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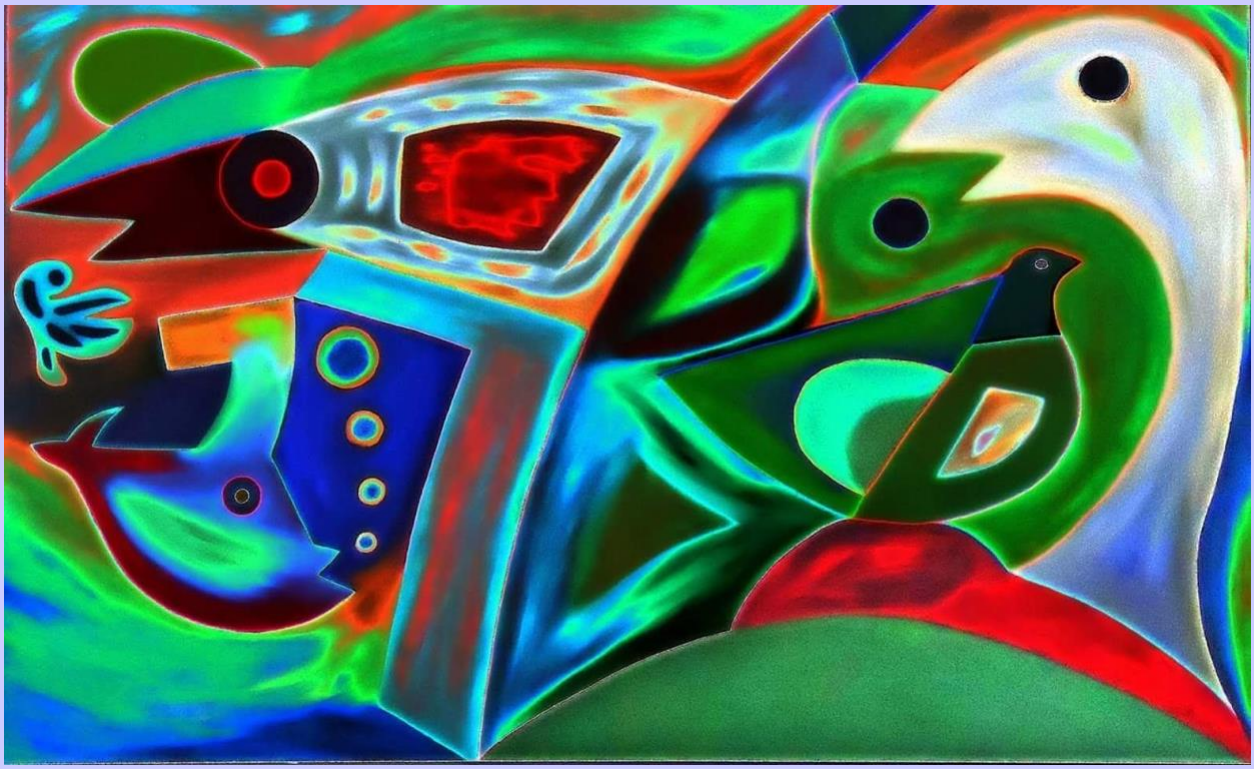

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CONTENTS

Sentiment Evolution Analysis and Association Rule Mining for COVID-19 Tweets

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Abstract. This article presents a data mining study carried out on social media users in the context of COVID-19 and offers four main contributions. The first one consists in the construction of a COVID-19 dataset composed of tweets posted by users during the first stages of the virus propagation. The second contribution offers a sample of the interactions between users on topics related to the pandemic. The third contribution is a sentiment analysis, which explores the evolution of emotions throughout time, while the fourth one is an association rule mining task. The indicators determined by statistics and the results obtained from sentiment analysis and association rule mining are eloquent. For instance, signs of an upcoming worldwide economic crisis were clearly detected at an early stage in this study. Overall results are promising and can be exploited in the prediction of the aftermath of COVID-19 and similar crisis in the future.

Keywords: COVID-19, Twitter Dataset, Tweets Analytics, Sentiment Analysis, Sentiment Evolution, Data Mining, Association Rule Mining, FP-growth.

1. Introduction

Nowadays, people are becoming more dependent on social media in their daily life. They use them to share their feelings and opinions about common subjects. The benefits of these platforms become more evident in situations such as social movements, natural disasters and pandemics. With the widespread of COVID-19 around the world, which forced the whole planet to adopt new drastic measures and behaviors, it becomes interesting to investigate the impact of this pandemic through social media.

The present work conducts a tweets analytics study on COVID-19, focusing on discovering social features and relations with the hope of achieving important insights. More precisely, we present a study that we performed by analyzing Twitter publications related to this disease, posted between the 27th February and the 25th March 2020. This is the same period during which COVID-19 was officially declared as a pandemic by the World Health Organization, which made it the hottest topics of public concern in the world at that time. We believe that our study is comprehensive as it deals with several and various aspects. For instance, we use an elegant approach to extract data from Twitter by covering a large number of hashtags. Furthermore, we use a substantial sentiment analysis repertoire containing ten different emotions. In addition to that, we perform tasks such as an analysis of tweets trends and distributions with descriptive statistics as well as mining frequent patterns and association rules.

The findings of our study could help dressing an inventory for the history of the outbreak and especially how it was apprehended by the world population. Technically, we first collect tweets related to COVID-19 and store them in a dataset that we make available for download. In a second step, we perform a preprocessing phase on the crawled data followed by a statistical analysis in order to extract knowledge and

facilitate its understanding. Thereafter, we propose a new algorithm using the inverted file lexicon-based approach to conduct a sentiment analysis task on a large number of tweets. We also study the sentiment evolution over a period of four weeks to come up with the variations related to the feelings of the considered twitter users. In addition to these contributions, we adapt the FP-Growth algorithm to make it able to efficiently extract the most frequent patterns directly form social media with the aim of grasping social features related to COVID-19. Some interesting association rules were then derived and analyzed.

This study has been significantly improved from a preliminary work published as a preprint published in [1]. In terms of the construction of the dataset, a new task consisting in bot detection was undertaken. We found out that around 4.1% of the extracted tweets were provided by software applications. All these tweets were eliminated from the dataset to avoid any kind of noisy or biased data. The bot elimination helped to enhance the results of the different tasks including the sentiment evolution analysis and the association rule mining. A more in-depth analysis of the achieved outcomes such as the prediction of important events like the economic crisis were included. Additionally, we considerably improved the presentation of the article and the visualization of the results with completely new and enhanced graphs. Finally, we reported and discussed some limitations of the study.

The paper is organized as follows. The next section discusses background and some related works. Section 3 presents the approach of the construction of the COVID-19 tweets dataset as well as the bot detection and some preprocessing tasks. Section 4 exposes three important datamining tasks applied on the dataset; an exploratory study, an analysis of sentiments evolution and an association rule mining process. The experimental results of these tasks are presented in Section 5. The main contributions of this work are highlighted in Section 6. Finally, Section 7 concludes the paper and discusses some limitations of the study.

2. Background

COVID-19 appeared in December 2019 in Wuhan China and within a couple of months, it strongly impacted the world, which led to the evocation of well-founded concerns about the future. The World Health Organization declared the outbreak a public health emergency of international concern on 30 January 2020, and a pandemic on 11 March 2020. Studies from all around the world have been performed within a short period of time as COVID-19 took its toll in almost all countries [2]. This fact translates the importance of studying this virus in order to speed up the mastery of the disease and the discovery of a remedy. On the other hand, an impressive number of articles covering COVID-19 has been widely published on the media on a daily basis, relating the disease spread, the population concerns and also helping to cope with cultural customs and urge for people isolation to limit the propagation [3].

This invisible virus is currently considered to be one of the most dangerous enemies of humanity and the metaphor of a war situation was adopted by certain scientists who advice the use of some military strategies to combat this disease [4].

Doctors, affected persons and their relatives, politicians, economists, celebrities as well as ordinary people are actively talking about the pandemic on social media, which have become an essential means of communication in our daily lives. The analysis of internet users' behavior has shown that they are mostly either seekers of information from the Web or from social media (Facebook, Twitter, microblog, etc.) [5, 6, 7]. A better understanding of this data flow would allow to make informed and focused decisions on how to meet certain goals. It can be therefore of great benefit to people and to industry, even knowing that such data may contain some biased elements.

Tweets analysis has recently witnessed an increasing number of efforts. Most of them are interested in determining features of social interactions between users [8, 6] and their behavior [5, 7].

On the other hand, there is a recent and rich literature on sentiment analysis (SA) and its applications to various fields. SA has been also investigated for social networking data and is generally used by companies for analyzing the opinion and feelings of the customers about products, services and company strategies [9, 10, 11, 12, 13, 14].

Besides, developments on data mining have yielded advanced tools such as classification, clustering and association rule mining (ARM) [15; 16; 17]. ARM have also known an impressive development for use on huge volume and complex data [18, 19, 20].

3. Crawling tweets and building the dataset

In this section, we present the different steps performed to build a dataset of tweets on COVID-19 of a high quality. We provide metadata for the dataset, which merely describes its specifications such as the content of the tweet, the terms, the hashtags, the mentions, the links, the date of publication and the author.

3.1. Extraction of raw data

We undertook a task of tweets crawling during a consecutive period of 28 days starting on the 27th of February and ending on the 25th of March 2020. The extracted tweets are related to the Coronavirus topic and highlighted by the following hashtags: #COVID-19, #COVID19, #COVID, #Coronavirus, #NCoV and #Corona. During this phase, the world has known tremendous changes affecting its whole organization. The huge number of infected and dead people provoked public panic and fear, which raised supply shortages not only in pharmaceuticals and PPE (Personal Protected Equipment) but also in food. Several countries have known a bad public health management and a rapid scalability in world economic crisis has been observed during a very short lapse of time. Rushes on public markets have been seen before certain governments decreed isolation and quarantine for inhabitants and especially for returning travelers. All these upheavals have considerably impacted the usual behavior of people and were visible in their interactions and exchanges on social media. The aim of this study is to shed light on all these aspects through data mining tasks on the extracted collection of tweets. The latter contains more than half a million tweets written in several languages and sent from over 130 countries.

3.2. Bot detection

Following the data extraction phase, we cleaned up the obtained data by removing any noisy parts. We paid particular attention to the provenance of the tweets and wanted to make sure they were generated by real persons rather than by bots. A bot is a software application that performs automated tasks over the Internet and is generally used to promote certain ideas and spread disinformation at a large scale. This represents a major concern on the credibility and the authenticity of the information provided on social media [21]. In recent years, the majority of social media platforms have dedicated efficient tools and algorithms focused on detecting bots and deleting their content. Twitter for example suspended more than 70 million accounts between May and June 2018 and reached a suspending rate of more than 1 million per day in recent months [22].

In order to evaluate the presence of bots in our dataset, we implemented a bot detection program based on the open-source tool *Tweetbotornot* [23] using R

programming language. We rewrote some parts of the code and rebuilt the package to make it work. We adopted a user-level model based on features such as the user's biography, location, number of followers, profile picture, etc. Using additional features based on the user's tweets would improve the accuracy. However, due to Twitter rate limits, such method can be very slow, and its implementation would be quite impossible with voluminous datasets like ours.

3.3. Preprocessing the tweets

A textual preprocessing phase was first held to eliminate hyperlinks, mentions and punctuation. Stop words such as articles, prepositions of time and place, conjunctions and superfluous and unnecessary words, were removed as they do not have impact on the text semantics. We then determined the set of terms to be considered in the rest of the study by applying the *Porter stemming algorithm*, which consists in reducing each word to its stem. Note that some words were misspelled, an example is the word *carona* which was tweeted by *President Trump* and reused 8013 times by other users. This kind of typos was simply eliminated.

4. Used Data Mining techniques

In this section, we describe three data mining techniques we explored for the dataset we built. First, tweets analytics were investigated in order to get preliminary insights from the considered users communication. Then a sentiment analysis was handled to discover the users' sentiments during the studied period as well as their evolution throughout the weeks. Association rule mining has also been considered in order to enrich our findings on COVID-19 insights.

