understand the relationship between the impact of creativity techniques on firm performance through a qualitative methodology that will answer eight research questions to know if the interviewees think the use of creativity techniques impacts firm performance.

To support the relationship between creativity techniques and firm performance, Alencar (1996) emphasizes the emergence of creativity within organizations, due to the frenetic pace of scientific and technological advances that have made knowledge obsolete quickly, requiring a capacity for continuous and permanent learning. This scholar also refers to the impossibility of predicting what knowledge will be needed in the future, creativity emerges as an indispensable skill to help the individual adapt to the new situations of uncertainty and complexity of the scenario of changes.

This final thesis is organized as follows: First, the theoretical framework for this study is presented. The following section presents the methodology. Then, the results are analysed. Finally, we discuss these results and present our conclusions.

LITERATURE REVIEW

CREATIVITY

Concept and evolution

Bagulho (2014) refer that Creativity was born along with human existence, without it, we would not have survived and evolved to what we are today. However, this author also sustains that the way of thinking about creativity has changed throughout history.

According to Jones, Svejenova et al. (2016), creativity is seen as an emergence of new ideas through experimentation. Earlier definitions claim that creativity is a purposeful activity (or set of activities) that produces valuable products, services, processes, or ideas that are better or new (DeGraff & Lawrence, 2002). Another definition is that creativity is an intuitive process that arrives at the solution of a problem without going through a structured procedure and uses a whole set of knowledge that the individual has, often unconsciously (Vasconcellos, 1990). In this way, the author states that creativity can take several forms, that is, it can be relative, productive, negative or destructive. Alencar (1996) defines creativity as a process resulting from the emergence of a new good or service, perceived as useful, satisfying and/or of value by a significant number of people at a given time.

For Csikszentmihalyi (1996, p.23), creativity "does not occur within individuals but is the result of the interaction between the individual's thoughts and the sociocultural context. Creativity must be understood not as an individual phenomenon but as a systemic process". According to Bagulho (2014), recent studies on creativity focus on a more comprehensive perspective advocating interdisciplinarity in the study of the phenomenon. Lubart (2003) defends that creativity is understood as the result of a convergence of cognitive, emotional and environmental factors that impact the individual in isolation, or within a group or organization. On the other hand, Amabile (2012) refers that creativity needs to interconnect three factors and defends them as being mastery skill, creative processes and motivation. Mastery skill is the knowledge of available techniques and knowing how to apply them; Creative processes are related to the individual himself, his experiences, personality, discipline, persistence and the ability to approach a situation from a new perspective. Finally, motivation is the pleasure that comes from the proposed challenge. This scholar sustains that it is by combining these three factors in a balanced way that the individual will be able to produce creative thinking.

Costa (2011) sustains that there are many definitions of creativity, and it is undoubtedly a complex and multifaceted concept, which is conditioned by the scope of application and can be approached from many different perspectives. In Table 1 we can see the concept of Creativity evolving throughout the years and how the term was viewed from a different perspective over time.

Table 1 - Creativity concept evolution

Author(s)	Year	Perspective On Creativity
Kris	1952	"Seen as motivation"
May	1958	"Bringing something new into birth"
Campbell	1960	"Seen as blind variation"
Mumford & Gustafson	1988	"A complex phenomenon as a journey from an idea to a product"
Vasconcellos	1990	"Creativity is an intuitive process that arrives at the solution of a problem"

Alencar	1996	"a process resulting from the emergence of a new good or service"
DeGraff & Lawrence	2002	"a purposeful activity (or set of activities) that produces valuable products, services, processes, or ideas that are better or new"
Jones, Svejenova, Pedersen, & Townley	2016	"Emergence of new ideas through experimentation"
Ohly	2018	"Generation of Novel and Useful Ideas"
Chummee	2022	"Ideas are brought Creativity into the production of goods and services"

Source: Adapted from Walia (2019).

Bagulho (2014) states that at a time when the economic climate, enhanced by globalization, is increasingly competitive, it is becoming increasingly necessary to generate original ideas and products that put organizations in a prominent position. Despite the special importance of creativity for today's economy, this idea is far from recent. Schumpeter (1942) emphasizes the importance of creativity for the economy. For Ohly (2018) creativity is the generation of novel and useful ideas. Organizations, including universities and other research institutions, need to develop novel and useful products to satisfy constantly evolving customer needs. Also according to this scholar, the world is changing fast and it's important to be authentic about your ideas and try to keep up with the changes in behaviour in society.

Next, Amabile and Khaire (2008) defend that it's important to encourage individuals to create the perfect environment for them to be creative. Some examples that help to enhance creativity in the work environment are the freedom to do the work, collaborative work teams, a focus on generating ideas, leaders who encourage the development of new ideas, appropriate recognition of creative work, and mechanisms that enable the development of new ideas, and procedures that stimulate the exchange of ideas across the organization. This scholar also states that people will be more creative when they feel motivated mainly by self-interest, by enjoying the task, having satisfaction and by the challenge of the task itself and not due to extrinsic motivators.

Below, in Figure 1, we can see a framework that portrays the relationship between the concepts of creative person, creative task and creative product.

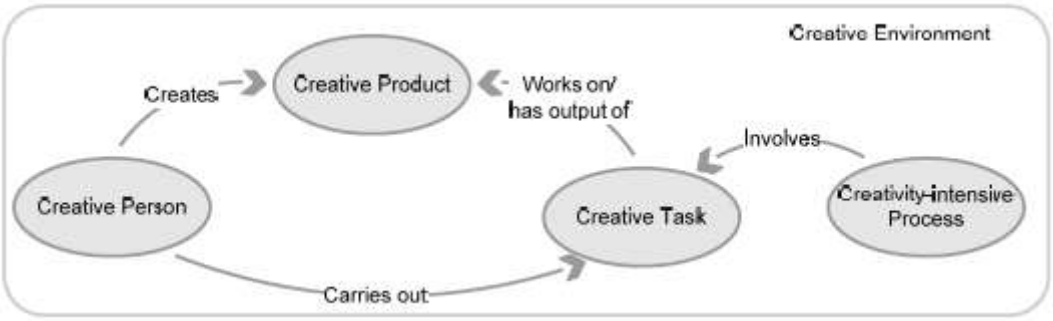

Figure 1 – Relationship between Creative Person, Task and Product
Source: Seidel et al. (2008).

In Figure 1, we can see the relationship between Creative person, task and product. The creative product is an artefact that serves a particular purpose and is characterized by novelty (Seidel et al., 2008). It is the output of a creativity-intensive process. The same scholar states that the creative person is the individual that carries out a creative task to create a creative product. The creative task of the same author is the task that is carried out to produce a creative product. They consider that Creative tasks have a high variance in process and outcome.

According to Mumford et al. (2002), there are two sets of processes that are involved in creative work: (a) activities leading to idea generation (ideation) and (b) activities needed to implement ideas (implementation). This scholar states that the identification of an unsolved problem (conceptualization) requires creativity and could be considered a creative task in itself. With this statement, this scholar defends firmly that what generates a creative task is an opportunity to solve an unsolved problem.

Seidel et. al (2008) defends that one of the main topics to discuss when measuring what creativity can provide to organizations is to evaluate the impact that creative tasks have. Creative tasks are those that result in creative products as part of a business process. A comparison between creative and non-creative tasks is shown in Table 2

Table 2 - Creative tasks and non-creative tasks

Non-Creative Task	Creative Task
Pre-Arranged	Hard to predict
High Repeatability	Low Repeatability (variance in the process)
Low creativity in that the outcome is pre-arranged	High Creativity in that the outcome is often hard to predict (variance in the product)
Low knowledge-intensity	Knowledge-intensive, to a high degree influenced by previous knowledge
Low risk, mainly technical risk that can be mitigated through according to routines	High risk, particularly creative risks
Low level of communication-intensity	High level of communication intensity

Source: Adapted from Seidel et al. (2008).

Seidel et al. (2008) sustain those creative tasks are tasks within business processes that have creative products as an outcome. The characteristics of creative tasks have been systematically compared to those of noncreative tasks. To do so, properties of the category have been identified and different tasks have been classified dimensionally. Pink (2011) defends that although it is still an under-explored field, some studies prove that workers who in their daily lives develop creative tasks have higher job satisfaction and lower intention to quit.

Creativity factors

Lacombe and Heilborn (2003) state that companies that react quickly to permanent change thrive, and sometimes, they are the only companies to survive. This ability to react

requires considerable and necessary flexibility and openness to new ideas and approaches. According to Motta (1995), creativity is a characteristic that exists in all individuals and can be developed and transformed into new individual skills. Vasconcellos (1990) shares and emphasizes that the individual's creative potential is little used by the company for a lack of mechanisms and adequate stimulus. The emphasis on creativity is always connected with intrinsic and extrinsic factors, and also with rewards. To Ohly (2018) intrinsic motivation refers to motivation stemming from the task itself, whereas extrinsic motivation refers to motivation to gain some extrinsic reward. This scholar also states that rewards might even enhance creativity when given contingent on creativity performance. Furthermore, the usefulness of an idea will only be evident after some time when it becomes clear that a problem is solved in a better way than was previously possible.

In Table 3 below we can observe factors that facilitate creativity and some factors that block it.

Table 3 - Factors that facilitate creativity and factors that block creativity

Facilitate creativity	Block creativity
Freedom and autonomy	Rigid organizational structures
Wages and benefits	Lack of communication
Good communication and participation	Rigid leadership characteristics
Organizational support from management and co-workers	Lack of technological and material resources
Positive physical environment	Negative physical environment
Versatile organizational structure	Task characteristics

Source: Adapted from Lavadouro and Rodrigues (2007).

Focusing on the psychological climate, Alencar (1995) refers to aspects related to the organizational work environment. This scholar defends that organizations have a predominant psychological climate that corresponds to a factor of fundamental importance for the promotion of creativity and the generation of innovative proposals. VanGundy (1987) did research about characteristics of this favourable climate and the six main topics taken are (1) autonomy: which refers to the degree of freedom that people are given to expose ideas and take initiatives, (2) performance and competence reward system refers to the perception of the existence of a fair and adequate system based on people's competence and performance, (3) support for creativity: refers to people's perception that the organization supports new ideas, (4) acceptance of differences and interest in diversity among people: refers to the space given for divergent opinions and proposals, (5) personal involvement: refers to the recognition of people's skills and efforts and (6) management support: refers to the support of the organization's top management in the configuration of a creative climate.

Creativity techniques

According to Gafour (2020), a definition of creativeness is defined as a way to seem at and solve problems from a singular perspective, avoiding orthodox solutions and thinking outside the box. As the same scholar states, this creative process allows you to discover connections, meet new challenges and seek resolutions that are uncommon, original and new. Several consider that creative thinking techniques are built on experience and knowledge. According to Gaubinge et al. (2015) creativity techniques act as a kind of catalyst, releasing a person's or a group's creative potential. In general, they are based on the application of heuristic principles such as association, abstraction, analogy, combination, variation, etc. They are commonly perceived as search techniques used for problem-solving or for finding new ideas. Costa et al. (2011) refer that for everyone to develop and enhance their creative potential, and use it, both professionally and personally, there are techniques and methods. The methods and techniques for stimulating creativity have different approaches. According to the same scholar, they can be classified as:

- Psychological incentive: Tools that have the purpose of freeing your mind from the mental blocks that inhibit imagination. Ex: Brainstorming.
- Reasoning orientation: Tools that have the purpose of orienting creative thinking by offering concepts and directions for the generation of new ideas. They are structured methods, with full freedom of imagination, but following general guidelines to ensure a reasonable level of relevance. Ex: List of attributes, mind maps.

Mind Map

Gaubinger et al. (2015) refer that the creativity technique was developed in 1974 by Tony Buzan. Its primary purpose is to help structure and visualize problems, considering the interplay of both hemispheres of the brain by combining visual with logical thought. In this way, the problem can be presented in the form of an overview with an open structure, making it possible to illuminate minor aspects, show new connections or add new points. This scholar also states that the Mind-map technique materializes as a tree-like map of ideas, with the problem featured as the stem, the different solutions as major branches and all further ideas and aspects as minor branches. With the use of terms, pictures, numbers and colours, ideas are visualized in the shape of a unique field of solutions, with the option of adding on new ideas at any time. Hogan (1994) defines Mind Mapping as a process of stimulating creative thinking, planning, summarizing and memorizing, which allows relating a set of ideas, which generates new ideas, achieving a virtuous circle that is the essence of creative thinking. On the other hand, Campos (2020)

sustains that the fundamental principle of the mind map is that ideas are not born in the human brain in an organized way, but in a disorganized and chaotic way, as disconnected and random images, that become clearer as the brain works out its relationships with previous experiences. To finalize, Gaubinger et al. (2015) refer that mind mapping lends itself very well to search and analysis in the process of defining problems.

Buzan (2000) the creator of the technique created the 7 principles for making mind maps. These 7 principles according to this scholar are (1) start in the centre of the page, which should be in a landscape (horizontal) direction, (2) use one image for your central idea, (3) use lots of colours, (4) connect the main branches to the central image (subtopic to central topic) and the secondary branches to the main branches, (5) make the branches flow organically and in curves, (6) use only one keyword per line, and (7) use many images to illustrate. Buzan (1996) argues that by organizing the thought in a similar way to the brain's way of working, the mind map potentiates its abilities, favouring the understanding, analysis, interpretation, and memorization of the exercise. This scholar through research identifies several advantages in the use of Mind Map and it's showcased in Table 4 below.

Table 4 - Advantages in the use of Mind Map

Advantages in the use of Mind Map
Reduction in the time it takes to write down information, avoiding loss of content;
Reduction in reading time: faster identification and absorption of information
Reduction in the time it takes to identify the key words in a text since these are the words used in the Mind Map
Greater power of correlation between information

Source: Adapted from Campos (2020).

Brainstorming

Gaubinger et al. (2015) refer that brainstorming is not only the oldest creativity technique but also the best-known one. It was developed in the 1930s by Alex F. Osborn, co-owner of a large American advertising company, and is used for collecting a large number of ideas over a very short period. This scholar also states that Brainstorming can be used at any point in the problem-solving process, from the initial question via clarification and rephrasing of the problem up to the collection of spontaneous solutions. Stein (1975) reinforces this idea by saying that this technique is the most researched of all the procedures for creative problem-solving. The research in this scholar supports the notion that brainstorming results in more ideas than techniques that allow or encourage judgment or evaluation during idea generation. To strengthen, the praise for this technique, Costa (2011) states that brainstorming is a method that aims to encourage the production of solutions originally and creatively.