4.1. Tweets analytical insight for COVID-19

As a second contribution following the dataset construction, we performed an analytical study in order to mine knowledge allowing an understanding and a mastery of the considered users insights. This analysis aims to yield data trends and distributions, descriptive statistics as well as data groupings. It also helps formulating hypotheses that can contribute in the interpretation of certain events.

4.2. Tweets sentiment evolution analysis

In addition to the previous task, a sentiment analysis was investigated aiming at capturing the tone of the tweets. We know that during the COVID-19 period, people changed their behaviors and experienced different feelings and emotions compared to those they have known before. This has considerably impacted their lifestyle, which has shifted to something completely new. The algorithm described in the next subsection was adopted and implemented to shed light on tweeters sentiments.

4.2.1. Sentiment analysis algorithm

The sentiment analysis algorithm we propose relates on a lexicon-based approach. As input, it takes the set of preprocessed words of the dataset and a sentiment lexicon. There are several known emotions lexicons that can be used for sentiment analysis. As examples we cite AFINN, Bing and NRC [24, 14]. AFINN computes a score from the range (-5,5) to each word and deducts the positive sentiment if the score is positive and the negative sentiment otherwise. Bing assigns straightly a positive or a negative emotion to each word. NRC considers ten categories of sentiments, which are *positive*, *negative*, *anger*, *anticipation*, *disgust*, *fear*, *joy*,

sadness, *surprise*, and *trust* and assigns to each word at least one of these categories. We adopt the NRC lexicon as it provides specific sentiments other than positive and negative. This lexicon contains a total of 6468 words distributed over the ten categories. The number of words in each category is shown in Table 1.

Table 1. Sentiment categories and their respective cardinalities in NRC

Category	Anger	Anticipation	Disgust	Fear	Joy	Negative	Positive	Sadness	Surprise	Trust
Cardinality	1247	839	1058	1476	689	3324	2312	1191	534	1231

The framework of the algorithm is shown in Fig. 1. After the preprocessing step, the list of words contained in the dataset is determined. Meanwhile, the NRC inverted file is built and converted to a hash table. Initially each category is assigned a counter equal to 0, which represents the number of words that are associated to that category. Then, for each word in the dataset, the algorithm calculates its hash key to access the index containing its address in the NRC lexicon structure. Next, using that address, the algorithm retrieves the categories to which the word belongs from the NRC lexicon. Each category counter is then incremented accordingly. When the process is completed, the score of each category is computed as the ratio of its corresponding count over the total number of words in the dataset.

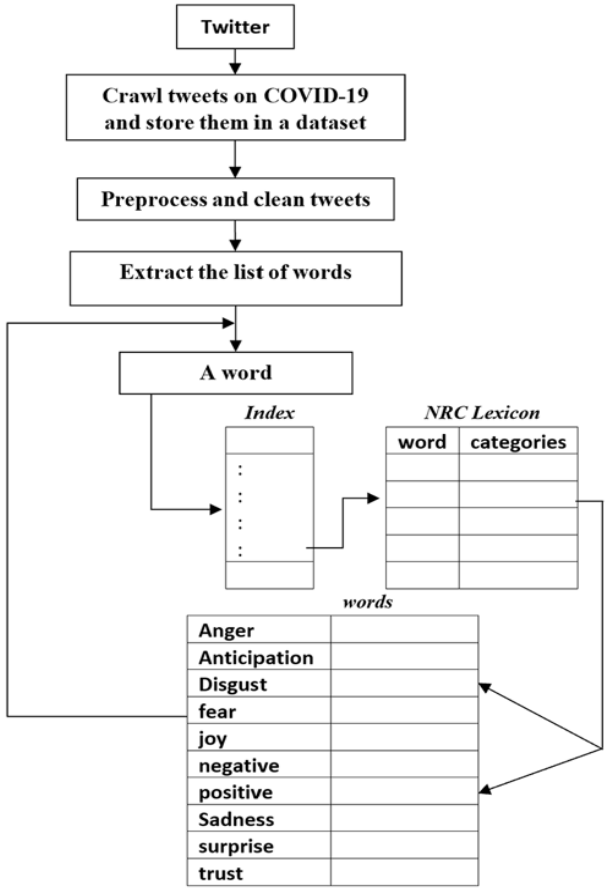

Fig. 1. Sentiment Analysis Flowchart.

4.3. Tweets Association Rule Mining

Data mining technology proposes a large spectrum of tools to extract interesting and potentially useful patterns from huge and complex volumes of data. Association Rule Mining (ARM) is one of those techniques that can be adapted to various domains such as health, trade and industry. The generation of ARM is achieved within two steps:

- Discovering Frequent Patterns for a *minimum support*.
- Filtering association rules from the extracted frequent patterns with respect to a *minimum confidence*.

The patterns correspond to the most frequent words used in the tweets and hashtags, which represent all insights on this social media for COVID-19. Since the algorithms for Frequent Pattern Mining (FPM) are computationally expensive, a lot of research has been carried out for further improving their effectiveness and efficiency. FP-Growth algorithm [19] was developed in order to cope with the main drawbacks of previous FPM algorithms, especially Apriori and ECLAT. Therefore, we use FP-Growth to discover frequent patterns and association rules in our tweets dataset.

FP-Growth on COVID-19 Tweets

The FP-Growth algorithm draws its strength from the fact it uses a sophisticated and optimal data structure called FP-tree that condenses only relevant data in a vertical format. By scanning the tree, the frequent words respecting the minimum support are determined. The support of a word is calculated as the number of its occurrences in the tweets and a minimum support is introduced for the algorithm as an input. Our adaptation of the FP-Growth algorithm for mining frequent tweets keywords is outlined in Algorithm 1.

Algorithm 1. FP-Growth on COVID-19 tweets

Algorithm: FP-Growth-Tweets

Input: *D* the tweets dataset;
minsup, the minimum support count threshold.

Output: subsets of frequent keywords of length 1, 2, ...

Begin

1. Scan the dataset *D* once and find frequent words (single word pattern);
2. Sort frequent words in frequency descending order to constitute the *f-list*;
3. Construct FP-tree by scanning once more *D*;
4. **For each** path of the tree do
    a. *l* := 2 ;
    b. output all sub-paths (non-necessary consecutive) of length equal to *l* with *minsup*;
    c. increment *l*;
5. **End for**

End

The advantage of the *f-list* is to eliminate at the beginning the words that do not respect the minimum support. Then the construction of the *FP-tree* data structure considers only the *f-list* words, which makes it reduced to only relevant information. It starts with an empty node, then it creates nodes taken sequentially from the *f-list* and links them if they belong to the same tweet, while scanning the collection of tweets and incrementing their frequency.

4.3.2. Association Rule Mining for COVID-19 Tweets

Association rules are derived from the frequent patterns calculated by the adapted FP-Growth algorithm. Suppose w_1, w_2 and w_3 are words appearing frequently in the collection of tweets with a minimum support equal to *minsup*. Then, from this subset of words (called itemset in the traditional frequent patterns mining algorithms), we can generate four association rules that are:

$\rightarrow w_1, w_2, w_3$ (*minsup*, *minconf*)
$w_1 \rightarrow w_2, w_3$ (*minsup*, *minconf*)
$w_1, w_2 \rightarrow w_3$ (*minsup*, *minconf*)
$w_1, w_2, w_3 \rightarrow$ (*minsup*, *minconf*)

The first rule means that in all tweets, the three words exist with the indicated minimum support. In the second one, the rule is interpreted as: whenever w_1 exists in a tweet, w_2 and w_3 appears in the same tweet. The other rules follow the same principle. Note that we need to specify another measure for the rule besides the support, which is the confidence. The confidence of a rule is defined to be the probability whenever an antecedent of the rule is in a tweet, the consequent is also in the same tweet. It is calculated as follows:

$$Confidence(rule) = \frac{\big(support(antecedent, consequent)\big)}{\big(support(antecedent)\big)}$$

5. Results

All the experiments showcased in this section were held on a laptop running Windows 10 with an Intel Core i5-7300U CPU at 2.60 GHz and 8GB of RAM. *Java* and *R* programming languages were used to implement the different techniques described in the previous section.

5.1. Dataset Construction

We built a dataset composed of 653 996 tweets posted by 390 458 users, using *NodeXL* and *Java*. The dataset is available online and can be downloaded from the *Zenodo* platform [25]. The specifications of the dataset as well as the results of the bot elimination are shown in the following subsections.

5.1.1. Descriptive dataset and metadata

The created dataset includes the features shown in Fig. 2 with an example for each one of them. The Attributes are all of string type except for the date which follows the *month/day/year* format. The dataset contains 653 996 tweets with no missing values. Table 2 gives an overview of a portion of the tweets included in the dataset.

Author	jmcrhealthdept
Recipient	tndeptofhealth
Hashtags	coronavirus
Language	en
Relationship	Mentions
Location	United States
Date	2/27/2020
Source	Twitter for iPhone

Fig. 2. Example of extracted features.

Table 2. A sample of tweets extracted from the dataset

N°	**Tweet**
1	Concerned about #coronavirus? We are closely monitoring the situation along with @TNDeptofHealth and @CDCgov. For the general American public, the immediate health risk from COVID-19 is believed to be low at this time. Find current and accurate info at https://t.co/aQqARorfCM. https://t.co/Hjc3OnMSLY
2	Australia now has more than 1000 confirmed cases of coronavirus .. case numbers rising steeply over last 2 days. ABC is compiling the latest statistics from states and territories .. This graph is up to 7.30 tonight https://t.co/Zz8B3oVSHM https://t.co/Wb7fss0Ivi
3	Es imposible no estresarse viendo las líneas de carros afuera de los supermercados, la siguiente semana no tendrá clases y el resto del semestre lo haré virtual como medidas preventivas #COVID2019.
4	#PlaceCoronavirusDansUnFilm Ququ'on a fait au bon Caronavirus ?

Fig. 3 shows the WordCloud of the raw dataset before proceeding to the text preprocessing and the bot detection phases. Only an English stop words list was applied to the text.

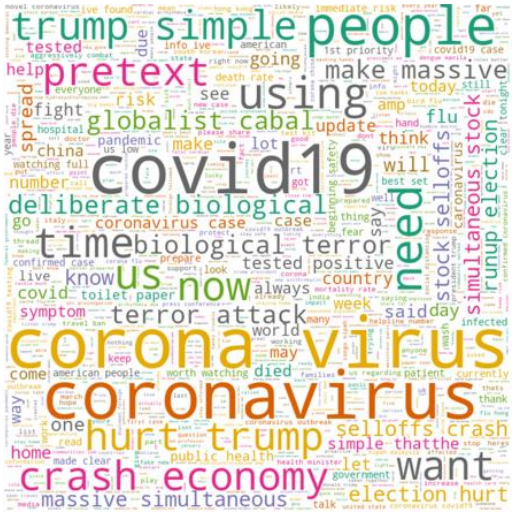

Fig. 3. TweetsWorldCloud

5.1.2. Bot detection

Fig. 4 shows the results of the bot detection task. We found out that among a total of 390 458 users present in our dataset, 26 874 (6.88%) were determined as bots accounts while 363 584 were tagged as real users. This means that around 4.1% of the tweets were provided by software applications. All these tweets were eliminated from the dataset to avoid any kind of noisy or biased data.

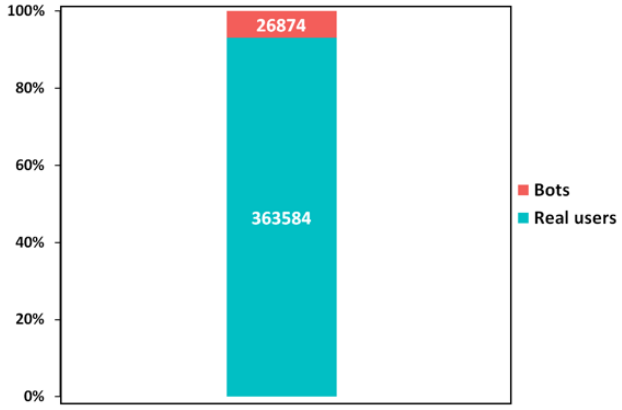

Fig. 4. Number of bots versus Number of real users in the dataset

5.2. Tweets Analytics

The experiments of the developed program for analytics were performed on the tweets after the text preprocessing and the bot elimination phases like explained in Section 3. The different outcomes are exhibited in the following subsections.