For Timbadia and Khavekar (2017) the basis of Brainstorming is to increase the volume of possible ideas by sharing a problem across five to ten members to obtain a wider array of

different ideas within a short time. This same scholar defends that with a group of people brainstorming is a powerful technique as it helps to create new ideas for solving problems through the motivation of team members, refers that the technique is not a random activity, and it needs to be structured and must require to follow brainstorming rules. According to Osborn (1957), the creative brainstorming process should follow four rules: generate as many ideas as possible, do not judge the ideas generated, generate "wild" ideas and build new ideas from others. By following these rules the author believed that teams could get better results. Melo (2008) sustains that Brainstorming has many applications, some of them are: helps to improve and develop products; problem-solving, foreseeing consequences, generating alternative solutions, or analyzing and assessing impacts; in process and project management improving production processes and risks, qualifications, responsibilities, and basic structuring and method solving issues; and finally in team building with the division and discussion of ideas stimulating reasoning. Montana and Charnov (2003) also highlight brainstorming as a technique to increase the creative contribution of a group of employees, encouraging the participation of each one without criticizing the person who presents his or her ideas about a certain subject or problem.

Costa (2006) states that after the brainstorming was created, emerged some variants. Table 5 show some examples.

Table 5 - Brainstorming Variants

Stop and Go Brainstorming	Consists of alternating periods of idea production with periods of silence, suggesting 3 to 5 minutes for both, repeating these steps until the end of the session;
Sequential Brainstorming	Each participant is asked, in a sequential manner, to state his or her idea. In the case of a participant not having any ideas when they are supposed to speak, the session is continued with the next participant;
Post-It's Brainstorming	It is intended that each member write down each idea on a post-it legibly. You should also refer to it audibly and then the moderator collects all the noted ideas and places them in a visible place;
Anonymous Brainstorming	Allows the suppression of mutual interaction in the production of ideas. The basis of this technique is that each element expresses its idea for the solution of the problem anonymously, thus ensuring that there is no influence from the other elements.
Collective Notes	To implement this technique, all participants are provided with a document about the problem at hand, as well as its definition, the data and all the information deemed necessary to solve it. Each element, for about a month, writes down at least one idea a day on this document
Brainwriting	This process begins with each participant writing down four ideas on a sheet of paper. All the sheets are collected and placed in a way that their contents cannot be seen and are accessible to everyone. Next, each participant should collect another sheet and develop ideas on it, or comment on them. This action is cyclical, until the end of the session when the generated ideas are evaluated.

Source: Adapted from Costa (2006).

To finalize, Minucucci (2001) states that the brainstorming technique is more than a group dynamics activity, it is a way to encourage the simple promotion of ideas and to increase the potential of an individual or group without restrictions.

FIRM PERFORMANCE

Concept and evolution

For Miller et al. (2013) firm performance is one of the most prominent concepts in organizational research. These scholars also defend that despite its importance, and the many developmental critiques that have appeared over the years, performance continues to be a difficult concept to apply in a scientifically rigorous way. To complement this Laranjeira (2008) claims that the definitions are diverse and the difficulty in defining them is due to the existence of a multiplicity of factors, making it necessary to use methods and techniques associated with well-defined dimensions that can provide management with a better perception of business performance. On the other hand, Bartoli and Blatrix (2015) believed that the definition of performance should be achieved through items such as piloting, evaluation, efficiency, effectiveness, and quality.

Earlier definitions claim that the criteria used for assessing firm performance are productivity, flexibility, and inter-organizational tensions (Georgopoulos & Tannenbaum, 1957). Later in the 60s and 70s, organizations began to explore new ways to evaluate their performance. Yuchtman and Seashore (1967) defined performance as an organization's ability to exploit its environment for accessing and using limited resources. On the other hand, Katz and Kahn (1978) sustain that the effectiveness and efficiency of an organization were similar, and both were crucial components of global organizational performance, which can be assessed by maximizing the entire returns of all kinds. In the 1980s a different approach emerged with Porter (1986) because he views that the firm performance depended on its ability to create value for its clients. Robbins (1987) defined performance as the extent to which an organization, as a social system, could consider both its means and ends. Cherrington (1989) states that performance is a concept of success of an organization, and an indication of the organizational manner that it is performing effectively to achieve its goals successfully. During the following decade, Adam (1994) considered organizational performance as deeply dependent on the employees' performance quality. This scholar believed that to guarantee a high-quality organizational performance, it is essential to have regular exposure of the workers of the company to new and up-to-date knowledge and skills, which would, in turn, help them keep up

with the new changes happening in the market, and, ultimately, increase the quality of organizational performance.

Peterson et al. (2003) stated that the definition of organizational performance principally focused on the capability of an organization to efficiently exploit the available resources to achieve accomplishments consistent with the set objectives of the company, as well as considering their relevance to its users. On the other hand, Verboncu and Zalman (2005) appreciated that performance is a particular result obtained in management, economics, and marketing that gives characteristics of competitiveness, efficiency, and effectiveness to the organization and its structural and procedural components. The factors that drive performance are presented in Figure 2.

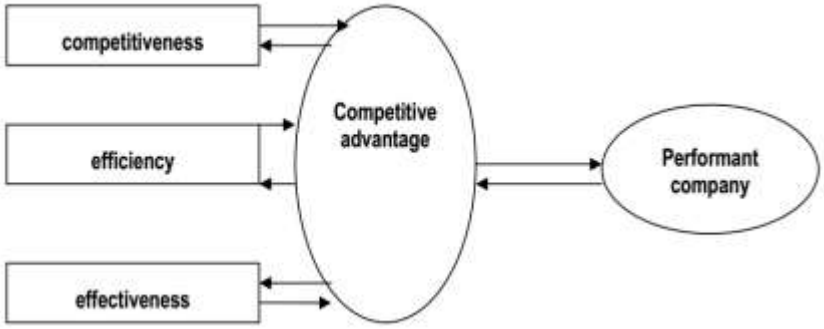

Figure 2 - Performance factors
Source: Verboncu and Zalman (2005).

Explaining in more detail, Lebans and Euske (2006) came up with a set of definitions to illustrate the concept of organizational performance:

1. Performance is a set of financial and non-financial indicators that offer information on the level of accomplishment of objectives and results;
2. Performance is dynamic, requiring judgment and interpretation;
3. Performance may be illustrated by using a causal model that describes how future results can be affected by current actions;
4. Performance may be understood differently depending on the person involved in the assessment of the firm performance;
5. To define the concept of performance, it is necessary to know its fundamentals characteristics for each area of responsibility;
6. To report a firm's performance level, it is necessary to be able to quantify the results.

Siminica (2008) sustain that superior performance must evolve at the same time efficient and effective. Therefore, the performance is a function of two variables, efficiency and efficacy. The concept and evolution of firm performance are displayed in Table 6.

Table 6 - Firm performance: Concept and evolution

Author(s)	Year	Concept
Georgopoulos and Tannenbaum	1957	"The criteria used for assessing performance are productivity, flexibility, and interorganizational tensions"
Harrison	1974	"Defines performance as the outcome of evaluating effort."
Porter	1986	"The firm performance depended on its ability to create value for its clients"
Sink	1993	"Business performance is usually analyzed along three dimensions: efficiency, effectiveness, and efficacy."
Adam	1994	"Considered organizational performance as deeply dependent on the employees' performance quality."
Araújo	2001	"company's performance as a function of a complex interaction among seven criteria: efficiency, effectiveness, quality, productivity, quality of life at work, innovation, and profit."
Peterson, Gijsbers, and Wilks	2003	"Organizational performance principally focused on the capability and ability of an organization to efficiently exploit the available resources to achieve accomplishments consistent with the set objectives of the company"
Verboncu and Zalman	2005	"Performance is a particular result obtained in management, economics, and marketing that gives characteristics of competitiveness, efficiency, and effectiveness to the organization and its structural and procedural components."
Siminica	2008	"a firm is performant when it is at the same time efficient and effective. Therefore, the performance is a function of two variables, efficiency and efficacy."
Bartoli and Blatrix	2015	"The definition of performance should be achieved through items such as piloting, evaluation, efficiency, effectiveness, and quality"

Source: Adapted from Taouab and Issor (2019).

To finalize this chapter, according to Suárez (1995) in general, when we talk about firm performance evaluation, we have as reference the analysis of its results, which, in a first approximation, suggests that we can identify it with the company's results.

SMEs firm performance

According to Sousa and Wilks (2018), the digital age forces companies to deal with new challenges: new and emerging customer segments, cultural diversity in a global market, market volatility, customer expectations about the quality of products and services, as well as the impact of the internet on business focus. To Mukhopadhyay (2021) the role of Small and Medium Enterprises (SMEs) and their performance is critical in any economy, both developed and developing ones. This scholar states that several studies indicate that the performance of

SMEs is essentially related to the leadership of the firms. Leadership can move an organization forward in a changing, competitive landscape by motivating, organizing, managing and leading employees to a higher level of performance. Some of the visible limitations experienced by SMEs are the number of employees, financial resources, and technical and managerial expertise. This author sustains that leadership in SMEs, therefore, continually addresses these challenges at various levels. Grimmer (2017) also suggested that strategic factors such as entrepreneurial competencies significantly impact SMEs. However, this scholar underlines that the specific competencies of SMEs entrepreneurs are essential for successfully identifying business opportunities. Sousa and Wilks (2018) defend that SMEs contribute to economic growth and employment. However, SMEs are not homogeneous, since, besides the differences in size (micro, small and medium enterprises), they develop activities ranging from unskilled to high-tech activities.

To complement this idea, Ropega (2011) states that despite their relevance in the economy, SMEs are more exposed to threats than larger companies as they are more prone to financial difficulties which may lead them to decline and compromise their continuity. Patalas-Maliszewska (2012) sustains that the use of information systems, integrated into management, allows a holistic view of SMEs, with the achievement of a correct assessment of the financial situation. Broszeit (2016) reinforces this by stating the impact of formal management practices on SME performance, finding that such practices have a positive83 effect, but one which is weaker than that found among larger firms. To Kaplan (1983), Lynch and Cross (1991), Collier (1995), Laitinen (1996), and Medori and Steeple (2000) the principal characteristics and dimensions of an ideal SME performance measurement system should include assessment, design, implementation, communication/alignment, and review.

To conclude, to Keskin et al. (2010) under the above-mentioned developments, SMEs are vital actors in enhancing innovation, competitiveness, entrepreneurship and the establishment of an effective innovation system for developing countries.

METHODOLOGY

QUALITATIVE METHODOLOGICAL APPROACH

Costa (2016) sustains that the definition of the materials and methods applied for the execution of work is, without doubt, the support of the work. This scholar also states that establishing a methodology for the development of a research project serves as a guiding plan for the authors in the pursuit of the objectives previously defined objectives and to support its

organization and structuring. Flick (2005) states that the selection of research methods depends on the research methodology that is to be followed. According to Reis (2010) methodology is characterized as a way of producing research using theories, language, techniques and instruments to answer problems in a given area of study. To complement, Silverman (2013) defends that considering the fundamental objective and research proposition of this study, the adoption of the qualitative methodology, using the case study method, proved to be adequate. This scholar also ensures that the qualitative methodology, to the detriment of the quantitative methodology, focuses mainly on the meaning of phenomena and not on their measurement.

Denzin and Lincoln (2004) sustain that qualitative research is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret phenomena, in terms of the meanings people bring to them. The qualitative method is typically used on purpose in research. Leedy and Ormrod (2005) indicate that qualitative research is not the approach to take if you are looking for quick results and easy answers. This scholar also states that it involves enthusiasm and the determination to dig deep to understand a situation or process and often needs a longer time and further inquiry to better understand a situation through observation, interviews and further follow-up sessions. For Taylor and Bogdan (1998) qualitative research is usually inductive, in which concepts and perceptions are developed based on data patterns rather than by data collection to assess preconceived hypotheses or theories.

Regarding the investigation strategy, it was found to be relevant to use the single case study method. According to Silverman (2013), the choice of method should encompass a general research strategy because it is the methodology that defines which methods are used and how. Yin (2001) sustains that the case study has, effectively, a particular methodology that aims to know the “how” and “why” of a phenomenon. To Eisenhardt (1989) this method should be applied in contexts where relatively little is known about a theme or where existing theories are inadequate or with little empirical support, as is the case of the present study.

According to Saunders et al. (2019), the research begins by collecting data to study a phenomenon and then building a conceptual framework.

CASE STUDY: UNIFY

The single case study is about the company UNIFY. Founded in 2007 by Doctor Eduardo Silva in Guimarães, although today it is headquartered in Vila Nova de Famalicão. The company was structured with the following areas/functions: Web design, Design, Marketing, Video, Photography and 3D. The company currently has 11 employees.

Drucker (2011) states that the mission of a company is important for its growth and strategy, it should above all clear what its benefits are, to serve its target audience, but above all the mission clarifies the realistic goals of the company. It is considered the central purpose for which the organization is created. The mission statement should be summarized in a way that it can be remembered and should catch the attention of the general public and especially the staff of the organization in question. Unify's mission is to guarantee its performance by presenting specific communication solutions and these are done successfully, with the approval and satisfaction of customers, maintaining their identity.

Collins and Porras (1998) point out that in addition to the mission, clarifying a company's vision makes clear what its goals are for the future. The vision is a path to reach a destination, it is the reason for a company's strength, to continue working with a focus on the future. In a very summarized way, UNIFY seeks to be a reference agency in the areas where it works and develop innovative solutions that add value to value to our client's brands.

The values of an organization must be practised by all its constituent elements if the vision of the future is to become a reality one day. Values serve to complete, strengthen, and enhance the character of a company. In UNIFY's case, the values have prevailed since its year of creation and are perfectionism in the execution of tasks, creativity and innovation, two keywords in navigating new ideas for projects and finally, trust to establish new partnerships.

DATA COLLECTION INSTRUMENT

According to Yin (2001), data collection for case studies is based on many sources: documentation, archival records, interviews, direct observation, participant observation, etc. Glaser and Strauss (1967) refer that theoretical sampling, which originates from grounded theory methodology, is a prominent strategy for sampling and a special case of purposive sampling. The same scholar also sustains that this is a so-called iterative procedure, in which data collection and analysis constantly alternate. Edwards and Holland (2013) defend that the interview is one of the most used methods in qualitative research and can take several forms: structured, semi-structured and unstructured. For this research, the interview applied was semi-structured so that, within the scope of an exploratory study, one may broaden the understanding of the research question. Saunders et. al (2019) states that this type of interview allows flexibility in the flow of conversation, and the order and content of questions so that both the interviewees and the researcher can raise new or previously neglected topics.

PARTICIPANTS' SELECTION

Edwards and Holland (2013) state that qualitative research is guided by theory and therefore also the construction and selection of the sample replicates a theoretical model. According to Eisenhardt (1989), the cases selected may be chosen to fill a theoretical category or to exemplify polarized cases. The method of selection of companies was carried out through the results that I intend to obtain. The same happened with the individuals who will be interviewed.

In research in organizational studies, management and business, the interviewee may be selected either as an individual or as a representative of their team, organization, or industry (Rowley, 2012). The individuals that I interviewed were chosen to obtain the best answers. Thus, the following employees were chosen: Rafael Valle, leader of the marketing department, marketer (X1); Eduardo Silva, CEO of Unify, belongs to the Administrative Department (X2); Rita Pinheiro (X3) and Margarida Silva (X4), two employees belonging to the marketing department and finally, Márcia (X5), who was a designer at the company.

RESEARCH QUESTIONS

Edwards and Holland (2013) sustain that there is typically flexibility in how and when questions are asked, the researcher must have a list of questions or topics to guide the interview. Yin (2001) refer that research questions are the main focus and most important step in qualitative studies. After reviewing the most relevant aspects of the literature and the respective authors who mention them, a set of essential propositions that we intend to test according to the following research questions (RQ):

RQ1: What creativity techniques UNIFY already use in the work environment?

RQ2: What creativity techniques do you use to create posts for the client's social media?

RQ3: What barriers do you encounter when trying to use brainstorming among members of the company?

RQ4: How UNIFY deals with those barriers?

RQ5: What steps do you take to encourage yourself to be a creative individual in the company?

RQ6: How do you encourage a creative environment for all members at work?

RQ7: What are the main benefits to UNIFY when everyone contributes ideas for a project within the organization?

RQ8: Do you think the use of creative techniques impacts the firm performance?

Table 7 display the linkage between constructs, authors and research questions.

Table 7 - Theoretical justification of the research questions

Category	Authors	Research questions
Creativity Techniques	Gaubinger et al. (2015); Costa et al. (2011);	RQ1, RQ2, RQ3
Creativity Factors	Lavadouro and Rodrigues (2007); Vasconcellos (1990); VanGundy (1987)	RQ4
Enhance Creativity	Amabile and Khaire (2008); Ohly (2018)	RQ5, RQ6
Firm Performance	Adam (1994); Araújo (2001); Verboncu and Zalman (2005)	RQ7, RQ8

Source: Own elaboration.

INTERVIEW PROCEDURES

Before the interviews in person, the participants were informed about the purpose, process and duration of the interview. Likewise, the interview questions were sent beforehand to allow the interviewee to prepare and generate ideas around the questions and, possibly, introduce new relevant topics. To Edwards and Holland (2013) in qualitative interviews, the words spoken can be subject to various interpretations, audio recording is recommended and has become a standard. The same scholar also mentions that recording can be useful not only during the interview so that the interviewer can focus on listening, probing and following up but also after the interview. Therefore, authorization was requested from all participants for the audio recording, which later served the purpose of transcription.

RESULTS

Considering the content and evidence taken from the interviews carried out, it is important to present the results considering the research questions of the present study and cross them with the theoretical framework. The main questions were selected to comprehend the different perspectives of different employees in the company and to better understand how creative techniques are implemented in the organization and what benefits we can get from using them.

Regarding the first research question (RQ1) we can state that everyone that was interviewed said that Brainstorming is the technique that Unify already uses in the work environment (Table 8). Individual 1 made the distinction between group and individual brainstorming, but when in a group, the most used is Group Brainstorming. Individuals 1 and 5 also highlighted that they use the Mind Map to organize their work. This question tries to understand what techniques are already used in the work environment.

Table 8 - RQ1: What creativity techniques UNIFY already use in the work environment?

Category	Statement
Creativity Techniques	- *"I would say that the main one will be Brainstorming, both group and individual and Mind Map <…>"* – X1 - *"Here in the organization the main and most effective is brainstorming. <…>"* – X2 - *"When we are face to face in the office, brainstorming is the most effective method for us to use as a group <…>"* -X3 - *"Group brainstorming is one of the most common approaches I'm aware of here. <…>"* – X4 - *"Brainstorming is what I use the most. In an individual context I also use the mind map."* – X5

Source: Own elaboration.

The second research question (RQ2) tries to understand what creative techniques this company already uses to do a specific task (Table 9). We can say that for creating posts for the clients' social media the most common used creative technique is Brainstorming. The individuals all state that they come together, try to give as many as ideas possible for a specific post and then select the better one. Individual 2 refers that he's not a part of that department but he recognizes that the employees come together and try to have a more creative outcome about the creation of posts.

Table 9 - RQ2: What creativity techniques do you use to create posts for the client's social media?

Category	Statement
Creativity Techniques	- *"Brainstorming. We are already used to doing it, even though it's not as common as it should be, we all gather at the table, and we all share our ideas. <…>"* – X1 - "*As I'm not part of that department, I can't say 100%. But I recognize that employees sometimes get together and think about a post and say, what more creative way can we do this?" – X2* - *"To create an Instagram post for a company the most common is Brainstorming. <…>"* – X3 - *"<…> we reunite all of us, look at a product and try to give as many ideas as possible, so we can say that we use Brainstorming sometimes."* – X4 - *"<…> When the task is assigned to all or 3 of us, we gather and produce a group brainstorming because we believe it is the most beneficial to present the best results."* – X5

Source: Own elaboration.

Bearing in mind that the main results of the previous questions were linked to the strong use of brainstorming in the company, the third research question (RQ3) sought to understand what the main barriers to the use of brainstorming in the company are (Table 10). Individuals 1 and 2 underline that the fact that there is a lot of work to do does not allow workers to stop to do these brainstorming sessions. Individual 3 points focus on the goals of the group to perform the brainstorming. Argues that keeping everyone on the same page is one of the barriers. The perspectives of individuals 4 and 5 are similar. One argues that teleworking is a barrier and the other says it's the fact that they're not all in the same space all the time.

Table 10 - RQ3: What barriers do you encounter when trying to use brainstorming among members of the company?

Category	Statement
Creativity Techniques	*"The biggest challenge would be that there are too many tasks to be able to stop even if there are 3 workers and be able to exchange ideas together. <…>"* – X1 *"<…> clearly, the amount of work sometimes forces these creative processes to not exist more often in the company."* – X2 *"<…> Another barrier is keeping everyone on the same page and focused and not letting the group stray too far from the main objective."* – X3 *"<…> I would say that one of the barriers would be teleworking."* – X4 *"The biggest challenge will be that we are not all always on the same task and in the same space. <…>"* – X5

Source: Own elaboration.

Research question 4 (RQ4) seeks to understand how Unify deals with the main barriers collected in research question 3 (RQ3) (Table 11). For the dispersion of attention present in the brainstorming, individuals 1 and 2 said that one way to alleviate this was to have one or two moderators present to lead the session. Individual 4 also, underlines that establishing a time limit to come up with ideas helps people to stay focused. For the fact that there is teleworking, and they are not always present in the office individual 3 says that a virtual room is always a solution to do the technique. Individual 5 says that if it is planned, it is easily no longer a barrier, the fact that they are not always in the same space.

Table 11 - RQ4: How UNIFY deals with those barriers?

Category	Statement
Creativity Factors	- *"<…> The way we deal with this is to define very well the time we are going to waste and define the moderators in a way that we don't lose focus."* – X1 - *"<…> there are two solutions: a coffee to boost creativity and moderators to guide us through the entire process for people to be more serious about the situation."* – X2 - *"When it comes to teleworking, a virtual room is always one of the options. <…>"* – X3 - *"<…> In person, when we are on a task, the best thing is to establish a time limit to come up with ideas <…>"* – X4 - *"We plan sometimes when we are going to do these exercises and we plan for the days we will be in the office."* – X5

Source: Own elaboration.

The fifth research question (RQ5) seeks to understand which steps are important to encourage individuals to be creative in the company, that is, how to emphasize creativity in the work environment (Table 12). Individuals 1, 4 and 5 all report that there must be a comfortable physical environment to be able to work and be comfortable. Individuals 1 and 3 talk about music while doing the tasks. Individual 2 talks about creating an environment that accepts everyone and does not condemn anyone's views.

Table 12 - RQ5: What steps do you take to encourage yourself to be a creative individual in the company?

Category	Statement
Enhance Creativity	- *"<…> Two crucial steps, in my opinion, are good installation spaces and some good music to accompany."* – X1 - *"<…> Create an environment that does not condemn anyone's point of view and provide an adequate space to accomplish all of the above."* – X2 - *"Sometimes I listen to music and go outside to get some fresh air, and other times I just remove all distractions. <…>"* – X3

	- *"Being physically comfortable is the most important thing. We have wonderful areas in the office <…>"* – X4 - *"<…> you'll need a good environment where you can engage with others and think about new ideas."* – X5

Source: Own elaboration.

Unlike research question 5 (RQ5) which focused on the steps to take to be a creative individual, research question 6 (RQ6) focuses on how to encourage a creative environment in the company (Table 13). Individual 1 defends the reward system. He mentions that it is important to give recognition to someone whenever they come up with creative ideas. Individuals 2 and 5 argue that the use of the Brainstorming method among everyone is, in itself, a fact that encourages a creative environment.

Table 13 - RQ6: How do you encourage a creative environment for all members at work?

Category	Statement
Enhance Creativity	- *"What makes creativity move is also its recognition, so whenever someone comes up with an idea that we all like, we reward them <…>"* – X1 - *"Using Brainstorming is something that encourages us all to maintain the creative environment <…>"* – X2 - *"<…> usually support when people make mistakes and create mini and coffee breaks so people can rest <…>"* – X3 - *"It is related to the environment that we propagate to our fellow colleagues. <…>"* – X4 - *"One of the great ways to encourage people to be creative is to use the Brainstorming method. <…>"* – X5

Source: Own elaboration.

The seventh research question (RQ7) seeks to understand what are the main benefits that the company has when everyone participates and has a contribution, being linked to firm performance (Table 14). The first individual says that with everyone participating it's more likely that the people will be more creative. Individual 2 says that it's more likely to come up with a better solution to the task. Individuals 3 and 4 say, respectively, that there is a greater chance of coming up with the greatest content and a greater chance to have the best result in the end. Finally, the fifth individual says that it is an opportunity to see things from multiple angles and different perspectives.

Table 14 - RQ7: What are the main benefits to UNIFY when everyone contributes ideas for a project within the organization?

Category	Statement
Firm Performance	- *"It is crucial <…> that everyone participates and contributes when we complete a task in a group because it allows us to be more creative <…>"* – X1 - *"The more ideas and opinions, the more prepared we will be to give a better solution to the task."* – X2 - *"The main advantage of having all of us participate is that we have a better chance of coming up with the greatest content <…>"* – X3 - *"<…> more ideas involved, and there is a greater change to have a better result in the end."* – X4 - *"<…>*we may see things from multiple angles and come up with a more creative and new ideas <…>" – X5

Source: Own elaboration.

The eighth and final question (RQ8) is the most direct and seeks to understand whether the company's employees believe that the use of creative techniques impacts firm performance (Table 15). All individuals believe that it has a positive impact. After asking to develop more these were the answers that were collected: individual 1 focuses on the importance of using techniques, but that it is not always possible to use them daily; individual 2 emphasizes that the most successful publications are those that emerged from the techniques; the individual 3 says that the best results come when everyone participates and brings new ideas; the individual 4 argues that brainstorming is an asset for the results that will be presented; to conclude, the individual 5 says that the use of these techniques stimulates creativity in the work environment and keeps everyone more inspired and prepared.

Table 15 - RQ8: Do you think the use of creative techniques impacts the firm performance?

Category	Statement
Firm Performance	- *"I think so, without a doubt. But I know that it is not always possible to use creative techniques on a daily basis. <…>"* – X1 - *"<…> our publications with the best engagement are those that emerged from the use of one of these techniques."* – X2 - *"<…> that we will get the best results whenever more people participate and come up with ideas <…>"* – X3 - *"<…> if we think of brainstorming, where all company employees can participate in decision making is an asset for the results that we are going to present <…>"* – X4 - *"<…> Using these techniques only stimulates creativity in the workspace and keeps everyone more inspired and ready to innovate."* – X5

Source: Own elaboration.

DISCUSSION

After the in-depth analysis of the single case study, the realization of the interview and adding the knowledge derived from the literature review, we can now discuss the results and compare them with existing data from the literature reviewed. According to Osborn (1957), the creative brainstorming process should follow the rules; by following them, the author believed that teams could get better results. Some of the suggestions the interviewees gave when they answered research questions 3 and 4 about the main barriers that occur when trying to perform a Brainstorming session and how to deal with them were: the existence of moderators and having a time limit for each session. These two things are already implemented in the brainstorming rules. Osborn (1996) states that the realization of a brainstorming session begins with the choice of the coordinator of the process. This same scholar also says that the duration time should not be extensive and should be between 30 and 60 minutes.

Timbadia and Khavekar (2017) reinforce that brainstorming is not a random activity; it needs to be structured and must follow the rules. Gaubinger et al. (2015) refer that

brainstorming is not only the oldest creativity technique but also the best-known one. This explains why is the most used because it is the most known by everyone. This scholar also, reinforces that Brainstorming can be used at any point in the problem-solving process, from the initial question via clarification and rephrasing of the problem up to the collection of spontaneous solutions. Two interviewees also answered research question 1: They used the mind map individually to organize their work. According to Costa et. al (2011), the mind map assists in managing ideas and strengthens your problem-solving creativity.