5.2.1. Top hashtags

The hashtags #COVID-19, #COVID19, #COVID, #Coronavirus, #NCoV and #Corona that served for the construction of the dataset are not considered since each tweet contains at least one of them. Fig. 5 shows the 25 most used hashtags, which report some events and situations people are dealing with, such as: pandemic, update, outbreak, stay at home, curfew, confinement and quarantine. On the other hand, countries and regions such as China, Iran, Wuhan, India and Italy, that were the most affected by the virus during that period are cited. Note that the wide virus spread wave in India was just starting at the end of the studied period, we assume it is evoked among these countries because of its large population.

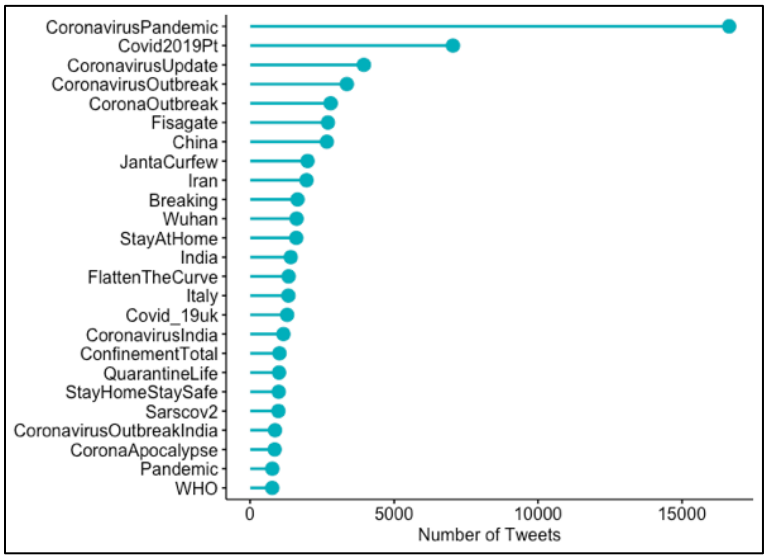

Figure 5. Top 25 most used hashtags

5.2.2. Top keywords

The 25 top words are shown in Fig. 6 with their respective frequencies. These terms are eloquent as they are similar to the words expressed by the majority of people in real life. We observe four sets of words with approximately the same frequency, cited in a decreasing order of their occurrence as follows:

- virus, people
- Flu, Cases, Trump, test
- Spread, Health
- Work, outbreak, death, update, home, China, hands, report, world, country, call, confirmed, infected, week, risk, panic, pandemic

We can observe that most these words belong to the new vocabulary utilized by people and the media in real life during this period.

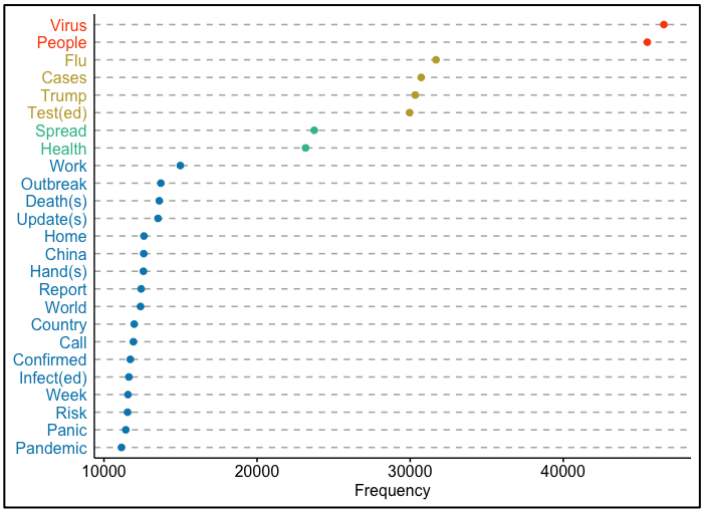

Fig. 6. Top 25most used terms.

5.2.3. Number of tweets per country

The first ascertainment about the origin of the tweets is that a significant number of users do not give access to their geolocation information and therefore do not indicate their country. That being the case, the results hereafter are valid only for tweets whose authors provide geolocation information. Fig. 7 shows the worldwide tweets distribution based on the number of tweets in each country. The color palette indicates the density of the tweets, starting from blue for countries that count a low number of tweets and going up to red for countries containing a large number. Note that the count of tweets for the countries colored in gray is equal to 0. We observe that the majority of the published tweets emanate from the USA. The second remark is that users belong to several countries from all the continents. We also notice that the number of tweets is for some countries as important as their respective demography. For instance, India is ranked in 3rd place while it has the second largest population in the world. The same observation can be done for Nigeria and South Africa that count respectively the largest populations in Africa. Also, the countries the most affected by the virus such as Spain, France and Italy show a high density of tweets.

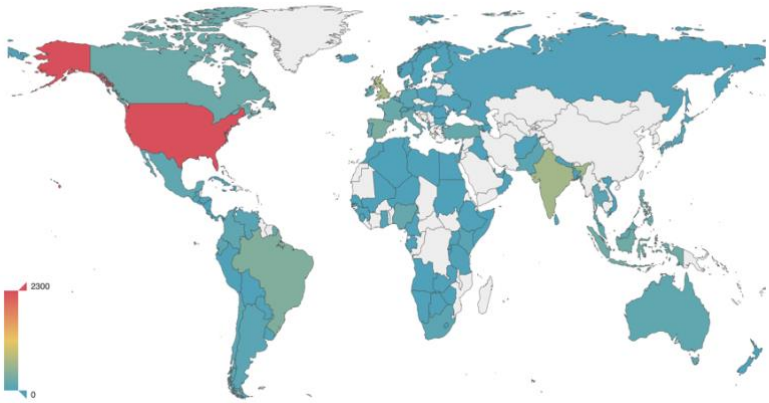

Fig. 7. Tweets distribution over countries.

5.2.4. Tweets' languages

The languages of tweets were also explored, Fig. 8 gives an insight about this feature. We note that English prevails over the other languages. This can be explained by the fact that according to the previous statistics, the three top countries in terms of the number of tweets are the USA, United Kingdom and India, where the communication language is English. Also note that English is scientifically and technologically universal and is written by a large population in other countries. Spanish is ranked in the second position in this graph because it is spoken in several countries in Latin America like Colombia and Mexico that appear in the previous figure. Also, all the languages spoken in highly affected countries during this period exist in this graph.

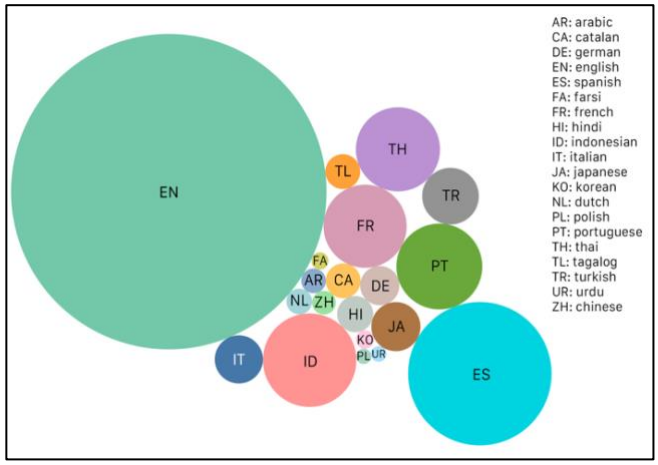

Fig. 8. Most used languages

5.2.5. Correlations

We can think about several possible correlations between the parameters identified previously. We investigated the correlation between the number of new infected cases and the number of tweets published each day. The intuition is that the evolution of the number of infected cases urges people to communicate more about the virus via social media. Figure 9 depicts the case of the UK, where the *x* axis represents the number of tweets per day and the *y* axis the number of new cases tested positive to the coronavirus per day. We observe a positive trend for the correlation confirmed by a Pearson coefficient equal to 0.55.

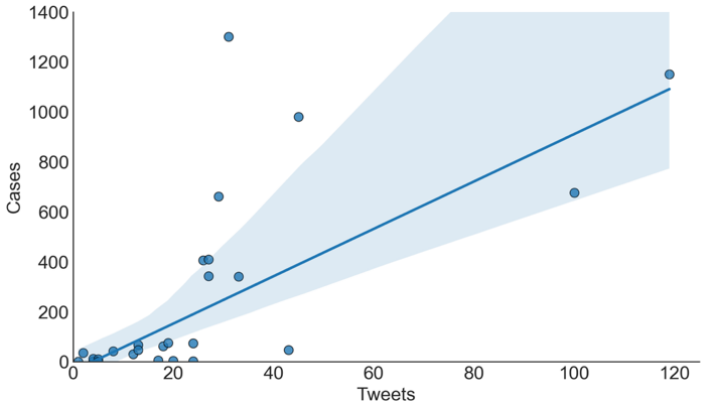

Fig. 9. Correlation between the number of new cases and the number of tweets in the UK.

5.3. Sentiment analysis

5.3.1. Tone of the tweets

Fig. 10 shows the results yielded by the sentiment analysis algorithm. We observe that the *negative* sentiment has a score slightly greater than that of the *positive*. *Fear* has an important score whereas *joy* and *disgust* have the lowest. Despite this difficult period and sad situation, the users seem to have trust in gaining the battle against the virus.

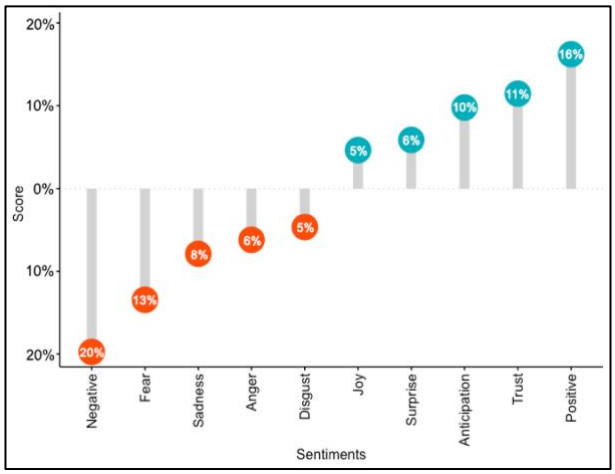

Fig. 10. The tone of tweets captured by the sentiment analysis.

5.3.2. Sentiment evolution

To track the sentiments evolution during the studied period, we divided the 28 days into four intervals each constituting a week. The first week starts on the 27th of February 2020, the second on the 5th of March 2020, the third on the 12th of March 2020 and the fourth on the 19th of March 2020. We used these dates as point-in-time snapshots in order to capture the score of each sentiment and then compare its variation over time and analyze its evolution.

Fig. 11 displays the sentiment density variation over the sentiment rate during the 4 weeks period. We can distinguish three intervals of scores:

The first interval [0.13, 0.27] incorporates the highest sentiments rates and includes two sentiments "positive" and "negative". This reflects that both sentiments are the most prevalent among the rest during the studied period. The low density of these sentiments is due to fact that they are distributed over a relatively large interval, which results in a prominent evolution over time.

The second interval [0.08, 0.15] includes two other sentiments "fear" and "trust" with medium density.

The third interval [0.02, 0.10] contains the six remaining sentiments, namely "anger", "anticipation", "disgust", "joy", "sadness" and "surprise". These sentiments have a high density because of the reduced range of values they occupy. This means that their evolution over time is less prominent compared to the sentiments of the first and second interval.

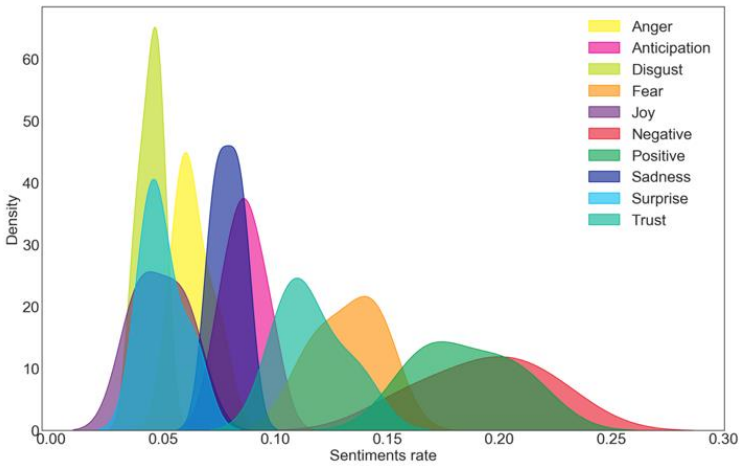

Fig. 11. Sentiment density variation.

Fig. 12 details the evolution of the sentiments during the four weeks period. We notice that the *negative* sentiment was high in the beginning of the period then it knew a little increase in the second week and since then it has considerably decreased. On the contrary, the *positive* sentiment follows the opposite behavior. *Fear* has almost the same evolution as the *negative* sentiment but with less magnitude whereas *trust* behaves as the *positive* sentiment with a lower rate. On the other hand, *Joy* is at a constant slow increase throughout the studied period and has one of the lowest scores. *Anticipation* has an overall constant curve whereas *anger*, *disgust*, *sadness* and *surprise* vary with very low rate from week to week.

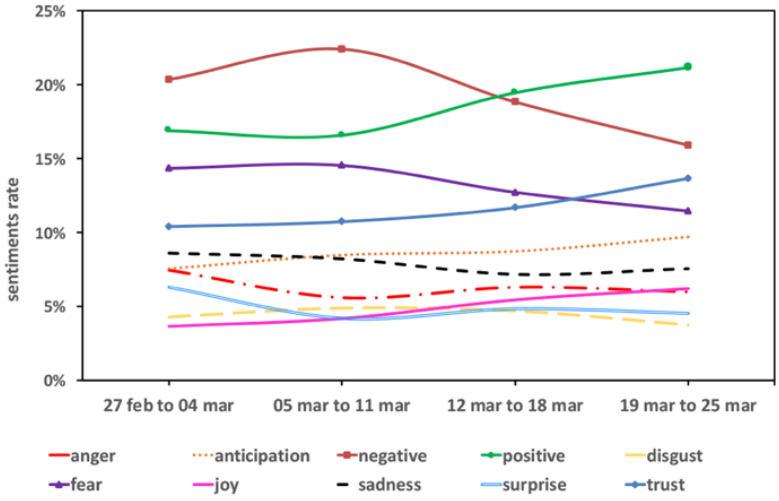

Fig. 12. Sentiment evolution over time

As tweets can be distributed by country as shown in Fig. 7, the sentiment analysis can be carried out for each country and each region by merging the tweets of the countries of the region in one dataset. Examples were performed for the USA and Canada separately and for the region of North America including both countries.

India has also undergone such treatment. Note that the sentiments evolution can also be drawn for countries and regions.

5.4. ARM experimental results

The adapted FP-growth algorithm was implemented in Java. The most frequent words in the tweets published in English are reported in Table 3 in descending order of their minimum support. We can confirm that these words constitute an important part of the daily vocabulary used in real life by people during the pandemic.

Table 3. The most frequent patterns with their minimum support

Word	MinSup
people	26214
virus	22830
cases	19118
flu	18363
tests	17163
spread	14650
health	13574
trump	11149
time	10104
work	9627
covid	9511
make	8731
outbreak	8629
pandemic	8319
day	8289
deaths	8265
china	8103
prepare	8030
update	7954

Similarly, the pairs of the most frequent words appear in Table 4, which shows examples of association rules ordered with respect to their minimum support on a total number of patterns equal to 19560. These associations are impressively similar to the ones people daily employ during the pandemic. For instance, the rule *wash* → *hand* has the highest confidence, which corresponds exactly to what we hear many times a day through the media.

On the other hand, some rules predicted the impact of COVID-19 and its imposed restrictions such as the quarantine measures. An example is the rule "*crash* → *economy"*, which has a high minimum confidence score. In fact, following the period of the study, several countries have known economic difficulties and crisis and some of them have publicly discussed the possibility of proceeding to an early lift of the lockdown in order to reduce the negative economic impact of the pandemic. The most significant event related to this situation was the holding of an economic summit that brought together the EU leaders for 4 days of talks and which was crowned on the 21st of July 2020 with an agreement on a post-coronavirus economic recovery plan.

Table 4. Examples of generated association rules with 2 frequent patterns

Association Rules	MinSup	MinConf
flu → virus	16068	0.5
found → virus	4712	0.68
confirmed → cases	9152	0.78
positive → tested	7689	0.72
wash → hand	7024	0.94
attack → biological	7436	0.83
low → preparation	3913	0.61

Association Rules	MinSup	MinConf
crash → economy	7486	0.92
massive → hurt	7416	0.85
rate → flu	4337	0.51

Table 5 and Table 6 show the association rules identified by the algorithm for respectively the 3 and the 4 most frequent patterns with a low support but a significant confidence. These rules are also expressive relatively to what people were living during these days. An eloquent example that confirms people panic, which was also reported by the media is the rule "*toilet → panic paper"*. Rules predicting an emanant economic crises such as "2020 → economy crash" and "economic → stock crash" can also be found in Table 5.

Table 5. Examples of generated association rules with 3 frequent patterns

Association Rules	MinSup	MinConf
low → prepare risk	3905	0.61
selloff → economy simultaneously	7416	0.99
terror → stock hurt	7416	0.98
economic → stock crash	7427	0.75
bird → virus flu	1918	0.83
2020 → economy crash	7420	0.5
priority → prepare american	2417	0.69
aggressive → risk people	2418	0.84
soap → home hand	1940	0.59

Table 6. Examples of generated association rules with 4 frequent patterns

Association Rules	MinSup	MinConf
low → risk made american	2414	0.41
minister → prepare year india	1480	0.43
season → health doctor role	1480	0.41
men → season journey role	1480	0.78
secretary → update confirmed units	1463	1
communicating → update confirmed statesamerican	1463	0.29
communicating → updates confirmed families	1463	0.29
update → cases units low	1463	0.18

6. Discussion

Within the framework of this study, we were interested in investigating people communication via social media during the starting period of the rapid spread of COVID-19 all around the world. Twitter was selected to undertake the study as it is one of the most used information sharing networks. Also, it offers different APIs for crawling tweets. As a first contribution, a dataset of 653 996 tweets was created and preprocessed in order to highlight useful insights.

The second contribution is an exploratory study on the collection of tweets, which was carried out to yield useful information and descriptive statistics. An important number of hashtags and topics were shared by users on Twitter and the most popular ones are exhibited in Fig. 5 and Fig. 6 respectively. Features such as the number of tweets posted per country (Fig. 7) along with the most used languages (Fig. 8) were extracted. An example of a correlation between the number of tweets posted per day and the number of infected cases per day was determined for the UK (Fig. 9).

A sentiment analysis followed, and the results showcased the tone of the tweets relatively to ten emotions, which are *anger*, *anticipation*, *disgust*, *fear*, *joy*, *negative*, *positive*, *sadness*, *surprise* and *trust*. The rate of words related to the negative

sentiment was close to 20% whereas that of the positive sentiment was a little bit greater than 16%. The rates corresponding to the other emotions are presented in Fig. 10. The evolution of the sentiments over a period of 4 weeks is illustrated in Fig. 11 and Fig. 12.

Data Mining technologies were afterwards exploited, and the FP-Growth algorithm was especially adapted to the tweets dataset in order to discover the most frequent patterns in an effective and efficient way. The derived association rules shed light on our understanding related to people interaction on COVID-19. The study highlights four major topics on COVID-19 that are sanitary measures, economy crisis, the origin and current state of the disease as well as social behaviors. An example of each one of them is respectively "*soap → home hand"*, "*bird → virus flu"*, "*2020 → crash economy"* and "*toilet → panic paper"*. For more details, Tables 4 to 6 show the main generated association rules.

7. Conclusion

This work allowed us to find out the state of mind of Twitter users during the first stage of the widespread of COVID-19. Several tasks were carried out to lead to an in-depth study. The beginning was the construction of a large dataset containing tweets posted between the 27th of February 2020 and the 25th of March 2020. Tweets coming from bots were eliminated in order to restrain the analysis we conducted to only real users, as our prime concern was to identify insights expressed by Twitter users on COVID-19. Then three main data mining processes were investigated on descriptive statistics, tweets sentiments analysis and frequent pattern and association rule mining respectively. All the findings of the different analyses are exhibited in the Results section using graphical formats and comments.

First, let us observe that the discussions and exchanges on COVID-19 were massive between the Twitter users. This proves that people's daily life was impacted by the pandemic phenomenon. Several aggregates and insights were determined thanks to the tweets analytics process.

The Twitter users' sentiments were also revealed, we know especially that in the beginning of the studied period, this population was afraid and that panic gradually faded until it was overcome by the end of the period.

Frequent used patterns such as "wash hand" were also shared among the people in real life. The confidence of such association was relatively high, which translates a good representativeness of people through the dataset. Also, predictions such as economic crisis were mined by the rules "2020 → crash economy" and "crash 2020 → economy". In fact, the predictions turned out to be correct as many countries have known economic difficulties and crises following the period of our study. These achieved findings can contribute in building the history of the COVID-19 pandemic.

At last, it is worth noting that this study has some limitations. First, the number of tweets extracted to undertake the study was limited to the machine capacity. Increasing the size of the dataset can improve the outcomes quality. Second the suppression of the tweets coming from organizations [26] was not treated due to the important size of our dataset (390,458 users), Twitter rate limits and time constraint. Addressing the individuals/organizations separation aspect can be very slow and its implementation would require a long period of time. Third, only tweets posted in English were considered in the sentiment analysis. A Multi-language analysis would potentially disclose more relevant insights. Fourth, certain tweets did not contain geolocation information, which could have affected the result of the distribution of the tweets over countries.

References

1. Y. Drias, and H. Drias, "Mining Twitter Data on COVID-19 for Sentiment analysis and frequent patterns Discovery". medRxiv preprint, **(2020)**/ https://doi.org/10.1101/2020.05.08.20090464
2. Z. Wu and J.M. McGoogan, "Characteristics of and important lessons from the coronavirus disease (COVID-19) outbreak in China: Summary of a Report of 72314 cases from the Chinese center for disease control and prevention". JAMA. **(2020)**. https://doi.org/10.1001/jama.2020.2648
3. J. Li and X. Guo, "Global Deployment Mappings and Challenges of Contact-tracing Apps for COVID-19", SSRN Electronic Journal, **(2020)**. https://doi.org/10.2139/ssrn.3609516
4. D.N. Maxwell, T.M. Perl and J.B. Cutrell, "The art of war in the era of coronavirus disease (COVID-19)", Clinical Infectious Diseases, ciaa229, **(2019)**. https://doi.org/10.1093/cid/ciaa229
5. D.R. Bild, Y. Liu, R.P. Dick and Z. Morley Mao, "Aggregate characterization of user behavior in Twitter and analysis of the retweet graph", ACM Transactions on Internet Technology (TOIT), vol. 15, no 4, **(2015)**. https://doi.org/10.1145/2700060
6. S.S. Ercetin and N.B. Neyisci, "Social network analysis: A brief introduction to the theory", In: Ercetin S. (eds) Chaos, Complexity and Leadership, Springer Proceedings in Complexity, Springer, Cham, 167-171, **(2014)**. https://doi.org/10.1007/978-3-319-18693-1_16
7. Q. Yan, L. Wu and L. Zheng, "Social network based microblog user behavior analysis. Physica A: Statistical mechanics and its applications", 7(392), 1712-1723, **(2013)**. https://doi.org/10.1016/j.physa.2012.12.008
8. T.D. Baruah, "Effectiveness of social media as a tool of communication and its potential for technology enabled connections: A micro-level study". International Journal of Scientific and Research Publications, 2(5), pp: 1-10, **(2012)**.
9. F. A. Pozzi, E. Fersini, E. Messina and B. Liu, B, "Sentiment analysis in social media". Morgan Kaufmann, **(2016)**.
10. K.S. Houtan, T. Gagne, C.N. Jenkins and L. Joppa, "Sentiment analysis of conservation studies captures successes of species reintroductions". Patterns 1, 100005, **(2020)**. https://doi.org/10.1016/j.patter.2020.100005
11. M. Thelwall, K. Buckley and G. Paltoglou, "Sentiment strength detection for the social web". JASIST, 63(1); pp:163-173, **(2012)**. https://doi.org/10.1002/asi.21662
12. B. Liu, "Sentiment analysis and subjectivity". Handbook of Natural Language Processing, 2nd edition, **(2010)**.
13. X. Guo and J. Li, "A Novel Twitter Sentiment Analysis Model with Baseline Correlation for Financial Market Prediction with Improved Efficiency". International Conference on Social Networks Analysis, Management and Security, **(2019)**. https://doi.org/10.1109/SNAMS.2019.8931720
14. W. Medhat, A. Hassan and H. Korashy, "Sentiment analysis algorithms and applications: A survey", Ain Shams Engineering Journal, 5(4), Elsevier, **(2014)**. https://doi.org/10.1016/j.asej.2014.04.011
15. J. Han, J. Pei and M. Kamber, "Data mining: concepts and techniques". Elsevier, **(2011)**. https://doi.org/10.1016/C2009-0-61819-5
16. X. Wu, X. Zhu and G. Wu, "Data mining with big data", IEEE transactions on knowledge and data engineering, 1(26); pp:97-107, **(2013)**. https://doi.org/10.1109/TKDE.2013.109
17. K. Heraguemi, N. Kamel and H. Drias, "Association Rule Mining Based on Bat Algorithm", Bio-Inspired Computing - Theories and Applications, Springer, **(2014)**. https://doi.org/10.1007/978-3-662-45049-9_29
18. C.C. Aggarwal, A.B. Mansurul and A.H. Mohammad, "Frequent pattern mining algorithms: A survey". Springer, Cham; pp:19-64, **(2014)**. https://doi.org/10.1007/978-3-319-07821-2_2
19. P. Fournier-Viger, J.C.W. Lin, B. Vo, T.T. Chi, J. Zhang and H.B. Le, "A Survey of itemset mining", WIREs data mining and knowledge discovery, Wiley, **(2017)**. https://doi.org/10.1002/widm.1207
20. H. Drias, C. Hireche and A. Douib, "Datamining techniques and swarm intelligence for problem solving: Application to SAT". World Congress on Nature and Biologically Inspired Computing, NaBIC, **(2013)**. https://doi.org/10.1109/NaBIC.2013.6617862
21. Y. Drias and G. Pasi, "Credible Information Foraging on Social Media", Trends and Innovations in Information Systems and Technologies, Advances in Intelligent Systems and Computing, vol 1159 Springer, **(2020)**. https://doi.org/10.1007/978-3-030-45688-7_43