When answering research questions 4 and 5 about how the company deals with barriers to the use of Brainstorming and how to encourage to be creative individuals in the company some interviewees refer to the importance of good installation spaces, being physically comfortable and a good environment where you can engage with others. To Lavadouro and Rodrigues (2007) some factors that facilitate the use of creativity in the company are a positive physical environment, good communication/participation and freedom/autonomy to do the work which is compatible with the interviewees' answers. To the same scholar, a negative physical environment is a factor that blocks creativity. We can consider the answers to research question 4 that stated that teleworking is a barrier because people are not in the same place to do the work, for example, where the physical environment is negative. After all, people are not present next to each other, which blocks the possibility to practice brainstorming and other tasks that can enhance creativity.

Research question 6 arises in the context of the author Amabile and Khaire (2008) having argued that it was necessary to encourage individuals to create the perfect environment for them to be creative. Analyzing the answer of individual 1 who argues that what drives creativity is the recognition you give it and being rewarded for having a creative behavior. To Ohly (2018), rewards might enhance creativity when given contingent on creativity performance. Individuals 2 and 5 argue that the use of the Brainstorming method among everyone is, in itself, a fact that encourages a creative environment, and according to Minucucci (2001), the brainstorming technique is a way to encourage the simple promotion of ideas and to increase the potential of an individual or group without restrictions. Melo (2008) reinforces this statement by saying that the process of Brainstorming values and rewards creativity. About the research question 7 when answering the interviewees, states that, in a general way, they agree that when everyone participates in a task, they have a better result, a better solution to the task and the company benefits from that. Adam (1994) considered that organizational performance is deeply dependent on the employees' performance quality. This author claims that firm performance relies heavily on employee performance quality, and the interviewees state that when everyone participates in a task, the better the company's performance.

To conclude, research question 8 seeks to understand if these employees think using creative techniques impacts the firm performance, and all responded positively. Gilson, (2008) and Simonton (2000) sustain that creativity is widely believed to be necessary for performance. To reinforce this statement, Weiner (2000, p. 253) refers that creativity requires people to go beyond “the average, the routine, the normal, the habitual”.

CONCLUSION

This research aimed to measure creativity techniques' impact on firm performance. According to the qualitative methodology carried out, the results gave evidence that creativity techniques have a positive impact on firm performance. It was also noticed that the most used technique in the company was Brainstorming, as the literature pointed out, which is the most popular technique. It was also concluded that the Mind Map is used more for organizing work and individually. With the answers of the interviewees I was also able to conclude that everyone thinks that when all people are involved in the final work, better results are presented. With this, we can affirm that when individuals have the freedom to be creative in the organization, the better the results obtained.

The literature review provided knowledge about creativity, creativity factors, creative techniques, firm performance and its relationship with SMEs. Therefore, it was possible to relate each point and understand the impact of creativity techniques on the firm performance, in this case, UNIFY.

It is essential to emphasize creativity in the workplace, make sure everyone is comfortable being creative, and use creative techniques to obtain better results. Good employee performance is the main factor connected to the firm performance and creativity is the key for everyone to work in a better way and in a better environment, more motivated and happier.

This study has some practical implications. Despite several studies on creative techniques and firm performance, the same does not happen with these two related ones. Few studies are dedicated to examining the impact of using these techniques on business performance in the Portuguese context. This investigation thus fills gaps in the literature in this field.

Consequently, one of the limitations found while carrying out the interview was that the five individuals interviewed were from different departments. For example, the second individual, the CEO, did not have much “creative” work to do, and the issues and results I was looking for might not fit the department.

For future research, we suggest the adoption of other types of methodologies, to come up with new conclusions. It may also be possible to combine qualitative and quantitative

methods. These two approaches may complement each other, reinforcing the study's results. We could also consider applying quantitative methods to several companies rather than just one.

REFERENCES

Adam, E. (1994). Alternative quality improvement practices and organization performance. *Journal of Operations Management*, *12*(1), 27- 44.

Alencar, E. (1995). Desenvolvendo a criatividade nas organizações: o desafio da inovação. RAE - *Revista de Administração de Empresas*, *35*(6), p. 6-11.

Amabile, T. (2012). *Componential Theory of creativity*. Harvard Business School.

Amabile, T., & Khaire, M. (2008). *Creativity and the Role of the Leader*. Harvard Business Review.

Bagulho, M. (2014). *Liderar Para a Criatividade: O Papel da Motivação Intrínseca no Desenvolvimento de Novas Ideias*. Mestrado em Ciências da Comunicação. Universidade Católica Portuguesa. https://repositorio.ucp.pt/bitstream/10400.14/15330/1/MLeonor%20Bagulho_Disserta%C3%A7%C3%A3o%20Liderar%20para%20a%20Criatividade.pdf

Bartoli, A. & Blatrix, C. (2015). *Management dans les organizations publiques* - 4ème édition. Dunod, Paris.

Bertoncelli, T., Mayer, O., & Lynass, M. (2016). Creativity, Learning Techniques and TRIZ. *Procedia CIRP*, *39*, 191-196.

Broszeit, S., Fritsch, U. Gorg, H. and Liable, M.C. (2016). Management practices and productivity in Germany. IAB Discussion Paper No. 32/2016. Nuremberg: Institute for Employment Research.

Buzan, T. & Buzan, B. (1996). *The Mind Map Book*. 2nd. Edition. Plume.

Buzan, T. & Buzan, B. (2000). *The Mind Map Book*. London: BBC Books

Campos, A. (2020). Use of mind maps as a project management tool in business and product consulting areas. Brazilian Journals of Business, 2(3). http://dx.doi.org/10.34140/bjbv2n3-086

Cherrington, D.J. (1989). *Organizational behavior: The management of individual and organizational performance*. Allyn & Bacon.

Chummee, P. (2022, January). The Adopting a Creative Economy for Competitive Advantages of Community Enterprises. *Turkish Journal Of Mathematics Education*, *13*(1), 236-240.

Costa (2011). A criatividade e a educação: percursos*. 23.º Encontro Nacional da Associação de Professores de Expressão e Comunicação Visual – Ensino das Artes Visuais: Identidade e Cultura no século XXI*, 97-118.

Costa, A., Merino, G., Nunes, J. V., & Fialho, F. (2011). *Creative thinking and design*. CORE Reader. https://core.ac.uk/reader/62722100

Costa, J. (2006). Criatividade – Definição, Utensílio e Aplicabilidade. *Proceedings 16th European Conference*. Universidade de Aveiro.

Csikszentmihalyi, M. (1996). *Flow and the psychology of discovery and invention*.Harper Collins Publishers.

DeGraff, J. & Lawrence, K. A. (2002). *Creativity at Work : Developing the Right Practices to Make Innovation Happen*. New York: Business & Economics.

Denzin, N.K. & Lincoln, Y. S. (2004). *Handbook of Qualitative Research*. Thousand Oaks: Sage

Drucker, P. F., (2003). *A Administração na Próxima Sociedade*. São Paulo: Nobel.

Edwards, R., & Holland, J. (2013). *'What is?' Research Methods series*. Bloomsbury Academic.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*, *14*(4). https://doi.org/10.5465/amr.1989.4308385

Evans, R., Russel, P. (1989*). O empresário criativo*. São Paulo: Ed. Cultrix.

Flick, U. (2005). *Métodos Qualitativos na Investigação Científica*. Lisboa: Monitor.

Forth, J., & Bryson, A. (2019, February). Management Practices and SME Performance. *Scottish Journal of Political Economy*. *66*(4), 527-558. https://doi.org/10.1111/sjpe.12209

Gafour, Ola & Gafour, Walid. (2020). Creative Thinking skills -A Review article. https://www.boostskills.eu/files/5-creative-thinkings-kills-analysis-article.pdf

Gaubinger, K., Rabl, M., Swan, S., Werani, T. (2015). Creativity Techniques. In *Innovation and Product Management*. New York, Springer.

Georgopoulos, S. & Tannenbaum, S. (1957) A study of organizational effectiveness. *America Sociology Review*, *22*(5), 534 – 540.

Gilson, L. L. (2008). Why be creative: A review of the practical outcomes associated with creativity at the individual, group, and organizational levels. In J. Zhou & C. E. Shalley (Eds.), *Handbook of Organizational Creativity* (pp. 303–322). New York, NY: Erlbaum

Glaser, B., & Strauss, A. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research* (0008th ed.). Aldine Publishing Company.

Grimmer, L. (2017) The Impact of Resources and Strategic Orientation on Small Retail Firm Performance. *Journal of Small Business Management*, *55*, 7–26.

Hogan, C. (1994) Mind mapping; some practical application. *Training & Management Development Methods*, *8*(1), 3.01-3.18.

Hussain, A. & Akbar, M. & Shahzad, A. & Poulova, P. & Akbar, A. & Hassan, R. (2022). E-Commerce and SME Performance: The Moderating Influence of Entrepreneurial Competencies. *Administrative Sciences*, *12*(1), 1-16. https://doi.org/10.3390/admsci12010013

Jones, C., Svejenova, S., Pedersen, J. S., & Townley, B. (2016). Misfits, mavericks, and mainstreams: Drivers of innovation in the creative industries. Organization Studies, 37, 751–768. https://doi.org/10.1177/0170840616647671

Katz, D. & Kahn, R.L. (1978). The social psychology of organizations.

Keskin, H., Genturk, C., Sungur, O., & Kiris, H. (2010). The Importance of SMEs in Developing Economies. 2nd International Symposium on Sustainable Development. https://core.ac.uk/display/153446896?utm_source=pdf&utm_medium=banner&utm_campaign=pdf-decoration-v1

Kris, E. (1952). *Psychoanalytic explorations in art*. New York, NY: International University Press.

Lacombe, F, & Heilborn, G. (2003). *Administração: princípios e tendências*. São Paulo: Saraiva.

Lambert, P.A. (2017). Understanding Creativity. In: Cummings, J.B., Blatherwick, M.L. (eds) Creative Dimensions of Teaching and Learning in the 21st Century. Advances in Creativity and Giftedness. SensePublishers, Rotterdam. https://doi.org/10.1007/978-94-6351-047-9_1

Laranjeira, G. (2008). *Proposta de um modelo de avaliação de eficiência relativa para aferir o desempenho empresarial*. Dissetação de Mestrado em Ciências e Tecnologias da Informação. Instituto Superior de Ciências do Trabalho e da Empresa, Departamento de Ciências e Tecnologias da Informação.

Lebans, M. & Euske, K. (2006). *A conceptual and operational delineation of performance*. Business Performance Measurement. Cambridge University Press.

Leedy, P., Ormrod, J.E. (2005): *Practical Research*. 8th Edition. Planning and Design.

Lubart, T. (2003). *Psicologia da Criatividade*. São Paulo: ARTMED

Ma, H (2000). Competitive Advantage and Firm Performance. *Competitiveness Review: An International Business Journal*, *10*(2), 15-32.

May, R. (1975). *The courage to create*. New York, NY: W. W. Norton.

Melo, E. (2008). *Aplicação de Técnicas de Exploração do Espaço Criativo ao Design de Jogos Digitais*. Universidade Federal de Pernambuco.

Miller, C. Washburn, N. Glick, W. (2013) PERSPECTIVE—The Myth of Firm Performance. *Organization Science*, *24*(3), 948-964. http://dx.doi.org/10.1287/orsc.1120.0762

Minucucci, A. (2001). *Técnicas de trabalho em grupo*. São Paulo: Editora Atlas.

Montana, J. & Charnov, H. (2003). *Administração*. São Paulo: Saraiva.

Moser, V. (2015). *A Criatividade - A Necessidade da Promoção da Atividade Criadora no Pré-Escolar*. Dissertação de Mestrado para a Qualificação para a Docência em Educação Pré-Escolar. Instituto Superior de Educação e Ciências.

Motta, P. (1995). *Gestão contemporânea: a ciência e arte de ser dirigente*. Rio de Janeiro: Record.

Mukhopadhyay, B.R. & Mukhopadhyay, B.K. (2021). *Leadership, Reward Culture, and SME Performance*. The Sentinel, Editorial.

Mumford, Michael D.; Scott, Ginamarie M.; Gaddis, Blaine & Strange, Jill M. (2002). Leading creative people: Orchestrating expertise and relationships. *Leadership Quarterly*, *13*, 705-750.

Njie, B., & Asimiran, S. (2014). *Case Study as a Choice in Qualitative Methodology*. IOSR Journal of Research & Method in Education (IOSR-JRME).

Ohly, S. (2018). Promoting Creativity at Work – Implications for Scientific Creativity. *European Review, 26*(S1), S91-S99. https://doi.org/10.1017/S1062798717000576

on Information Systems, Galway, Ireland.

Osborn, A. F. (1957). *Applied Imagination. Principles and procedures of creative problem-solving*. The Creative Education Foundation Press, New York.

Patalas-Maliszewska, J. (2012). Assessing the Impact of ERP Implementation in the Small Enterprises. *Foundations of Management*, *4*(2), 51-62

Peterson, W. & Gijsbers, G. & Wilks, M. (2003). An Organizational Performance Assessment System for Agricultural Research Organizations: Concepts, Methods, and Procedures. *ISNAR Research Management Guidelines*, No. 7. The Hague: International Service for National Agricultural Research.

Phihlela, T., & Odunaike, S. (2012). A Measurement Framework to Assess SME Performance. *2012 Proceedings of the Information Systems Educators Conference*.

PINK, D. (2011). *Drive – A surpreendente verdade sobre aquilo que nos motiva*. Estrela Polar.

Porras, J. I., & Collins, J. C. (1998). *Construindo a visão da empresa*. São Paulo: HSM Management.

Porter, E. (1986). *Estratégia Competitiva: Técnicas para análise de indústrias e da concorrência*. 7 ed. Rio de Janeiro: Campus

Reis, F. (2010). *Como elaborar um Dissertação de Mestrado*. Lisboa: Pactor.

Robbins, P. (1987). *Organizational Theory: Structure, Design, and Application*. San Diego: Prentice-Hall.

Ropega, J. (2011). The Reasons and Symptoms of Failure in SME. *International Advances in Economic Research*, *17*(4), 476-483.

Rowley, J. (2012). Conducting research interviews. Management Research Review, 35(3/4), 260–271. https://doi.org/10.1108/01409171211210154

Santos, J. (2008*). Uma Proposta de Conceituação e Representação do Desempenho Empresarial*. Escola de Administração de Empresas de São Paulo.

Saraiva, G. (2022). *O Processo de Turnaround nas PME Portuguesas*. Universidade Beira Interior.