22. C. Timberg and E. Dwoskin, "Twitter is sweeping out fake accounts like never before, putting user growth at risk", The Washington Post, July 6, 2018, **(2018)**. https://www.washingtonpost.com/technology/2018/07/06/twitter-is-sweeping-out-fake-accounts-like-never-before-putting-user-growth-risk/
23. M. Kearney, "Tweetbotornot: Detecting Twitter bots". web app: https://mikewk.shinyapps.io/botornot/,(**2018)**.
https://doi.org/10.13140/RG.2.2.10732.82562
24. Neviarouskaya, H. Prendinger and M. Ishizuka, "Sentiful: A lexicon for sentiment analysis", IEEE Transactions on Affective Computing, 2; pp:22-36, **(2011)**. https://doi.org/10.1109/T-AFFC.2011.1
25. Y. Drias and H. Drias, "COVID-19 Tweets: A dataset contaning more than 600k tweets on the novel Coronavirus (Version 1.0) [Data set]", Zenodo, **(2020)**. http://doi.org/10.5281/zenodo.4024177
26. Z. Wood-Doughty, P. Mahajan, M. Dredze, and J. Hopkins, "Classifying Individuals versus Organizations on Twitter", Proceedings of the Second Workshop on Computational Modeling of People Opinions, Personality, and Emotions in Social Media, pages 56-61 New Orleans, Louisiana, **(2018)**. http://doi.org/10.18653/v1/W18-1108

Digitalization and Backward Design take the finance teaching techniques and study plan strategy one step further

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Abstract. Digitization has been around for several years, but its use has become a necessity with the Covid-19 pandemic. Lockdown forced us to work remotely overnight, to use digital networks to communicate, make payments, learn all sectors of activity were forced to adapt to the digital age in one night. This paper shows how teaching, research, and the study plan must adapt to the new communication requirements and students' needs to achieve the course learning outcomes in a virtual environment. The paper proposes a realistic academic plan design - backward. Taking into account new environmental and digital challenges, the backward design facilitates the decision on the content of the study plan, the elimination of less important parts, and the application of new communication and assessment techniques.

Keywords: digitalization; backward design; teaching techniques for finance.

1. Introduction and literature review

This research builds on the findings of numerous academic researchers as follows; in 2008, Carrithers [1] investigated the critical thinking difficulties of finance specialists when asked to address poorly structured financing issues. Results suggest that given tasks, such as sets of quantitative problems that use algorithmic procedures, do not prepare learners to face poorly structured problems that require critical interdisciplinary analysis. This research confirms Carrithers's findings, because access placed only on quantitative assessments, with disregard of impact analysis on the organization and surrounding business environment, does not stimulate creativity and innovation. In 2015, Sharma [2] evaluates the use of specialized software in university trading rooms to allow students to experience a simulated environment that allows them to gain an appreciation of "real-life" decision-making in the financial and banking industry and become familiar with real-time data. This teaching technique aims to stimulate students in making responsible financial decisions. Here the author emphasizes the advantages of using specialized software in understanding and applying financial transactions, especially in how it improves students' learning experience and facilitates the development of valuable skills.

In 2018, Wang et.al. [3] argued that cross-disciplinary and cross-curricular education models have become a new direction of development. As a typical interdisciplinary specialty, most construction management gradually introduces innovative teaching methods, such as workshops, reverse classrooms, peer training. However, the current internal application of these teaching methods has not formed a systematic evaluation system. Based on the application of four innovative teaching methods in most construction management, this research analyzes the indicators for evaluating the teaching effect, which is consistent with the main one and uses the analytical ranking process and the Delphi expert scoring method to get a set of a measurable system of quantitative evaluation indicators. This research is to analyze how teaching and learning methods in higher education need to change from those applied on face-to-face approach to online mode. The study is to explore whether

there is a need for amendments of current teaching techniques and to assess the current approach to teaching. This research observed a clear need to amend current approaches to the educational process. The aim of this paper is to propose innovative teaching techniques, lesson plans, assessments and create a very clear teacher-student relationship.

The main activities carried out in higher education institutions aim a research and teaching; knowledge transfer through work-based learning or industry-oriented activities applied teaching and the development of digital skills through the increased use of digital technology [4]. In recent years, it has been observed that on-campus teaching, through face-to-face meetings, has been replaced by digital interactions or digitization. teaching needs to be updated. Nowadays, digitization and digital services in teaching finance and business management promise a universe of applications and digitalized assets that are expected to work together to allow rapid development of new capabilities that will give competitive advantage and equip the new generation of students with employment-ready skills [5-7]. Therefore, innovative education techniques such as flipped classrooms, blended learning, adequate assessments with a clear lesson plan, combined with a backward design study plan should be used to achieve the students' study plan.

2. Research methodology

The research started from three main objectives; amending the traditional teaching techniques; lesson and assessment design to meet the course learning outcomes within online delivery mode; student active engagement and student-centered learning. To achieve the research objectives, the study developed three main research questions: Are traditional teaching techniques relevant for face-to-face course/program delivery still able to lead the student to achieve the foreseen knowledge and skills? Are current lesson assessment plans adequate for online teaching and learning environment? Were there any changes in instructor-student rapport once Covid-19 social restrictions were imposed?

To answer these research questions, we adopted the interpretative qualitative research method [8]. Contemporaneous researchers underlined that interpretivism recognizes that social phenomena must be understood in the social contexts in which they are constructed and guided by the way people interpret and understand situations [9, 10]. For our study, it was considered that qualitative research is most appropriate as it crosscuts disciplines, fields, and subject matters [11].

The chosen research method, the qualitative one, was based on the skills of relationship and empathic listening, which the author used to build a bond of trust, care, and understanding so that participants are more willing to offer honest and multiple explanations for their views.

Fig. 1. Methodology Design

The research started in early 2020 when the world faced the Covid-19 pandemic. The research was carried out through successive interviews with representatives of higher education institutions, students, and professors from finance and business management specializations. The interviews focus on teaching and learning techniques and relevance of assessments amended for online delivery mode, student-centered learning, professor-student rapport in a virtual environment.

The analysis helped the research to understand the importance to be given to the achievement of course/program learning outcomes, the need to change the teaching, learning, and assessment techniques, the need to amend the teaching and learning plan, as well as a different approaches in giving assessment to ensure the achievement of learning outcomes within an online environment.

3. Findings and results

3.1. Are traditional teaching techniques, still relevant in a face-to-face course/program delivery and able to lead the student to achieve the knowledge, competencies, and skills, as per program learning outcomes?

To answer this research question, the questionnaire used for the interview, a research sub-questions were developed:

1. During Covid-19 pandemic social distancing, how did you continue your university education? what platforms did you use?
2. Has there been any difference between the classic board and chalk teaching method and the use of PPT? 3. Were the same teaching methods used or were they different?
3. Were the same assessment methods used?
4. Did you feel like part of the class?
5. How was class participation ensured?
6. How did online assessment affect students' academic performance.

Analyses of responses collected from about 100 representative actors in higher education in finance and business management specializations (both students and instructors) analyses reveal the following:

1) When social distancing restrictions started to be imposed (March 2020) it was during the middle of the Spring Semester. The majority of students and professors were forced to join their classes remotely. As such, for universities that deliver their programs on-campus, it was an unprecedented challenge. Faculty and students had to improve their digital skills on the spot, faculty and students had to have the necessary equipment and devices, distance learning teaching tools, adequate hosting platforms, and most importantly, Internet connection.

2) It has been noticed that most virtual learning platforms used for remote teaching, assessments, and other academic activities are Microsoft Teams, Moodle, and Zoom.

3) 25% of students admitted that it is more difficult to focus on during class when it is delivered in a virtual mode. 25% of students admitted that they have difficulties with cameras and their online engagement with the class. 50% of students revealed that it is very difficult to keep full attention during classes where theory or calculations are required, the absence of case studies or class discussions (Fig. 2).

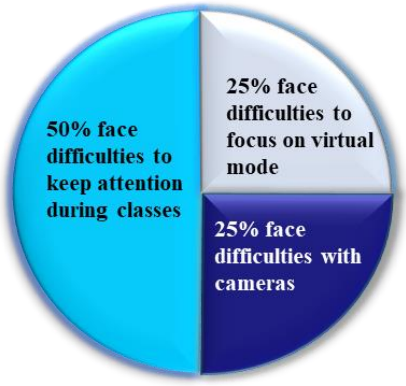


Fig. 2. Students' class attention on virtual environment class delivery.

4) Majority of the faculty claim that it is very difficult to talk live in front of the camera when they cannot see their students and most of them claim difficulties opening the camera. 50% admitted that is very difficult to engage the students in an online environment, and new teaching techniques need to be adapted but take time to redesign the entire lesson plan or to acquire/implement new technology.

5) In terms of teaching techniques, 75% of the students replied that teaching techniques were almost the same as those used on on-campus course delivery, and only assessments were slightly adapted for online teaching in terms of conducting an assessment on the spot, as well the feedback and grading (Fig. 3).

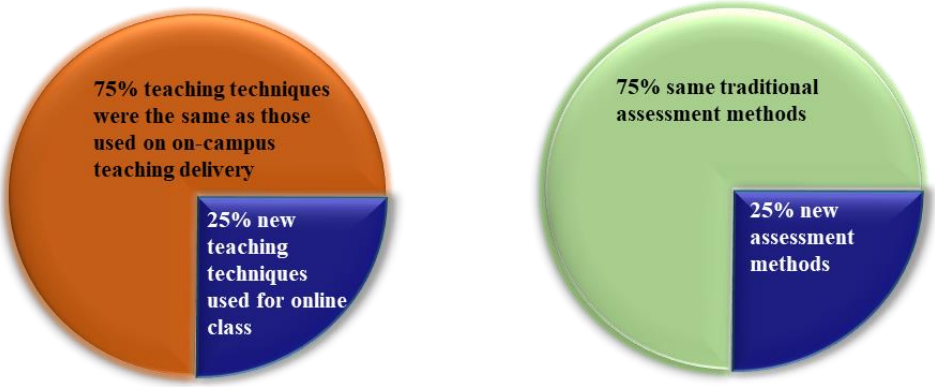


Fig. 3. Teaching and assessment techniques adapted for online environment mode

6) It was observed by the students and confirmed by the professors, that for classes that require calculations, the classic board and chalk were replaced with wireless keyboards and stylus pen or wireless pen mouse.