Saunders, M., Lewis, P., Thornhill, A., & Bristow, A. (2019). Understanding research philosophy and approaches to theory development. In *Research Methods for Business* (8.a ed., Vol. 4, pp. 128–171). United Kingdom: Pearson Education Limited

Schumpeter, J. (1942). *Capitalism, Socialism and Democracy*. Cambridge, MA: Harvard University Press.

Seidel, S., Rosemann, M., & Becker, J. (2008). How Does Creativity Impact Business Processes? *ECIS*.

Lavadouro, R. da S., & Rodrigues, L. D. do M. (2011). Estimulando a criatividade das pessoas nas organizações. *SINERGIA - Revista Do Instituto De Ciências Econômicas, Administrativas E Contábeis*, *11*(1), 17–26. https://periodicos.furg.br/sinergia/article/view/589

Silverman, D. (2013). *Doing Qualitative Research* (Fourth Edition). SAGE Publications

Siminica, M. (2008). The Performances of Industrial Firms from Romania. Correlation Dimension indicators of Results. *Theoretical and Applied Economics*, 71-78.

Simonton, D. K. (2000). Creativity: Cognitive, personal, developmental, and social aspects. *American Psychologist*, *55*, 151–158.

Sousa, M., & Wilks, D. (2018). Sustainable Skills for the World of Work in the Digital Age. *Systems Research and Behavioral*, *35*, 399–405.

Stein, M. I. (1975). *Stimulating creativity*. New York, NY: Academic Press Inc

Suarez, F. (1995) Dominant designs and the survival of firms. *Strategic Management Journal*, *16*(6), 415-430.

Sue-Chan, C., & Hempel, P. (2015). *The Creativity-Performance Relationship: How Rewarding Creativity Moderates the Expression of Creativity*. Wiley Online Library. https://doi.org/10.1002/hrm.21682

Taouab, O., & Issor, Z. (2019). Firm Performance: Definition and Measurement Models. European Scientific Journal, 15, 93. https://doi.org/10.19044/esj.2019.v15n1p93

Taylor, J. & Bogdan, R. (1992). *Introduction to qualitative research methods: A guidebook and resource*. (3rd ed.). New York: Wiley.

Timbadia, V. & Khavekar, R. (2017). Review on Creativity Techniques for Product Development. *Global Journal of Enterprise Information System*, *8*(82). https://doi.org/10.18311/gjeis/2016/15778.

Tschimmel, K. (2019). The evolution of the Creativity Concept: from a psychological to a systemic approach. In ***The Creativity Virus***. Porto: Ed. Mindshake. pp.33-35..

VanGundy, A. (1987). *Organization creativity and innovation*. In: ISAKSEN, S. G. (ed.). Frontiers of creativity research. Buffalo: Bearly.

Vasconcellos, E. (1990). *La empresa innovadora*. BID-SECAD-CINDA. Gestion tecnologica en la empresa. Santiago: [sed.].

Vasconcellos, S. (2016). O Processo Criativo de Escolha e Utilização de Diferentes Métodos de Investigação. *Revista Alcance*, *23*(3), 429-433. https://doi.org/10.14210/alcance

Verboncu, I. & Zalman, M. (2005). Management şi performanţe, Editura Universitară.

Walia, C. (2019). A Dynamic Definition of Creativity. *Creativity Research Journal*, 31(3), 237-247. https://doi.org/10.1080/10400419.2019.1641787

Weiner, R. P. (2000). *Creativity and beyond: Cultures, values, and change*. Albany: State University of New York Press.

Yin, R. (2001). *Estudo de caso: Planejamento e Métodos* (2a edição). Porto Alegre: Bookman.

Yuchtman, E. & Seashore, S. (1967). Factorial Analysis of Organizational Performance. *Administrative Science Quarterly*, *12*, 377-395.

Appendix 1: Interview

UNIFY – INTERVIEW TRANSCRIBED IN ENGLISH

Questions:

RQ1: What creativity techniques UNIFY already uses in the work environment?

Rafael X1: I would say that the main one will be Brainstorming, both group and individual and Mind Map, but more to organize what are our projects and ideas for any task or client.

Eduardo X2: Here in the organization the main and most effective is brainstorming. We use it to stimulate creativity, to have plenty of ideas for different projects and for everyone to have something to say in the final decision.

Rita X3: When we are face to face in the office, brainstorming is the most effective method for us to use as a group. All of the conditions are usually present for us to do this efficiently. I also, use Mind Map to organize my thoughts or plan something.

Margarida X4: Group brainstorming is one of the most common approaches I'm aware of here. Also, the individual. I take a break from the task sometimes and then try to come up with as many ideas as possible before moving on because something more dynamic can always arise.

Marcia X5: Brainstorming is what I use the most. In an individual context I also use the mind map.

RQ2: What creativity techniques you use in order to create posts for the client's social media?

Rafael X1: Brainstorming. We are already used to doing it, even though it's not as common as it should be, we all gather at the table, and we all share our ideas. I think it's very effective and I think it helps a lot to be successful because everyone gets to participate, and everyone gives their ideas. This way there is more possibility to be the most creative in the final product.

Eduardo X2: As I'm not part of that department, I can't say 100%. But I recognize that employees sometimes get together and think about a publication and say, what more creative way can we do this?

Rita X3: To create an Instagram post for a company the most common is Brainstorming. We all give our ideas in a more relaxed environment and after we have the list of ideas, we select the best one for the designer to try out the illustration.

Margarida X4: For example when doing illustrations for Instagram posts, we reunite all of us, look at a product and try to give as many ideas as possible, so we can say that we use Brainstorming sometimes. Everyone gives ideas and no one judges them, but of course we after that evaluate them and talk to the designer to try them out and see which one is better.

Márcia X5: The more correct answer once again is Group Brainstorming. When the task is assigned to all or 3 of us, we gather and produce a group brainstorming because we believe it is the most beneficial to present the best results.

RQ3: What barriers do you encounter when trying to use brainstorming among members of the company?

Rafael X1: The biggest challenge would be that there are too many tasks to be able to stop even if there are 3 workers and be able to exchange ideas together. It happens here sometimes, but if it doesn't happen anymore, it's because there's too much work to do.

Eduardo X2: In my opinion it's about keeping everyone focused on the process. It's always difficult to deal with a group and I think it's a barrier that can be alleviated. Apart from that, clearly, the amount of work sometimes forces these creative processes to not exist more often in the company.

Rita X3: In my opinion, the biggest barriers are: not always being in the offices, that is, it prevents us from all being in the same space saying ideas to each other. Another barrier is keeping everyone on the same page and focused and not letting the group stray too far from the main objective.

Margarida X4: First of all, to do the brainstorming we need a space where everyone from the team fits in. In the office we have but some tasks arise on the days that we are teleworking, so I would say that one of the barriers would be teleworking.

Márcia X5: The biggest challenge will be that we are not all always on the same task and in the same space. We are in a mist regime, so we if we go to the company, we have a space where everyone can fit in and participate.

RQ4: How UNIFY deals with those barriers?

Rafael X1: One of the biggest obstacles to using brainstorming is inattention. The way we deal with this is to define very well the time we are going to waste and define the moderators in a way that we don't lose focus.

Eduardo X2: To deal with the fact that we are not always fully focused there are two solutions: a coffee or a snack to boost creativity and moderators to guide us through the entire process for people to be more serious about the situation.

Rita X3: When it comes to teleworking, a virtual room is always one of the options. Another is that in Brainstorming, two Moderates are always present to keep the group under control and to go from one stage to the next. It consistently reduces lack of attention.

Margarida X4: When teleworking, I sometimes create a virtual meeting room with my colleagues, and we exchange ideas. In person, when we are on a task, the best thing is to establish a time limit to come up with ideas, short and so there quickly without wasting time we proceed to brainstorming.

Márcia X5: We plan sometimes when we are going to do these exercises and we plan for the days we will be in the office. I would say the main way is to learn to benefit from barriers.

RQ5: What steps do you take to encourage to be a creative individual in the company?

Rafael X1: When I'm given a task, all I have to do is block out all other distractions and concentrate solely on the subject at hand. Two crucial steps, in my opinion, are good installation spaces and some good music to accompany.

Eduardo X2: I believe it is essential to respect other people's perspectives. Create an environment that does not condemn anyone's point of view and provide an adequate space to accomplish all of the above.

Rita X3: Sometimes I listen to music and go outside to get some fresh air, and other times I just remove all distractions. It helps me concentrate on the subject at hand and encourages me to be more creative.

Margarida X4: Being physically comfortable is the most important thing. We have wonderful areas in the office, and we let each of us be in our own space and surroundings to think freely.

Márcia X5: To enhance creativity in the workplace, you'll need a good environment where you can engage with others and think about new ideas.

RQ6: How do you encourage a creative environment for all members at work?

Rafael X1: What makes creativity move is also its recognition, so whenever someone comes up with an idea that we all like, we reward them with positivity and congratulations for having given a good idea and we let him chose one music to play!

Eduardo X2: Using Brainstorming is something that encourages us all to maintain the creative environment. And another is the fact that UNIFY has a great office space and we can easily do it in the company.

Rita X3: People in UNIFY usually support when people make mistakes and create mini and coffee breaks so people can rest during the day. This helps people to not be afraid to make a mistake and keep the creative attitude towards the tasks.

Margarida X4: It is related to the environment that we propagate to our fellow colleagues. By assigning all tasks we always encourage you to think outside the box and without fear of being judged.

Márcia X5: One of the great ways to encourage people to be creative is to use the Brainstorming method. Is a technique that will definitely encourage people to think outside the box and to come up with the most bizarre and unique ideas that we all need sometimes.

RQ7: What are the main benefits to UNIFY when everyone contributes ideas for a project within the organization?

Rafael X1: It is crucial, in my opinion, that everyone participates and contributes when we complete a task in a group because it allows us to be more creative, but its not always possible we know. Having a creative behavior in everything we do is the key to success today.

Eduardo X4: The more ideas and opinions, the more prepared we will be to give a better solution to the task.

Rita X3: The main advantage of having all of us participate is that we have a better chance of coming up with the greatest content and having multiple perspectives on the same subject.

Margarida X4: I believe that success comes when everyone works together. There are more minds participating, more ideas involved, and there is a greater change to have a better result in the end.

Márcia X5: By listening to everyone's ideas and opinions, we may see things from multiple angles and come up with a more creative and new ideas to the task we're dealing with.

RQ8: Do you think the use of creative techniques impact the firm performance?

Rafael X1: I think so, without a doubt. But I know that it is not always possible to use creative techniques on a daily basis. Sometimes we have more work, and it is difficult to reconcile everyone's schedules, in the case of using these techniques in a group.

Eduardo X2: Unify's performance is always linked to creativity. The use of these techniques will certainly present the best results for the company, because, for example, our publications with the best engagement are those that emerged from the use of one of these techniques.

Rita X3: My opinion is that we will get the best results whenever more people participate and come up with ideas. The techniques we talked about earlier are good, both individually and in groups, for both organizing a project and coming up with ideas out of the box.

Margarida X4: Yes! I think the fact that if we think of brainstorming that all company employees can participate in decision making is an asset for the results that we are going to present to the client.

Márcia X5: The best ideas, the best results are always obtained when there is an environment conducive to creativity. Using these techniques only stimulates creativity in the workspace and keeps everyone more inspired and ready to innovate.

CHAPTER 4 – INFLUENCE OF INTERNAL COMMUNICATION ON SPORTS PERFORMANCE IN FOOTBALL

Rodolfo Fontes

Orlando Lima Rua

ABSTRACT

This research aims to analyze how internal communication affects sports performance in football. Therefore, the objective of this study is to understand the impact of internal communication on sports performance.

A quantitative methodology was conducted, through a questionnaire with the response of 111 people, all of them male amateur football players in Portugal.

The data obtained was studied through reliability and descriptive analysis, to discover the relationship between internal communication and sports performance.

The results show that there is an influence between internal communication and sports performance in football. The relationship between these two variables is positive as the data reveal a positive impact on sports performance when there are good internal communication practices.

The conclusions drawn from this study are that there is a correlation between internal communication in a football team and the individual sports performance of the athletes and the collective performance of the team. This correlation, after analyzing the results, is positive since when there is good internal communication, sports performance is better.

In this way, it is recommended that football coaches give importance to team meetings and also find a way to keep athletes interested and attentive to them, as if they achieve this, they will have good internal communication within the team, leading to better sports results.

Keywords: Internal Communication, Sports Performance, Football.

LITERATURE REVIEW

COMMUNICATION: CONCEPT AND EVOLUTION

Human communication started with touch, then moved on to gestures and sounds until it finally reached the spoken word and then with the development of oral languages, the arrival of writing facilitated the development of communication (Rowland, 2006).

For Hauser (2000) the power of communication between members of the same tribe through language was of utmost importance in the development of man and the strength of the language is helped by the expressive movements of the face and body however, there is no reason to believe that any muscle was developed or even modified solely for expression.

Christiansen and Kirby (2003) state that understanding the evolution of communication and language is one of the most difficult problems in science and presents extremely complicated challenges. Nolfi and Mirolli (2010) refer that one of the main difficulties in understanding the evolution of communication and language arises from the need to address highly interdisciplinary issues such as: how animal and human communication systems are structured and how they differ; how communication and language affect and are affected by the behaviour and cognitive abilities of individuals; how humans acquire language during development; how evolution, learning and culture interact.

In this sense, language, culture and technology are inseparable elements of the communication process (Perles, 2007).

Vaz (2016, p. 339) states that communication is a word derived from the Latin term “communicare”, which means "to participate in something, to make common". According to the same scholar communication is sharing, is what drives people's actions, is the exchange of ideas, is efficient when the theme and the result that you want to obtain are defined and it’s also important when communicating with someone to have a guarantee that the message that was transmitted was received correctly.

Communication is an exchange of ideas, information and knowledge between two or more individuals to reach a mutual understanding (Ali & Anwar, 2021). Communication is the exchange of information by symbols, signs or words and also the exchange of views, thoughts, beliefs and facts about common purpose, efforts and interests (Khan & Abdullah, 2019). Anwar and Abdullah (2021) define communication as any behaviour that results in an exchange of meaning. Communication is the action of passing private information from one individual to another (Ganeshkumar et al., 2019).

Communication is defined by many authors as the exchange of information between recipient and sender by which a message is directed from one point to another point and communicators are all linked together through communication channels (Abdullah and Afshar, 2019). Finally, for Men and Bowen (2017) communication is managing interdependence and building mutually beneficial relationships between the organization and its employees.

Hauser (2000) states that in the world nothing would work if there was no communication because flowers have to communicate with the bees for successful pollination, the male birds communicate with females to mate and have children, lions in a cooperative hunt have to communicate with each other about how they will attack their prey, a human child must communicate with its parents so that the needs of both are carried out, great speakers like Jesse Jackson use their communication skills and abilities to captivate and manipulate their audience's emotions. According to the same scholar for all organisms, including humans, communication is a vehicle that serves to convey information and express to others what has been understood. But each organism is different in what it can transmit and in what it can understand. In this way, there is a huge diversity of communication systems in the world.

People cannot confuse communicating with to inform because to inform is only to transmit the information therefore many times it is not known if the message was received accurately. In this way communication is an integration tool and necessary in all areas, both personal as well as professional (Vaz, 2016).

INTERNAL COMMUNICATION

Abdullah (2018) states that internal communication is a process in which individuals share information, to achieve mutual understanding. This author also says that internal communication is an outline of meanings and the individual interaction that takes place within organizations. Furthermore, internal communication is social interaction through messages (Abdullah & Othman, 2016). Presenting an incentive in organizations that empowers and enables employees to perform their tasks effectively (Anwar & Abdullah, 2021).

Abdullah and Rahman (2015) refer that internal communication is necessary for management activities in all organizations as it is considered a vital factor for all employees at all levels in organizations to get information about their tasks and duties. For many years, internal communication was aimed at the internal public (board, management and employees) seeking to inform and integrate the various segments of this public with the organization’s objectives and interests (Curvello, 2012).

Internal communication plays a fundamental role in the permanent construction of exchange between employees and the organization, it must be combined with the

organizational policy of people management, aiming at achieving the company's objectives in conciliation with the interests of employees, generating intrinsic motivation (acceptance and belonging) and extrinsic (material or immaterial goods) through rewards and incentives (França and França, 2022).

Verčič (2019) states that internal communication is a multidisciplinary area, positioned between public relations, human resource management and marketing – it is simultaneously part of several organizations' functions and not part of anyone. Also according to this scholar in 2016, numerous functions claim internal communication, but it is the public relations and corporate communication functions that have the best understanding of internal audiences. However, for Helsby (2002) internal communication still needs to establish clearer links with business objectives and have a stronger focus on strategy despite the importance it has gained as a discipline. Therefore, Verčič and Špoljarić (2020) say it is essential to recognize the importance of communication channels to connect employees.

Internal communication (IC) has developed as a specialization that has been growing within the broader fields of strategic public relations, strategic communication and corporate communication. Just as public relations concerns have increased in more than one direction of messaging, so has internal communication increased interest in having “inside conversations”; encouraging employees to discuss and debate issues with each other and with senior management. In the same way that public relations are not just media relations, IC is much more than company newsletters or parties (Yeomans & FitzPatrick, 2017)

Rhodia (2003) refers that internal communication is a strategic tool for reconciling the interests of employees and the company, through the stimulation of dialogue, the exchange of information and experiences and the participation of all levels. Argentei (2006) states that it has to start with managers, they need to recognize that they need to contribute information to employees and learn to listen and together organize goals for the organization.

A company with an integrated internal communication system makes its employees more motivated to carry out activities, shows their importance and how much they are needed to function, makes them work more responsibly, receive information from their superiors at the right time and in the right amount. Because sometimes the superior delegates so many tasks that the employee feels lost, the importance of language at the right time should not be underestimated (Santiago, 2003).

Kunsch (2002) refer that internal communication works with communication strategically, as it “aims to provide means to promote greater integration within the organization through dialogue, the exchange of information and experiences and participation at all levels”. Also according to the same scholar in 2003, we can say that “internal communication is a strategic

tool for reconciling the interests of employees and the company, by encouraging dialogue, the exchange of information and experiences and the participation of all levels". Machado (2022) states that it is important to work on communication with employees so that they feel valued and that they belong to the organization.

For Verčič (2019) internal communication creates and maintains communication systems between employers and employees. Representing to Bahtijarevic-Siber & Sikavica (2001) a transfer of ideas, information, attitudes and emotions between people.

Ruck and Welch (2012) state that effective internal communication is essential for organizational success. According to Welch (2012), it can improve internal relationships as well as communication between employees and managers. And when managed carefully for Verčič (2019) internal communication can lead to greater awareness of threats and opportunities, on the other hand, it can be a risk if the communication is bad. Internal communication can increase an organization's productivity, performance and external customer orientation (Downs & Adrian, 2004).

However, for internal communication practices to prove effective, the seven guiding principles must be considered (Redford, 1985) (Figure 1).

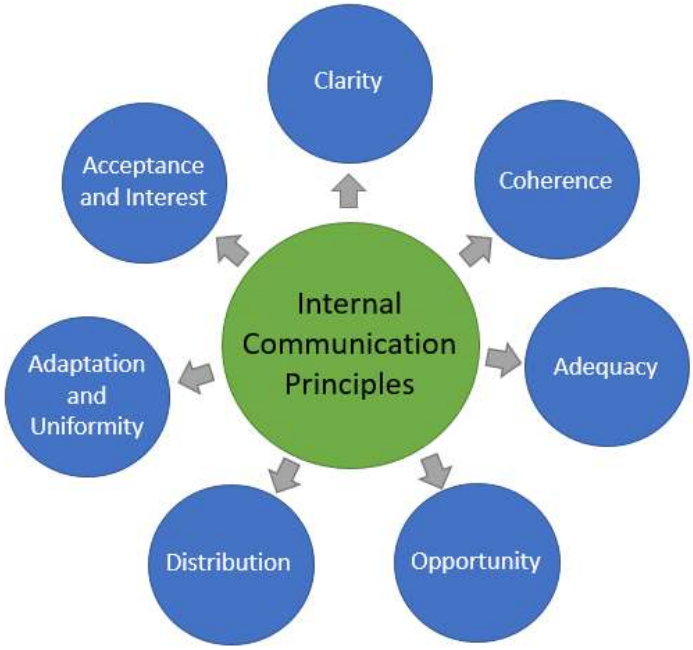

Figure 1 - Seven guiding principles of internal communication
Source: Adapted from Redford (1985) and Oliveira (2021).

Internal communication is not just a concern for large organizations or multinationals that need to communicate with thousands of employees. While an international company like Sony

needs to have a sophisticated communication system to engage with its employees around the world, a small, family-owned printing business also benefits from sharing information and feedback to help the business better perform. IC is also vital when an organization of any size or sector undergoes change or transformation. Internal audiences will need to have a clear understanding of what is required of them. Companies need to explain customer needs, public sector organizations need to promote an understanding of service priorities, and every organization needs employees who are committed and enthusiastic about the tasks given (Yeomans and FitzPatrick, 2017).

Verčič et al. (2015) define internal communication as an integrated system that includes the entire flow of formal and informal communication that takes place in various interrelated dimensions within the organization.

Cummings et al. (1983) state that internal communication is essential to increase employee satisfaction and productivity, regardless of formality (Figure 2).

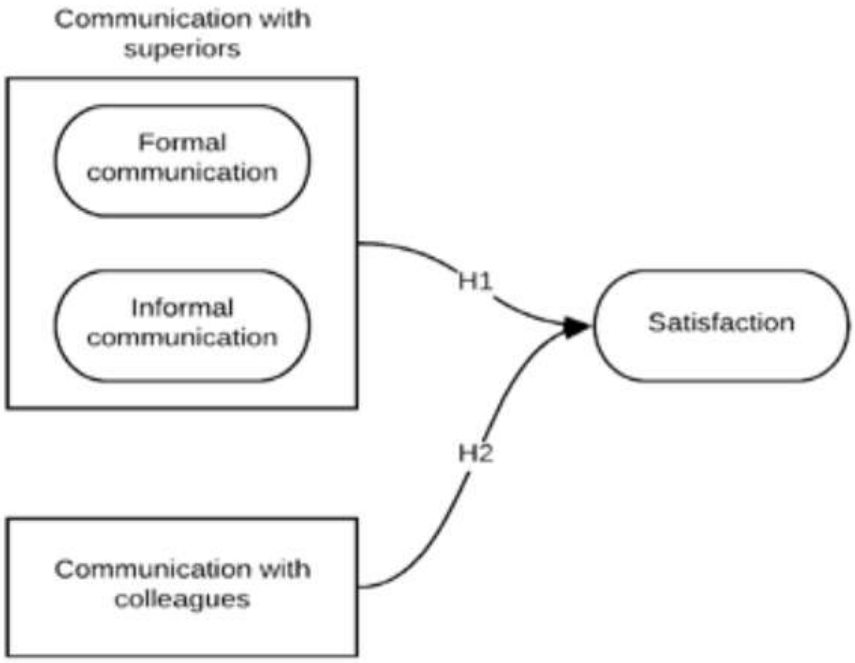

Figure 2 - Research Model
Source: Tanković et al. (2021).

Chen and Cheng (2012) refer to internal communication as the exchange and sharing of knowledge between employees. It encompasses all communication processes, enables organizational functioning, connects employees (Gray & Laidlaw, 2002), and on top of that stated by Gomes et al. (2011) brings a competitive advantage.

Gillis (2011) said that there are three fundamental building blocks for internal communication to work, which are: hierarchical communication, in which executive directors (CEOs), vice presidents, directors, managers and frontline supervisors play key roles in the

communication process; mass media communication, in which newsletters, emails, videos, blogs and other vehicles reach a large audience of employees; and the social networks of invisible communicators who organically spread the word. On top of these three elements are the comparatively new social media tools such as LinkedIn, Facebook, Twitter, and YouTube, which are migrating from the real world to the corporate environment (Figure 3).

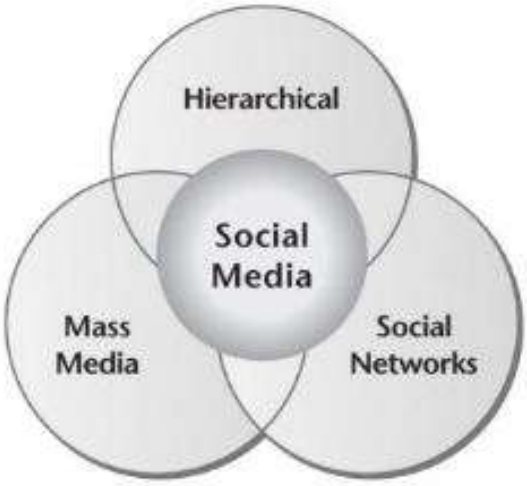

Figure 3 - Building blocks of an internal communications program
Source: Whitworth (2011).

SPORTS PERFORMANCE

Sport is a playful-agonistic corporal practice, institutionalized and with rules, in which its actions influence political acts that create collective and social consequences (Sérgio, 2003). O'Donoghue (2010) states that high-performance sport is a phenomenon of worldwide expression with marked economic and social importance, which is currently on par with the world's largest organizations, and which is supported by athletes capable of challenging the limits of human performance. The process of analysing sports performance is a very important factor to regulate training and competitions (Garganta, 2001). Currently, football is indisputably the sport with the greatest impact worldwide and can even be seen as a total anthropological phenomenon, as it is a phenomenon of Man, in his social context, suffering ontogenesis resulting from all the social factors that act on him and around him (Faria, 1999).

Spessoto (2008) refers that there is a tendency for football to be a business, an attractive source of profits for investors and sponsors, but the sport has not yet reached its maximum potential. The statement above demonstrates its value, as a high-performance sport today moves increasingly relevant financial values, with highly sophisticated management models developing business standards.

Melo (2022) refer that globalization has meant that there is a high level of interaction between leagues and their adjacent ones. The Fédération Internationale de Football Association (FIFA) currently has 208 associated countries and territories, more than the United Nations (UN), which has 193 members, which demonstrates the scale that has been achieved.

Tucker and Collins (2012) state that there is a lot of research on the roles played by genetic and training factors in determining elite sports performance, the exclusion of genetic or training factors for performances is impossible in sports science, as there is so much evidence to distinguish elite athletes from athletes with lower performance concerning both genetic factors and training histories. Nonetheless, according to the same scholar the polarization of this debate has recently become prominent in popular literature, with at least three books dedicated to defending the theory that it is deliberate training, not genetics that produces champions. The 'born versus bred' question goes back to 1800, and the theory of Sir Francis Galton which postulated that mental capacities are limited by hereditary factors. The Galtonian model proposed that practice and training lead to improvements in performance, but that there is a ceiling for each person, influenced by hereditary characteristics. In contrast, Ericsson and others have suggested that performance is limited not by genetic factors or innate factors, but by engaging in deliberate practice and training during optimal periods of development. According to this model, practice is both necessary and sufficient for the achievement of deliberate performance, and it is effective because it "selectively activates dormant genes that are contained in the DNA of all healthy individuals."

SPORTS SUCCESS

Csató (2021) refers that football is probably the most popular sport around the world: FIFA World Cup 2018 matches were watched by more than half of the global population (FIFA, 2018).

Therefore, according to Csató (2021) analysing the determinants of success in football, for example, the factors on which the participation of national teams in the FIFA World Cup finals depends, is an important topic for academics and football fans. This scholar still refers that one might think that the chance of qualifying has to do with the player's talents, the skills of the coach or the implementation of innovative tactics - in other words, elements that are independent of the organizer's decisions. But this is not the case. In addition to the performances of the contestants, the structural dimensions of the contest also have a non-negligible effect on its expected result.

FIFA (2014 and 2016) states that the Fédération Internationale Football Association (FIFA) reinforced the importance of developing women's football as a fundamental objective for the

future of football. Thus, continental football federations began to implement various strategic plans and investments to develop women's football around the world.

Jacobs (2014) refer that as a result, studies were carried out to arrive at empirical evidence that tests the role of program-level factors in predicting the success of women's football. The same scholar concluded that there are two major factors, which are: sports programme-level factors and country-level factors. For UEFA (2017) the last factor is subdivided into several sectors which are: economic development and talent pool, climate, socio-cultural, political system and sports tradition.

During the last few decades, the struggle between countries to achieve international success in elite sports has increased. Under the assumption that success in sports can be achieved through strategic investments, many national organizations have increased their investments in elite sports. As such, there is a growing institutionalization of elite sport, with governments becoming more actively involved in the belief that success is developable (i.e. can be influenced by policy making) and that international sports success leads to broader outcomes such as international prestige, national reaffirmation, greater economic income related to the holding of major events, or an increase in the population that participates in sports through the so-called "demonstration effect" (De Bosscher at al., 2015).