7) Based on 75% of students' responses, as far as assessment is concerned, the same traditional methods were used, and this, in turn, affected students' academic performance.

3.2. Are current lesson assessment plans, adequate for online teaching and learning environment?

To answer this research question, the questionnaire used for interviews, researchers developed several sub-questions: 1. Did the professor/instructor explain the lesson plan from the beginning of each class? 2. Did the professor explain the link between the course lesson and the course learning outcomes? 3. Did the teaching strategy change? 4. Did the professor/instructor use students' feedback to improve lesson delivery, and assessment plans? 5. How the professor/ instructor succeeds in engaging students within the virtual classroom? 6. How does the professor/instructor succeeds in ensuring that course learning outcomes are achieved?

Analyses of collected responses, reveal the follows:

1) During the academic year of 2020/2021, students were forced to be familiar with the online classroom environment very quickly and were less motivated. This was the main challenge for both, professors/instructors, and students. Professors/instructors struggled to engage students, and students become less focused, and their attention span was distracted.
2) More than 60% of students reported that professors/instructors did not explain course lesson plans clearly at the beginning of the semester, or on weekly basis.
3) Asking professors/instructors about lesson and assessments plans, more than 50% responded that they did not amend the assigned syllabus, as being given, and that they are respecting weekly topics. The majority of

professors/instructors admit that they are not changing the assigned syllabus, but rather they are making comments in course review reports.

4) 80% of professors/instructors stated that assessments are not always correlated with course learning outcomes.50% of students revealed that assessments did not show a clear link with the course learning outcomes. And assessments don't have clear evaluation criteria (Fig. 4).

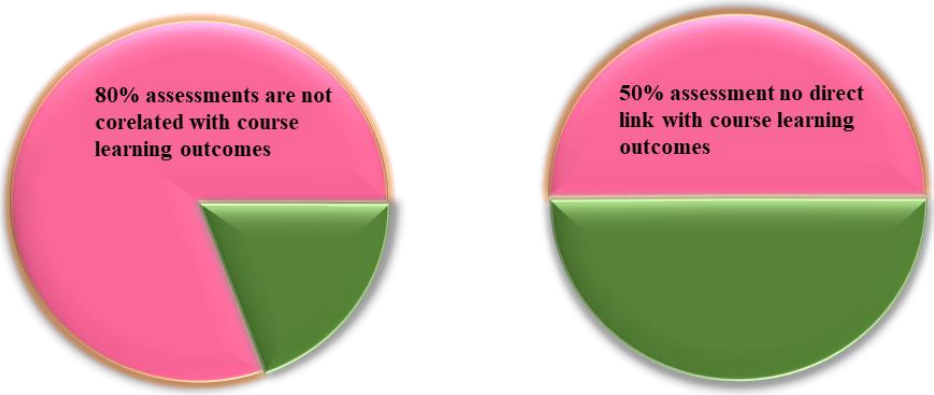


Fig.4. Correlation between assessments and course learning outcomes stated in the syllabi (curriculum)

5) Analyses further revealed that teaching strategies were not changed. Professors continue to have the same teaching style while teaching remotely.
6) 80% of respondents revealed that weekly students' feedback was not required by faculty. Respondents stated that end-of-semester students' feedback was used only for course review purposes, but no improvement.
7) The main challenge was, how professors/instructors manage to engage students within a virtual learning environment? Analyses show that at the start of the pandemic, and during the lockdown, there was the difficulty experienced by students to attend on time or to turn on their cameras to attend a class.
8) As for the question How the professor succeeds in engaging students within the virtual classroom environment? Both parties replied that debates and discussions were used as a primary technique.

3.3. Were there any changes in instructor-student rapport, once Covid-19 social restrictions were imposed?

To answer this question, researchers developed several sub-questions:

1. Is there any professor/instructor-student rapport established during a lockdown? If yes, how was such rapport established during Covid-19 social distancing restrictions?

2. How office and advising hours are conducted remotely?

Analyses revealed the following results:

1) 90% of students reported that there are office hours set by their instructors, however, students were only able to use office hours via email and set appointments to meet up with their instructors.
2) 76% of instructors stated that even though there were fixed office and advisory hours, students were not using office hours because they rather sending emails at their convenience.

3) 68% of students responded that the biggest challenge in online learning was Internet connectivity. Students had difficulty connecting to classes because of inadequate bandwidth or lack of availability of fast Internet connections.
4) 73% of the students stated that learning new tools, such as Moodle, MS Teams and Zoom was challenging for an online classroom learning environment. They had to develop a learning cycle of getting used to the tools to be proficient at them.
5) 86% of instructors stated that they still face difficulty adapting to online-learning tools such as Moodle, MS Teams, and Zoom, particularly during exams. Switching to online examination and quizzing mode remains to be a challenge for instructors (Fig. 5).

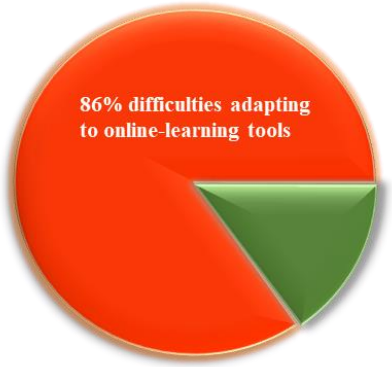


Fig. 5. High percentage of professors in adapting and using online-teaching tool

4. Results and discussions

Are traditional teaching techniques, still relevant? in a face-to-face course/program delivery and able to lead the student to achieve the knowledge, competencies, and skills, as per program learning.

This research started with general questions about learning outcomes, the teaching environment under lockdown, the experiences of students and teachers, and assessments in the specialization of finance and business management.

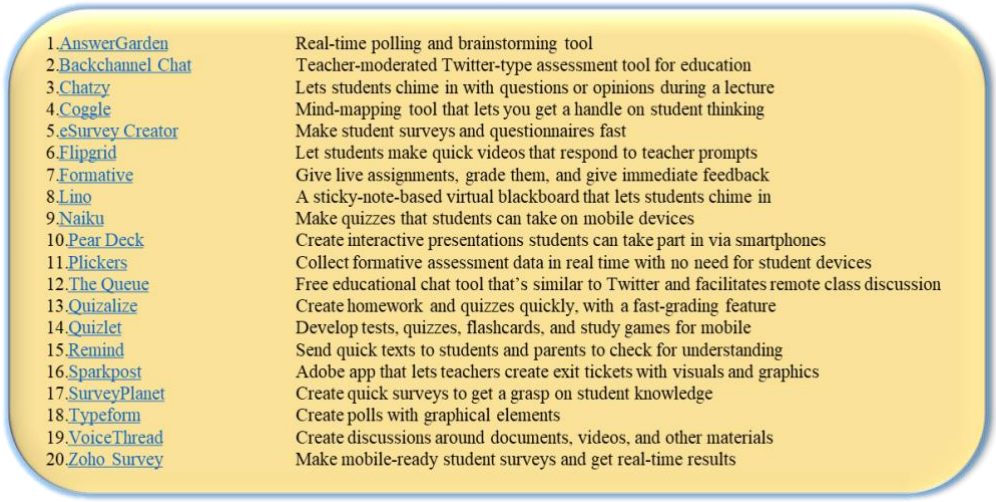
4.1. Adapting the traditional teaching approach for a virtual teaching mode to be able to lead students to achieve the desired level of competency, knowledge, and required skills, as per program learning outcomes

Since there are different learning styles by learners' gap in receiving information amongst people, there are four main factors associated with this gap between minds: mental state inference (what kind of information an educator could take from the students to see if they understood the topic or not, the behavior and learner's response). As such, various factors may be taken into consideration, and technique of teaching vary according to learners' background, level of competency, ability to speak, write, and interact with others [11-15].

4.2. Adapting lesson plans and assessments for online teaching and learning

The design of lessons is crucial to achieving learning outcomes. This research finds that students are motivated when the concept taught in class is explained with the help of examples from a familiar environment to the student. This is particularly true if the situation or experienced is known to the learner. Certainly, students' motivation depends on the subject taught and on the way in which the instructor engages the learner in the delivery of the lesson. At the same time, the way students are engaged in the teaching process, usually depends on the size of the class and the

delivery method. Information is comprehended better when examples are given that relates to learners' existing knowledge and are associated with learners' background.



1.AnswerGarden	Real-time polling and brainstorming tool
2.Backchannel Chat	Teacher-moderated Twitter-type assessment tool for education
3.Chatzy	Lets students chime in with questions or opinions during a lecture
4.Coggle	Mind-mapping tool that lets you get a handle on student thinking
5.eSurvey Creator	Make student surveys and questionnaires fast
6.Flipgrid	Let students make quick videos that respond to teacher prompts
7.Formative	Give live assignments, grade them, and give immediate feedback
8.Lino	A sticky-note-based virtual blackboard that lets students chime in
9.Naiku	Make quizzes that students can take on mobile devices
10.Pear Deck	Create interactive presentations students can take part in via smartphones
11.Plickers	Collect formative assessment data in real time with no need for student devices
12.The Queue	Free educational chat tool that's similar to Twitter and facilitates remote class discussion
13.Quizalize	Create homework and quizzes quickly, with a fast-grading feature
14.Quizlet	Develop tests, quizzes, flashcards, and study games for mobile
15.Remind	Send quick texts to students and parents to check for understanding
16.Sparkpost	Adobe app that lets teachers create exit tickets with visuals and graphics
17.SurveyPlanet	Create quick surveys to get a grasp on student knowledge
18.Typeform	Create polls with graphical elements
19.VoiceThread	Create discussions around documents, videos, and other materials
20.Zoho Survey	Make mobile-ready student surveys and get real-time results

Fig. 6. Type of online assessment tools for professors [16].

Curricula need to be reviewed and improved cyclically. In these times, curricula should include on-campus, online and blended learning, and all staff and students of the higher education institution is better to be involved through regular feedback loops. new technologies for teaching in the virtual environment must be considered in order to facilitate this transition to the digital age, taking into account priority teaching, learning and assessment. It should be emphasized that online learning is more than access to online resources independently. Adequate online resources must support the real curriculum and contribute to creating a real commitment between tutors and students. The face-to-face course design and program should be reviewed for online delivery in all respects: the design of learning outcomes, their delivery and assessment, and should include a separate reference to techniques that enhance student interaction and assess student learning.

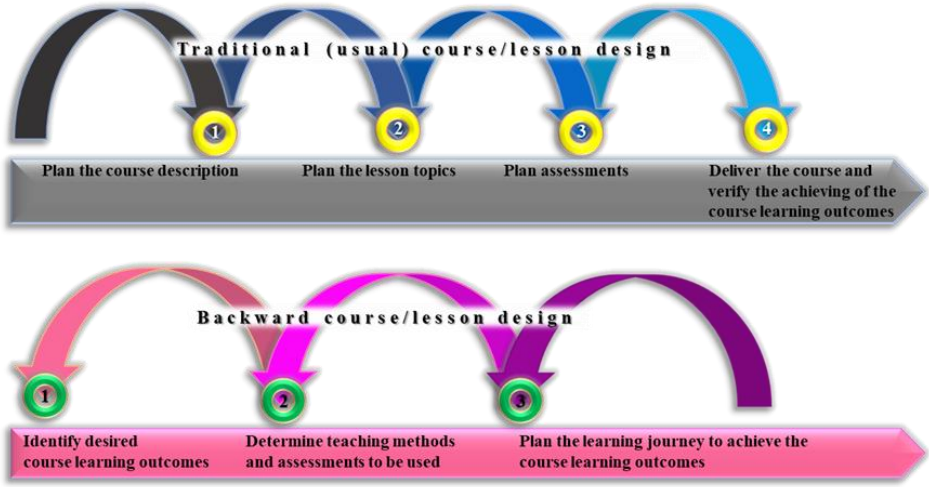


Fig. 7. Backward design

Real-life examples, analogies with current cases, storytelling are found to be great facilitators of comprehension and understanding of information in finance and business studies. Asking students to solve case studies by applying immediate knowledge gained, think within a group, 1-minute paper, respond-react-reply, or search and give an answer with the support of reasoning for the given answer are found to be some of the effective methods to be used in an online and off-line teaching environment. According to Grant Wiggins and Jay McTighe [17], teachers often approach course design in a *direct design* manner, which means that they take learning activities into account, develop assessments around their learning activities, then try to draw connections with the learning objectives of the course. In contrast, the redesign approach requires teachers to first consider the learning objectives of the course and then the methods that are approached to verify the acquisition of knowledge. Backward design can help the instructor and the student to have a clear perception of the course: what they will learn and how their performance will be evaluated under a certain learning outcome (Fig. 7).

4.3. The professor/instructor-student rapport and the study plan continuity as per the academic calendar

This research further finds that as per students' experience, a clear and continuous rapport of the learner is vital to the effectiveness of achieving learning outcomes and students' success. Establishing a rapport with students, help facilitate the learning experience, provides mental comfort, and a relaxed learning environment. Such a relaxed learning environment is found to facilitate the level of engagement and clarifying expectations.

Student motivation is one of the main challenges when comes to teaching and learning in a virtual environment. There are two main types of student motivation intrinsic and extrinsic based on we can encourage motivation and performance. Does intrinsic motivation refer to the one that steams personal from individual students, usually under the questions Why I am learning dins subject? When and how I will use it? Extrinsic motivation refers to other factors than personal nature, factors that encourage students to participate and perform well. The most challenging part is how the professor will balance the intrinsic and extrinsic motivation to maintain the students' attention and participation in the course. According to Bain [17], there are many strategies to motivate the students, all referring to the relation between professor and students, and the opportunities given by the professor to the students to express their own ideas and inputs. Fig. 8 present the main eight strategies for students' active class participation.

1. **Engage the students** – the more professor is engaged into the topic and talks with passion; the more students will pay attention to it.
2. **Student-professor relationship** – knowing your students, invest in their performance will give their courage to be actively participate.
3. **Contextualize information** – professor should use examples, story-telling involving the students too.
4. **Active learning techniques** – such techniques which will give students the occasion with involve with their academic performance and growths.

5. **Realistic Course Learning Outcomes** – identify the relevant learning outcomes to be achieved at the end of the course, sent clear milestones which can be used by students to measure their performance and academic standings.
6. **Appropriate grading** – professor should give explicit assessment, clear guidance and evaluation rubrics.
7. **Feedback** – professor and students should provide regular feedback.
8. **Encourage active participation** – professor should give students opportunities, encouraging to identify individual topics, case studies, projects.

Fig. 8. Strategies that professor can use to motivate their students [17].

Another approach, which has a direct impact on students' academic experience is related to applied of inclusive teaching [18, 19]. Based on our research and literature review, this was referred mainly to: learn more about each individual student; create a safe learning environment; set a clear rapport (rules and expectations); create universal lessons and assessments on which students can apply to their context; build a rapport among the group, giving the students opportunity to interact one with each other; anticipate, address individual needs; adapt existing policies to ensure that no students are excluded; involve the students in adjusting the curriculum; diversify course materials; starting from the students feedback, regularly analyze, amend and improve the teaching and assessment techniques.

5. Conclusion

Intelligent learning and research are happening everywhere, nevertheless, conventional teaching and learning in universities, based on face-to-face or in-person approach is still the basic environment. Actual movements in socio-economic life around the world impose e-learning and e-presence. However, moving digital is more than online teaching, which is changing the environment [20, 21].

This study offered an in-depth exploration of the most important dimensions of the teaching portfolio; teaching techniques, reporting, assessment, maintaining students' attention and involvement, class design, lesson design to meet the course learning outcomes, and challenges facing both, learners, and faculty.

As technology continues to reshape industries including the education industry, curriculum, and teaching techniques are looking for ways of optimizing teaching, learning, and assessment. Keeping pace with large-scale digital transformation in a short period of time is challenging for both learners and instructors alike. The challenge is not limited to maximizing results, meeting labor market demands for both knowledge, skills, and abilities, but it extends to mastering an entirely new set of technologies to effectively deliver instructions, knowledge, and ultimately competency. Challenges in the online education environment are still persisting and not fading away for both learners and educators. This is particularly true in the face

of slow Internet and numerous parts of the world including the developed world as learners struggle to have access to the Internet in many developing countries.

As such, to be effective in higher education, teaching techniques must be further developed to adopt new approaches, to effectively meet expected outcomes of education institutions, learners, and the industry. Applying new technologies in the new digital age, however, poses a greater challenge on the human mind to adapt to a limited range of options such as Blackboard, Moodle, MS Teams, and Zoom, The main challenges of approaching new teaching methodologies in finance science and business administration, and based on answers received from students and teachers/instructors, based on their own academic experiences, taking into account the evolution of labor market requirements and the increasing use of digital technology are therefore summaries below:

In a higher education institution, instructors need to create a friendly learning environment in digital learning to be effective in building a rapport. It is crucial for instructors and learners to grow the desire to learn, building relationships of collegiality is one way for such a goal to be achieved. Instructor's closeness to students, in the sense of showing caring and understanding is another way for growing a desire to learn. Effective assessment of the knowledge gap between experience, and knowledge of the instructor and students can make a difference in being effective in teaching and achieving learning outcomes. It is essential for instructors to explain to the students the objectives of the learning outcomes in every meeting, as this help student understand the overall picture and ultimate objectives of the lesson. Research findings as far as challenges facing students were topped by students stating that learning new tools, such as Moodle, MS Teams and Zoom was challenging for an online classroom learning environment. They had to develop a learning cycle of getting used to the tools to be proficient at them. The same challenge also poised for faculty and instructors as the significant majority exhibited facing difficulty adapting to online-learning tools such as Moodle, MS Teams, and Zoom and other technical issues pertaining to their respective educational institutions. For instructors, such challenges were particularly true during quizzing and examination as forms of assessments.

Backward Design helps professors, instructors, and educator decision-making to build a realistic curriculum adapted to the current requirements of the labor market, to determine what material is needed for students to meet the stated learning objectives [22]. Backward design is a very efficient method of drawing the lesson and the curriculum, clearly aware from the beginning which are program learning outcomes, course learning outcomes, and what has to be the lesson journey that must be followed to achieve them. It is even more efficient.

Finally, if we consider the backward design and implementation of the program, we can see that the time allocated to the creation of the curriculum, the clear presentation of the evaluation method (evaluation criteria, as well as the clear evaluation program throughout the semester) of resources needed for evaluation and planned teaching both synchronous and asynchronous, we can see that both professors and students are much more organized in the course plan and have visibly better academic performance.

Acknowledgments and limitations

While conducting research the author acknowledge limitation in finding official statistical data for our topic. Implementation of the new technologies offer many opportunities to develop the higher education system, and this a subject for further research.

References

1. Carrithers D., Ling W.C.T, Bean J.: Messy problems and lay audiences: Teaching critical thinking within the finance curriculum / Business Communication Quarterly, 71(2), pp. 152-170 (2008).
2. Sharma A.: Use of Bloomberg Professional in support of finance and economics teaching / Cogent Economics & Finance, 3(1), pp. 1115618 (2015).
3. Wang H., Cao C., Guan N., Huang Z.: Evaluation System Design for Application of Innovative Teaching Methods in Major of Construction Management: Case Study in a University of Finance and Economics / ICCREM 2018: Construction Enterprises and Project Management, VA: American Society of Civil Engineers, pp. 157-166. Reston (2018).
4. Márquez-Ramos L.: Does digitalization in higher education help to bridge the gap between academia and industry? An application to COVID-19 / Industry and Higher Education (2021).
5. Moşteanu N.R.: Education, qualification awareness and social civism to build and sustain a healthy and developed society / 28th European Biomass Conference and Exhibition Proceedings, Marseille, France, EUBCE, pp. 6-7 (2020).
6. Moşteanu N.R., Faccia A., Cavaliere L.P.L., Bhatia S.: Digital technologies' implementation within financial and banking system during socio distancing restrictions–back to the future", IJARET, 11(6), pp. 307-315 (2020).
7. Moşteanu N.R.: Financial and economic policies for a sustainable development through Green Economy and Artificial Intelligence / 28th European Biomass Conference and Exhibition Proceedings, Marseille, France, EUBCE, pp. 917-920 (2020).
8. Jiao Y., Li X., Zeng R.: Finance Course Reform Exploring Based on Financial Technique Background / DEStech Transactions on Social Science, Education and Human Science (2019).
9. Chetty L.: Innovative interpretive qualitative case study research method aligned with systems theory for physiotherapy and rehabilitation research: A review of the methodology / African Journal of Physiotherapy and Rehabilitation Sciences, 5(1-2), pp. 40-44 (2013).
10. Angen M.J.: Evaluating interpretive inquiry: Reviewing the validity debate and opening the dialogue / Qualitative Health Research, 10(3), pp. 378-395 (2020).
11. Moşteanu N.R. Teaching techniques adapted for online delivery to achieve course learning outcomes in a virtual environment. J. Digit. Art Humanit., **2**(2), 33-50. (2021). https://doi.org/10.33847/2712-8148.2.2_3
12. Moşteanu N.R.: Assessment of teaching and learning techniques for online environment. How to maintain students' attention and achieve course learning outcomes in a virtual environment using new technology. *International Journal of Innovative Research and Scientific Studies*. Forthcoming (2022).
13. Denzin N.K., Lincoln Y.S.: Introduction — the discipline and practice of qualitative research / Denzin, N.K. and Lincoln, Y.S. (eds.) Strategies of Qualitative Inquiry. Thousand Oakes: Sage, pp. 3 (2008).
14. Waytz A., Gray K., Epley N., Wegner D.M.: Causes and consequences of mind perception. Trends in cognitive sciences / 14(8), pp. 383-388 (2010)
15. Nickerson R.S.: How we know—and sometimes misjudge—what others know: Imputing one's own knowledge to others / Psychological bulletin, 25(6), pp. 737 (1999).
16. Fischhoff B., Beyth R.: I knew it would happen: Remembered probabilities of once—future things", Organizational Behavior and Human Performance, 13(1), pp. 1-16 (1975).
17. URL: https://www.hp.com/us-en/shop/tech-takes/best-online-assessment-tools-for-teachers , last accessed 2021/10/25
18. Bain K.: What the best college teachers do / Harvard University Press (2004).
19. Hockings C.: Inclusive learning and teaching in higher education: a synthesis of research / York: Higher Education Academy (2010).
20. Wiggins G.P., McTighe J.: The understanding by design guide to creating high-quality units / ASCD (2011).
21. Moşteanu N.R.: Digital Campus–a future former investment in education for a sustainable society / E3S Web of Conferences, 234, pp. 00029. EDP Sciences (2021).
22. Moşteanu N.R.: Digital University Campus–Change the Education System Approach To Meet The 21st Century Needs / European Journal of Human Resource Management Studies, 4(4), pp. 79-93 (2020)
23. URL: https://ii.library.jhu.edu/tag/backward-design/, last accessed 2021/06/12

Teaching techniques adapted for online delivery to achieve course learning outcomes in a virtual environment

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Abstract. Today we are moving from traditional learning to *e*-learning via digital means. The entire humanity *learned* how to adapt *overnight* to digital life and leave the traditional doing things behind. Digitization has been around for several years, but its use has become a necessity with the Covid-19 pandemic. The blockade forced us to work remotely overnight, to use digital networks to communicate, make payments, learn, all sectors of activity had to adapt to the digital age in one night. This paper shows how the teaching and learning approaches need to adapt to new communication requirements and students' needs to achieve course learning outcomes in a virtual environment. This paper uses both a quantitative and qualitative method to analyze the professors and students' perspectives on the techniques of online teaching-learning, during the isolation period and after, and what are the best methods recommended to be used for online learning taking into consideration how students can maintain their class's attention and how can get actively involved in a learning process. The value of this study is to develop a holistic image of online teaching-learning-assessment activities, to ensure the efficiency and quality of the educational process in the university environment.