The meaning of sports success is directly linked to the objectives proposed and outlined by the sports organization, varying according to its size. This success is generally measured by the sports results obtained, being that success is being able to fulfil the objectives, in the competitions in which the club participates. Financial success is seen as an effect of success in sports, so the greater the sports success, the greater your financial success. Sports success is related to the work carried out by the managers of the clubs, and by the governing structure, which ensure the best results possible (Fernandes, 2022).

Strauss, Senkse and Tietjens (2009) state that individuals tend to explain their success by referring to internal factors related to their characteristics, such as their athletic or mental strength, while they explain their failures by external factors that are not in their control, such as luck, misfortune or arbitration.

Fernandes (2022) advocate that sports success varies from club to club, and in Portugal, the goal of a club like the “Três Grandes”, Sports CP, FC Porto and SL Benfica cannot be the same as a club like FC Paços de Ferreira or Rio Ave. FC. The big three groups always aim to fight for the title of national champion and the national cups, while in terms of European competitions it is always relative, depending on whether they are competing in the Champions League or the Europa League. For a club in the middle of the national league table, like Rio Ave FC, the objective is to qualify for the Europa League and get as far as possible in the national cups, about European

competitions they always have the objective of reaching the stage of Europa League groups, if they are present at that time. Clubs like CD Tondela fight hard to maintain the national championship and try to get as far as possible in the national cups but often give up on them in favour of the national championship (Table 1).

Table 1 - Analysis of the sports performance of European clubs

Football Club	National Championship	National Cup	League Cup	Champions League	Europa League
FC Porto	29	17	Finalist	2	2
SL Benfica	37	26	7	2	Finalist
Sports CP	18	17	2	1/8 Final	Finalist
SC Braga	2nd Place	2	2	Group Stage	Finalist
Vitória SC	3rd Place	1	1/2 Final	1/4 Final	Group Stage
Rio Ave FC	5th Place	Finalist	Finalist	0	Group Stage
Marítimo	5th Place	Finalist	Finalist	0	Group Stage
B-SAD	9th Place	4th Round	2nd Round	0	0
Real Madrid	34	19	ND	13	2
Barcelona	26	31	ND	5	0
Valência	6	8	ND	Finalist	1
Villareal	3rd Place	1/4 Final	ND	1/4 Final	1/2 Final
Man United	20	12	5	3	1
Man City	7	6	7	1/2 Final	1/4 Final
Liverpool	19	7	8	6	3
Arsenal	13	14	2	Finalist	Finalist
West Ham	3rd Place	3	Finalist	0	Qualification
Juventus	36	13	ND	2	3
AC Milan	18	5	ND	7	1/8 Final
Napoli	2	6	ND	1/8 Final	1
Lyon	7	5	1	1/2 Final	1/2 Final
AS Mónaco	8	5	1	Finalist	1/2 Final
Celtic	51	40	19	1	Finalist

Source: Adapted from Fernandes (2022).

METHODOLOGY

METHODOLOGICAL APPROACH

In scientific research, the general procedure involves finding the problem, planning the study, obtaining the data, analysing them and ending the discussion of the results (Manzato & Santos, 2012).

The quantitative method is based on the quantification of the method of data collection, as well as the analysis of data through statistics (Richardson, 1989). In this method the technique used to work is the survey/questionnaires method (Hymann, 1967), this is a tool that uses structured questions involving many participants, however, there may be biases, since the interpretation of each individual is different.

The use of the quantitative method has great advantages since it can provide reliable and accurate data, data collection is fast and has the tendency to eliminate bias.

SAMPLE AND DATA COLLECTION

The study's data collection was provided by a survey questionnaire carried out among male amateur football players.

The questionnaire was applied between 11th July 2022 and 14th July 2022, having obtained a total of 111 complete and valid answers.

MEASURES

This study and the questions in the questionnaire were based on scales previously measured in other studies

To measure team meetings, ten items from Ali et al. (2021) scale were used. A five-point Likert scale ranging from "1 – strongly disagree" to "5 – strongly agree" was used to measure team meetings.

Table 2 shows all items of the internal communication dimension.

Table 2 - Internal Communication dimension items

Dimension	Items	
Internal Communication	IC1.	Team meetings are a waste of time.
	IC2.	Team meetings are essential to improve the team's sports performance.
	IC3.	Team meetings give the player the opportunity to give feedback and show their opinion.
	IC4.	The coach holds regular team meetings.
	IC5.	The coach involves everyone in team meetings.
	IC6.	The coach communicates effectively his ideas with the team.
	IC7.	The coach gives the team the opportunity to participate in decision-making.
	IC8.	All players give ideas to improve the sports performance of the team.
	IC9.	The team is committed to the meetings.
	IC10.	The coach is committed to team meetings.

Source: Own elaboration.

To assess sports performance, a five-point Likert scale from "1 – Strongly disagree" to "5 – Strongly agree" was used. Sports performance was assessed using items adapted from Nahum's (2016) scale (Table 3).

Table 3 - Sports Performance dimension items

Dimension	Items	
Sports performance	SP1.	I am satisfied with my sports performance.
	SP2.	I contribute positively to the sports success of my team.
	SP3.	I was able to play to the level of my best ability.
	SP4.	I contribute to an increase in the performance of my teammates.
	SP5.	My sports performance was regular during the season.
	SP6.	The coach was satisfied with my sports performance.
	SP7.	The coach was satisfied with the team's sports performance.

Source: Own elaboration.

RESULTS

SAMPLE RELIABILITY

When items are used to form a scale they need to have internal consistency. The items should all measure the same thing, so they should be correlated with one another. A useful coefficient for assessing internal consistency is Cronbach's alpha (Bland & Altman 1997).

Cronbach's alpha has been described as "one of the most important and pervasive statistics in research involving test construction and use" (Cortina, 1993, p. 98). In this study the sample Cronbach's Alpha is 0.867, which is considered quite positive since values above 0.7 already indicate results with acceptable consistency (Table 4).

Table 4 - Cronbach's Alpha

Cronbach's Alpha	Number of items
0.867	17

Source: Own elaboration.

DESCRIPTIVE ANALYSIS

Sample characterization

In the present study, there is no demographic analysis of the gender of the respondents as the questionnaire was exclusively sent and answered by male amateur football players. Therefore, asking a question about the gender of the respondent was not necessary.

The first three questions of the questionnaire are asked to obtain some background information about the athletes. Therefore, their age, the number of years of sports practice and the number of clubs that the athlete has represented during his career are questioned.

Table 5, shows the frequency, percentage, valid percentage and cumulative percentage of the age of the respondents in this study. Thus, we can see that in a total of 111 football players, 14 (12.6%) are under 18 years of age; 64 (57.7%) are between 19 to 25 years of age; 26 (23.4%) are between 26 to 35 years of age, and 7 (6.3%) are more than 36 years of age. The majority of the respondents are aged 19-25 years and the minority are older than 36 years.

Table 5 - Age

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	<18	14	12,6	12,6	12,6
	19-25	64	57,7	57,7	76,6
	26-35	26	23,4	23,4	100
	>36	7	6,3	6,3	18,9
	Total	**111**	**100**	**100**	

Source: Own elaboration.

Table 6, shows the frequency, percentage, valid percentage and cumulative percentage of years of sports practice of the respondents in this study. In this way, we found that in a total of 111 football players, 8 (7.2%) have been playing football for less than 5 years; 24 (21.6%) have been playing football for 6-10 years, and 79 (71.2%) have been playing football for more than 10 years. The majority of the respondents have been playing football for more than 10 years and the minority have only been playing football for less than 5 years.

Table 6- Years of sports practice

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0-5	8	7,2	7,2	78,4
	6-10	24	21,6	21,6	100
	>10	79	71,2	71,2	71,2
	Total	**111**	**100**	**100**	

Source: Own elaboration.

Table 7, shows the frequency, percentage, valid percentage and cumulative percentage of the number of clubs represented by the respondent in this study. Thus, we find that in a total of 111 football players, 40 (36%) represented 2 clubs or less throughout their career; 41 (36.9%) represented between 3 to 4 clubs, and 30 (27%) represented more than 4 clubs during their sports career. The majority by a very small margin of respondents have represented 3-4 clubs and the minority have played for more than 4 clubs.

Table 7 - Number of clubs represented during a sports career

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	0-2	40	36	36	63,1
	3-4	41	36,9	36,9	100
	>4	30	27	27	27
	Total	**111**	**100**	**100**	

Source: Own elaboration.

Internal communication

Regarding internal communication, we were able to verify that most respondents (mean = 1.54) do not consider team meetings a waste of time. According to the descriptive analysis, 70 (63.1%) respondents rated strongly disagree, 33 (29.7%) respondents rated disagree, 5 (4.5%) respondents rated agree, and 3 (2,7%) respondents rated how strongly I agree. Also, the standard deviation is 0.922 and this being less than 1 means that this is low-variance which indicates that the data is closely clustered around the mean.

Most respondents (mean = 4.24) consider team meetings essential to improve the team's sports performance. According to the descriptive analysis, 2 (1.8%) respondents rated it as disagree, 7 (6.3%) respondents rated it as neutral, 64 (57.7%) respondents rated it as agreed, and 38 (34.2%) respondents rated how strongly I agree. Also, the standard deviation is 0.650 and this being less than 1 means that this is low-variance which indicates that the data is closely clustered around the mean.

Most respondents (mean = 4.19) consider that team meetings allow players to give feedback and express their opinion. According to the descriptive analysis, 5 (4.5%) respondents rated as disagreed, 9 (8.1%) respondents rated as neutral, 57 (51.4%) respondents rated as agreed, and 40 (36.0 %) respondents rated how strongly I agree. Also, the standard deviation is 0.769 and this being less than 1 means that this is low-variance which indicates that the data is closely clustered around the mean.

Most respondents (mean = 4.19) consider that the coach holds team meetings regularly. According to the descriptive analysis, 1 (0.9%) of respondents rated it as completely disagree, 3 (2.7%) respondents rated it as disagree, 13 (11.7%) respondents rated it as neutral, 51 (45.9%) respondents rated it as I agree, and 43 (38.7%) respondents rated as I totally agree. Also, the standard deviation is 0.815 and this being less than 1 means that this is low-variance which indicates that the data is closely clustered around the mean.

Most respondents (mean = 3.43) consider that the coach involves everyone in team meetings. According to the descriptive analysis, 7 (6.3%) respondents rated it as completely disagree, 23 (20.7%) respondents rated it as disagree, 19 (17.1%) respondents rated it as neutral, 39 (35.1%) respondents rated as I agree, and 23 (20.7%) respondents rated as I totally agree. Also, the standard deviation is 1,211 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.94) consider that the coach effectively communicates his ideas with the team. According to the descriptive analysis, 1 (0.9%) of respondents rated it as totally disagree, 6 (5.4%) respondents rated it as disagree, 20 (18.0%) respondents rated it as neutral, 56 (50.5 %) respondents rated it as I agree, and 28 (25.2%) respondents rated as I totally agree. Also, the standard deviation is 0.856 and this being less than 1 means that this is low-variance which indicates that the data is closely clustered around the mean.

Most respondents (mean = 2.98) consider that the coach does not allow the team to participate in decision-making. According to the descriptive analysis, 9 (8.1%) respondents rated it as completely disagree, 39 (35.1%) respondents rated it as disagree, 21 (18.9%) respondents rated it as neutral, 29 (26.1%) respondents rated it as I agree, and 13 (11.7%) respondents rated as I totally agree. Also, the standard deviation is 1,191 and this being a value greater than 1

means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.34) consider that all players give ideas to improve the team's sports performance. According to the descriptive analysis, 3 (2.7%) respondents rated it as completely disagree, 28 (25.2%) respondents rated it as disagree, 25 (22.5%) respondents rated it as neutral, 38 (34.2%) respondents rated it as I agree, and 17 (15.3%) respondents rated as I totally agree. Also, the standard deviation is 1,100 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.48) consider that the team is committed to team meetings. According to the descriptive analysis, 5 (4.5%) respondents rated it as completely disagree, 19 (17.1%) respondents rated it as disagree, 23 (20.7%) respondents rated it as neutral, 46 (41.4%) respondents rated it as I agree, and 18 (16.2%) respondents rated as I totally agree. Also, the standard deviation is 1,094 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.96) consider that the coach is committed to team meetings. According to the descriptive analysis, 7 (6.3%) respondents rated it as totally disagree, 6 (5.4%) respondents rated it as disagree, 10 (9.0%) respondents rated it as neutral, 49 (44.1%) respondents rated it as I agree, and 39 (35.1%) respondents rated as I totally agree. Also, the standard deviation is 1,111 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

All this analysis is supported by the data presented in Table 8.

Table 8 - Descriptive Analysis of Internal Communication

Items	Scales	Frequency	Percentage	Mean	Standard Deviation
IC1 - Team meetings are a waste of time	1 – Strongly Disagree	70	63,1	1,54	.922
	2 – Disagree	33	29,7		
	4 – Agree	5	4,5		
	5 – Strongly Agree	3	2,7		
IC2 - Team meetings are essential to improve the team's sports performance	2 – Disagree	2	1,8	4,24	.650
	3 – Neutral	7	6,3		
	4 – Agree	64	57,7		
	5 – Strongly Agree	38	34,2		
IC3 - Team meetings give the player the opportunity to give feedback and show their opinion	2 – Disagree	5	4,5	4,19	.769
	3 – Neutral	9	8,1		
	4 – Agree	57	51,4		
	5 – Strongly Agree	40	36,0		

IC4 - The coach holds regular team meetings	1 – Strongly Disagree	1	,9	4,19	.815
	2 – Disagree	3	2,7		
	3 – Neutral	13	11,7		
	4 – Agree	51	45,9		
	5 – Strongly Agree	43	38,7		
IC5 - The coach involves everyone in team meetings	1 – Strongly Disagree	7	6,3	3,43	1,211
	2 – Disagree	23	20,7		
	3 – Neutral	19	17,1		
	4 – Agree	39	35,1		
	5 – Strongly Agree	23	20,7		
IC6 - The coach communicates effectively his ideas with the team	1 – Strongly Disagree	1	,9	3,94	,856
	2 – Disagree	6	5,4		
	3 – Neutral	20	18,0		
	4 – Agree	56	50,5		
	5 – Strongly Agree	28	25,2		
IC7 - The coach gives the team the opportunity to participate in decision making	1 – Strongly Disagree	9	8,1	2,98	1,191
	2 – Disagree	39	35,1		
	3 – Neutral	21	18,9		
	4 – Agree	29	26,1		
	5 – Strongly Agree	13	11,7		
IC8 - All players give ideas to improve the sports performance of the team	1 – Strongly Disagree	3	2,7	3,34	1,100
	2 – Disagree	28	25,2		
	3 – Neutral	25	22,5		
	4 – Agree	38	34,2		
	5 – Strongly Agree	17	15,3		
IC9 - The team is committed to the meetings	1 – Strongly Disagree	5	4,5	3,48	1,094
	2 – Disagree	19	17,1		
	3 – Neutral	23	20,7		
	4 – Agree	46	41,4		
	5 – Strongly Agree	18	16,2		
IC10. The coach is committed to team meetings	1 – Strongly Disagree	7	6,3	3,96	1,111
	2 – Disagree	6	5,4		
	3 – Neutral	10	9,0		
	4 – Agree	49	44,1		
	5 – Strongly Agree	39	35,1		

Source: Own elaboration.

Sports Performance

Regarding sports performance, we could see that most respondents (mean = 3.58) consider themselves satisfied with their own sports performance. According to the descriptive analysis, 5 (4.5%) respondents rated it as totally disagree, 23 (20.7%) respondents rated it as disagree, 6 (5.4%) respondents rated it as neutral, 57 (51.4%) respondents rated it as Agree, and 20 (18.0%) respondents rated it as totally agree. Also, the standard deviation is 1,141 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.79) consider they have contributed positively to the team's sports success. According to the descriptive analysis, 5 (4.5%) respondents rated it as totally disagree, 14 (12.6%) respondents rated it as disagree, 10 (9.0%) respondents rated it as neutral, 52 (46.8%) respondents rated it as Agree, and 30 (27.0%) respondents rated it as totally agree. Also, the standard deviation is 1,113 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.38) consider that they have played to the best of their ability. According to the descriptive analysis, 9 (8.1%) respondents rated it as totally disagree, 24 (21.6%) respondents rated it as disagree, 18 (16.2%) respondents rated it as neutral, 36 (32.4%) respondents rated it as Agree, and 24 (21.6%) respondents rated it as totally agree. Also, the standard deviation is 1,265 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.73) consider having contributed to an increase in the sports performance of their teammates. According to the descriptive analysis, 6 (5.4%) respondents rated it as totally disagree, 12 (10.8%) respondents rated it as disagree, 14 (12.6%) respondents rated it as neutral, 53 (47.7%) respondents rated it as Agree, and 26 (23.4%) respondents rated it as totally agree. Also, the standard deviation is 1,103 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.57) consider having had a regular sports performance throughout the season. According to the descriptive analysis, 3 (2.7%) respondents rated it as totally disagree, 28 (25.2%) respondents rated it as disagree, 9 (8.1%) respondents rated it as neutral, 45 (40.5%) respondents rated it as Agree, and 26 (23.4%) respondents rated it as totally agree. Also, the standard deviation is 1,180 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.66) consider that their coach was satisfied with their individual sports performance. According to the descriptive analysis, 4 (3.6%) respondents rated it as totally disagree, 19 (17.1%) respondents rated it as disagree, 17 (15.3%) respondents rated it as neutral, 42 (37.8%) respondents rated it as Agree, and 29 (26.1%) respondents rated it as totally agree. Also, the standard deviation is 1,148 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

Most respondents (mean = 3.85) consider that their coach was satisfied with the team's sports performance. According to the descriptive analysis, 6 (5.4%) respondents rated it as totally disagree, 15 (13.5%) respondents rated it as disagree, 9 (8.1%) respondents rated it as neutral, 41 (36.9%) respondents rated it as Agree, and 40 (36.0%) respondents rated it as totally agree. Also, the standard deviation is 1,208 and this being a value greater than 1 means that this is high variance which indicates that the data is dispersed over a wider range of values.

All this analysis is supported by the data presented in Table 9.

Table 9 - Descriptive Analysis of Sports Performance

Items	Scales	Frequency	Percentage	Mean	Standard Deviation
SP1 - I am satisfied with my sports performance	1 – Strongly Disagree	5	4,5	3,58	1,141
	2 – Disagree	23	20,7		
	3 – Neutral	6	5,4		
	4 – Agree	57	51,4		
	5 – Strongly Agree	20	18,0		
SP2 - I contribute positively to the sports success of my team	1 – Strongly Disagree	5	4,5	3,79	1,113
	2 – Disagree	14	12,6		
	3 – Neutral	10	9,0		
	4 – Agree	52	46,8		
	5 – Strongly Agree	30	27,0		

SP3 - I was able to play to the level of my best ability	1 – Strongly Disagree	9	8,1	3,38	1,265
	2 – Disagree	24	21,6		
	3 – Neutral	18	16,2		
	4 – Agree	36	32,4		
	5 – Strongly Agree	24	21,6		
SP4 - I contribute to an increase in the performance of my teammates	1 – Strongly Disagree	6	5,4	3,73	1,103
	2 – Disagree	12	10,8		
	3 – Neutral	14	12,6		
	4 – Agree	53	47,7		
	5 – Strongly Agree	26	23,4		
SP5 - My sports performance was regular during the season	1 – Strongly Disagree	3	2,7	3,57	1,180
	2 – Disagree	28	25,2		
	3 – Neutral	9	8,1		
	4 – Agree	45	40,5		
	5 – Strongly Agree	26	23,4		
SP6 - The coach was satisfied with my sports performance	1 – Strongly Disagree	4	3,6	3,66	1,148
	2 – Disagree	19	17,1		
	3 – Neutral	17	15,3		
	4 – Agree	42	37,8		

	5 – Strongly Agree	29	26,1		
SP7 - The coach was satisfied with the team's sports performance	1 – Strongly Disagree	6	5,4	3,85	1,208
	2 – Disagree	15	13,5		
	3 – Neutral	9	8,1		
	4 – Agree	41	36,9		
	5 – Strongly Agree	40	36,0		

Source: Own elaboration.

CONCLUSIONS

This study aims to analyze the influence of internal communication on sports performance. More specifically, we wanted to assess whether the practices of good internal communication in a football team contributed to the individual and collective sports success of a football team.

It was possible to verify that in most football teams there are good practices of internal communication, that is, team meetings are held regularly, both players and coaches are committed to them, the ideas are effectively communicated and the players themselves recognize the importance of team meetings

We can observe that most players attribute a positive evaluation to their individual and collective performance of the team, since both the players themselves and the coaches are satisfied with the individual and collective performance of the player and the team, each player contributed to a better performance of their colleagues and each player remained regular throughout the season.

The theoretical overview provided knowledge about the relationship between the two dimensions mentioned above, and thus it was possible to relate the variables and understand the influence on sports performance.

Therefore, comparing the data obtained in these two variables, it was possible to prove that when there are good practices of internal communication within a football team, this is

reflected on the field, contributing to a better individual sports performance of the players and consequently bringing sports success to the team.

The biggest limitation of this study is the small sample size since in Portugal football is the king sport and there are many amateur football teams and consequently many players but I only got 111 answers and therefore we cannot generalize the answers for all players of football.

As a researcher, the biggest limitation I had was time constraints, through my fault since I managed my time badly, having ended up doing things in a hurry and having little time to apply the questionnaire.

For future research line, I recommend the study be applied to all amateur football players in Portugal to verify if there are any changes in the results obtained. Additionally, I also recommend evaluating internal communication between teammates, as player-coach communication can be good but between players can be bad and this was not evaluated in this study. In addition, the study could also be carried out in more countries to compare results and verify if there are cultural differences regarding the influence of communication on the performance of a football player.

To conclude, it is important to teach the importance of internal communication to coaches and athletes, because especially at the level of amateur football, it is an aspect that is often undervalued, since people think a lot about training and the game and end up not paying much attention to the mental part of the players. And that can make a difference because good communication between coach and players is enough for athletes to feel good and motivated, improving their sports performance.

REFERENCES

Alfaro, A. M. R. (2018). *A prevenção da lesão como vertente de treino para o sucesso desportivo*. Relatório de Estágiode Mestrado em Treino Desportivo. Lisboa: Universidade de Lisboa.

Ali, B. J., Anwar, G., Gardi, B., Othman, B. J., Aziz, H. M., Ahmed, S. A., Hamza, P. A., Ismael, N. B., Sorguli, S., & Sabir, B. Y. (2021). Business Communication Strategies: Analysis of Internal Communication Processes. *Journal of Humanities and Education Development*, *3*(3), 16–38.

Bland, J. M., & Altman, D. G. (1997). Statistics notes: Cronbach's alpha. *BMJ*, 314(7080).

Csató, L. (2021). *On the role of tournament design in sports success: A study of the north, central american and caribbean qualification for the 2022 FIFA world cup* (pp. 1–22).

Čuić Tanković, A., Bilić, I., & Brajković, I. (2022). Internal communication and employee satisfaction in hospitality. *Journal of Contemporary Management Issues*, *27*(1), 1–16.

Fernandes, D. J. O. (2022). *Influência da despesa no sucesso financeiro e desportivo: estimação da eficiência e da produtividade*. Dissertação de Mestrado em Economia. Évora: Universidade de Évora.

França, F. Y. A., & França, S. A. (2022). A Importância da Comunicação Interna na Organização. *Revista Rumos Da Pesquisa Em Ciências Empresariais, Ciências do Estado e de Tecnologia*, *1*(6), 337–351.

Hauser, M. D. (2000). Synopsis of the Argument. In *The Evolution of Communication* (pp. 1–17). A Bradford Book.

Hymann, H. (1967). *Planejamento e análise de pesquisa*. Rio de Janeiro: Lidador.

Idiong, N. S., & Nda, I. C. (2022). Evolution of organisational communication in Nigeria. In B. Mutsvairo & N. T. Ekeanyanwu (Eds.), *Media and Communication in Nigeria* (pp. 110–123). Routledge.

Isabel, M., Sampaio, J., & Afonso, J. (2017). Análise da performance desportiva. In *Manual de Curso de Treinadores de Desporto – Grau III* (pp. 1–75). Instituto Português do Desporto e Juventude.

Machado, A. C. P. (2022). *Um estudo da cultura organizacional e da comunicação interna na startup Conube*. Curso de Graduação de Bacharel em Relações Públicas. São Borja–RS: Universidade Federal do Pampa.

Manzato, A. J., & Santos, A. B. (2012). *A elaboração de questionários na pesquisa quantitativa*. IBILCE-UNESP, Departamento de Ciência de Computação e Estatística.

Mateu, P., Vilanova, A., Ingles, E., & Bosscher, V. D. (2020). Academic studies and sports success. Analysing dual careers in 13 nations. *Journal of Sport Psychology*, *20*(77), 133–141.

Melo, M. H. O. (2022). *A associação entre o sucesso desportivo e o sucesso financeiro em clubes de futebol*. Dissertação de Mestrado em Direção e Gestão Desportiva. Évora: Universidade de Évora.

Nahum, O. (2016). Athlete's Subjective Performance Scale (ASPS). https://www.researchgate.net/publication/343307266_Athlete%27s_Subjective_Performance_Scale_ASPS?channel=doi&linkId=5f22b46492851cd302c89e87&showFulltext=true

Nolfi, S., & Mirolli, M. (2010). A Synthetic Approach to the Study of the Evolution of Communication and Language. In *Evolution of Communication and Language in Embodied Agents* (pp. 1–9). Springer.

Oliveira, A. R. B. de. (2021). *O papel estratégico da comunicação interna no reforço da cultura das organizações - estudo de caso: YKK Portugal*. Dissertação de Mestrado em Ciências da

Comunicação – Comunicação, Organização e Liderança. Universidade Católica Portuguesa.

Perles, J. B. (2007). *Comunicação: conceitos, fundamentos e história* (pp. 1–17). http://www.bocc.ubi.pt/pag/perles-joao-comunicacao-conceitos-fundamentos-historia.pdf

Qin, Y. S., & Men, L. R. (2022). Exploring the Impact of Internal Communication on Employee Psychological Well-Being During the COVID-19 Pandemic: The Mediating Role of Employee Organizational Trust. *International Journal of Business Communication*. https://doi.org/10.1177/23294884221081838

Richardson, R. J. (1989). *Pesquisa social: métodos e técnicas*. São Paulo: Atlas.

Ruão, T. (1999). A Comunicação Organizacional e a Gestão de Recursos Humanos: Evolução e Actualidade. In *Comunicação e Sociedade 1, Cadernos do Noroeste, Série Comunicação* (pp. 179–194). Universidade do Minho.

Sousa, R. P. D., Soares, H. C. C., Lima, J. R. M. de, Gonçalves, T. de O., Carvalho, V. G., & Fernandes, L. M. (2021). O poder da comunicação nos processos gerenciais. *Revista Científica Faculdade Atenas - Paracatu-MG*, 1–19.

Taber, K. S. (2017). The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education*, *48*(6), 1273–1296.

Tkalac Verčič, A., & Špoljarić, A. (2020). Managing internal communication: How the choice of channels affects internal communication satisfaction. *Public Relations Review*, *46*(3), 1–7.

Tucker, R., & Collins, M. (2012). What makes champions? A review of the relative contribution of genes and training to sports success. *British Journal of Sports Medicine*, *46*(8), 555–561.

Valenti, M., Scelles, N., & Morrow, S. (2019). Elite sport policies and international sports success: A panel data analysis of European women's national football team performance. *European Sport Management Quarterly*, *20*(3), 300–320.

Verčič, A. T. (2021). The impact of employee engagement, organisational support and employer branding on internal communication satisfaction. *Public Relations Review*, *47*(1), 1–7.

Vögele, C., & Schäfer, M. (2021). Internal and external attributions for sports success and failure (sports coverage). *DOCA - Database of Variables for Content Analysis*, 1–4.

Whitworth, B. (2011). Internal communicaton. In *The IABC Handbook of Organizational Communication: A Guide to Internal Communication, Public relations, marketing, and Leadership* (pp. 195–207). Jossey-Bass.

Yeomans, L., & FitzPatrick, L. (2017). Internal communication. In *Exploring Public Relations* (pp. 286–307). Pearson Education.


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