Keywords: online teaching and learning techniques; means of engagement; higher education.

1. Introduction

The emergence and spread of the Covid-19 pandemic triggered a major economic and social crisis. At the higher education level, the pandemic has brought to light a set of contradictions that have been present in relation to online teaching, the tendency to stagnate in the implementation of new information technologies, and reluctance to adopt the study plan to the needs of students. In the last year, it was said that the entire education system, at all its levels, was collapsed during the isolation of the Covid-19, around the globe. Contemporaneous authors underline again the importance of technologies, and this not because it gives students access to a plethora of online materials, but it also helps them study [1-2].

It is undeniable that the world wide web has launched a comfortable place for teaching and learning. Although educators at all levels have accepted the use of online technology as a teaching tool, the problem of the methods used and the evaluation of student learning in an online course must be solved for the real effectiveness of this approach. Digital campus and online teaching are not new techniques [3]. They have been used successfully by several universities in recent years. However, before the virus appeared, online teaching and adapting teaching and assessment techniques to the virtual environment was not a priority. Now, more than ever, it is necessary to adapt teaching and learning techniques, because the whole society needs a proper education. The year 2020 apparently was the one in which all educators realized that while traditionally, higher education has been designed in a face-to-face manner, not

only have learning activities moved online, but the campus experience is no longer the benchmark with which all university education is compared [4].

The present paper aims to present pertinent methods to maintain students' attention focused combined with different teaching, learning, and evaluation techniques specially adapted for online teaching. This paper presents teaching-learning-assessment methods and techniques encouraged to be used in the online environment, starting from the knowledge of how the student's memory and attention work in the learning process within the virtual environment; feedback received from both students and teachers; the gap between the minds; flexible teaching techniques centered on student-learning, student social identity and various classrooms.

2. Literature Review

The teaching method is the mechanism that is used by the professor to organize and implement a series of educational means and activities to achieve certain goals [5]. The chosen teaching aids must correctly reflect the learning process, by ensuring that competencies, knowledge, and skills are successfully acquired by students. Certainly, teaching is much more effective when tutoring methods are adapted to new technologies and to students' needs in order to be able to easily meet the new requirements of the labor market. Online teaching requires the active involvement of all staff, teachers, administrative staff, and students, as well as coordination between various institutional departments and between institutions themselves. Teachers are called to actively collaborate with administrative staff and those responsible for information technology.

Academics in the field of education [6, 7] have identified three types of assessment used for business education students: traditional, alternative, and performance. According to the authors, traditional assessment usually measures lower-level cognitive skills. These assessments are based on recall and understanding of the facts. The alternative assessment determines the affective domain and includes team activities, self-assessment and peer assessment, and reflection through journals and portfolios. This type of assessment examines students' attitudes and character traits. Performance appraisal measures the psychomotor field and includes students' demonstrations of proficiency in a skill or task. Examples include formatting documents and completing financial statements.

While many academicians and researchers tried focused on finding ways for a smooth and good transition from teaching and learning on-campus to online, some other educators and professors expressed their concerns related to the content communicated, delivered to the students [8]. Earlier in 2001, Professor Gold also stated that the transition from in-classroom instruction to online instruction is a complex one involving specialized training in the technical aspects of delivering quality educational materials (or environments) to the students, and specialized training in how to foster knowledge acquisition within this new environment [9]. Research has shown that teachers who have started teaching online have a more constructivist orientation, increasing the value of student-teacher interaction and communication, but there is no talk about the value of communication content.

In 2006, a study conducted by professors Lewis and Abdul-Hamid emphasizes the importance of feedback received from students but also given by teachers to students in the process of implementing online teaching practices [10]. Our research fully supports this statement and emphasizes that providing feedback to students is a constructive process, stimulates interaction and involvement, facilitates student learning, and support professor to organize/ adapt the course study plan according to the students' needs.

Later, in 2007, professors Zapalska and Brozik, from Finance and Management departments underlined that individual learning styles must be taken into account in

the course design template used in online education [11]. The paper argues that, once the professor identifies the students' learning ways, then it is viable to design an appropriate context of learning. Our research will present that students' learning style is better to be combined with different means to capture and maintain the students' attention. Hung and Zhang (2008) analyzed online behavior to be able to see the achievements of learning outcomes [12]. We strongly agree that student behavior is helping in developing the teaching, assessments, evaluation techniques. However, memory, attention focus, and students' feedback is better to be taken into consideration too, as it will be presented here.

A group of researchers from the School of Management Science and Engineering, Central University of Finance and Economics, Beijing, China [13] stated that cross-disciplinary and cross-curricular teaching and learning models have become a new direction of development. As a typical interdisciplinary specialty, most construction management gradually introduces innovative teaching methods, such as workshops, reverse classrooms, peer training. Though, the respective internal application of these teaching methods has not led to a systematic evaluation system. Therefore, the authors observed, indeed a clear need to amend current educational system approaches. In recent years, it has been observed that on-campus teaching, through face-to-face meetings, has been replaced by digital interactions or digitization. Teaching needs to be updated. Digitization and digital services in teaching finance and business management promise a universe of applications and digitalized assets that are expected to work together to allow rapid development of new capabilities that will give competitive advantage and equip the new generation of students with employment-ready skills [2], [14-17]. Technological innovations such as blended learning are rapidly changing teaching and learning in the higher education system [18]. The main activities carried out in higher education institutions aim at research and teaching; knowledge transfer through work-based learning or industry-oriented activities applied teaching and the development of digital skills through the increased use of digital technology [19].

One question emerged among teachers and students *This is how the education system will go from this moment forward – online?* There has been a lot of debate lately about the quality of online and face-to-face teaching and learning. These discussions focus more specifically on issues related to teacher engagement, resources, assessment and skills, their preparation to provide online learning effectively [20]. One thing is certain, society is evolving in the direction of digitalization, and education must adapt. So, online teaching will be common practice from now on. It is true that experience on-campus cannot be compared with the online one. The interaction is different, and rapport student-professor is more active within an on-campus environment. However, online education is already established, and it is here to stay, fully online or blended. Much more than this, the practical approach presented in the 21st academic study plan now enables practitioners to participate in a large number of blended courses, helping the educator and students to fill the gap between the theory and practice.

3. Data and Methodology

The research started from three main objectives: the gap between the minds and how to capture the student's attention; flexible teaching techniques student-learning centered; and teaching, learning, and assessments methods updated for online environment education delivery mode. To achieve the research objectives, this study used the data and results of previous research developed by the same author [21].

To answer these research objectives, we adopted the interpretative qualitative research method [17]. Contemporaneous researchers underlined that interpretivism recognizes that social phenomena must be understood in the social contexts in which

they are constructed and guided by the way people interpret and understand situations [22, 23]. For our study, it was considered that qualitative research is most appropriate as it crosscuts disciplines, fields, and subject matters [24].

The chosen research method, the qualitative one, was based on the skills of relationship and empathic listening, which the author used to develop confidence, care, and sense so that participants are more willing to offer truthful explanations for their views.

The research started in early 2020 when the world faced the Covind-19 pandemic. The research was carried out through successive interviews with representatives of higher education institutions, students, and professors from finance and business management specializations. The interviews focus on 1. students' ability to adapt to online teaching and learning process, to actively participate in each course, to demonstrate a comprehensive understanding of the subject taught, and to prove the successful achievement of knowledge, skills, and competences acquired, in line with the objectives of the course and program of education; 2. teaching and learning techniques and relevance of assessments amended for online delivery mode, student-centered learning, professor-student rapport on virtual environment.

The analysis helped the research to understand the importance to be given to the achievement of course/program learning outcomes, the need to change the teaching, learning, and assessment techniques, as well as different approaches in maintaining a centered student learning.

4. Results

4.1. How memory works and how to capture students' attention

The efficiency of the educational process is also given by the method in which the optimal teaching approach is identified, depending on the students' ability to understand the respective topic. It is also crucial to understand how students' learning takes place because of the teaching approach that the teacher chooses.

Memory implies a continuous process of retaining information over time. It is an integral part of human knowledge because it allows individuals to remember and be inspired by past events to frame their understanding and behavior in the present. Memory also provides individuals with a framework for making sense of the present and the future. As such, memory plays a crucial role in the teaching and learning process.

A closer look at the cognitive processes that underlie how people learn can help ensure that the teaching methods chosen are as effective as possible to reach your students. It is necessary at the beginning that every educator understands how human memory works. which is the foundation of students' understanding and performance. The research will make a brief review of the cognitive processes that allow problem-solving, encoding, recall, retention, and memory retrieval (Fig. 1). Thus, each educator had a better understanding of how learning works and how teaching methods should be best adapted to facilitate students' learning and understanding. Generally, there are three main processes that characterize how memory works: encoding, storage, and recall [25].

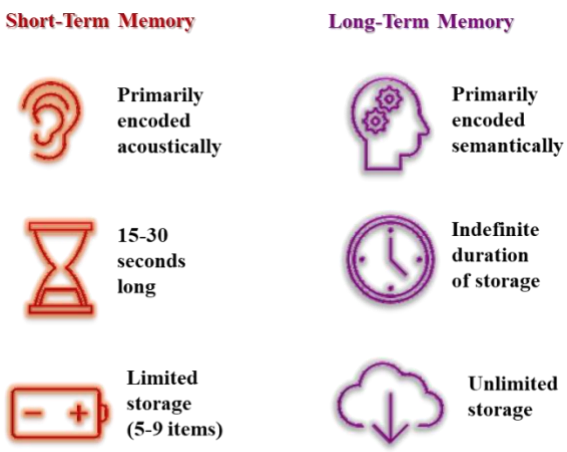

Fig. 1. Memory and learning process.

Encoding refers to the process by which information is learned. How information is retrieved, understood, and modified to better support storage. The information is usually encoded by one (or more) of the four methods [26]:

1. Visual coding (how something looks)
2. Acoustic coding (how something sounds)
3. Semantic coding (what something means)
4. Tactile coding (how something feels).

While information usually enters the memory system in one of these ways, the form in which this information is stored may differ from its original form. Usually, visual and semantic coding are long-term memory; while, acoustic and tactile is short-term memory.

Storage refers to how, where, and for how long the information encoded in the memory system is retained. According to Roediger and McDermott [27], storage highlights the existence of two types of memory: short-term memory and long-term memory. The encoded information is first stored in short-term memory and then, if necessary, stored in long-term memory.

Recall is the process by which people access stored information. The information is taken differently depending on how it was stored (short term or long term). While short-term storage is taken over in the order in which it is stored, long-term storage is taken over by association [27]. However, retrieval is subject to error because it may reflect a memory reconstruction. This reconstruction becomes a must when the stored information is lost over time due to damaged retention.

Now, knowing how the memory works, if educators want their students to recall the knowledge for a long term and also be able to implement it further in their work or further professional developments, they will use primary encoded visually (short video, graphics, educational games) and semantically (storytelling, cases from the real world, cases brought to your attention by students based on their experience or professional interests).

4.2. The gap between the minds

We have not often met professors who complain that students do not understand things that, in the educator's perspective, are very simple. Here, as an educator, it is important to recognize what is known as the gap between minds. Each professor should be aware of the gap between what you know and what your students know and then take the appropriate steps to reduce this difference. The teaching and

learning techniques used must also aim at reducing the gap between minds. The literature has identified four main factors associated with the gap between minds, namely mental state inference; the curse of knowledge; hindsight bias; and egocentrism.

Fig. 2. The gap between the minds.

Mental state inference. It is generally acknowledged that we are aware of what we think and feel at any given time. But how do you know what others think and feel? Because you don't have access to other people's minds, you need to do your best to guess what they're thinking based on the information you can observe. As an educator, you need to use a range of information to deduce students' mental states. This information is related to students' physical behavior, as well as the ability to put themselves in their place and imagine what you thought in their situation [28, 29]. As a professor, recognizing assumptions about what determines the behavior (and performance) of students it can help to shape the way the professor is teaching to better support learning and understanding. This can be done by using active and collaborative learning techniques, as well as through direct discussions with students about the ways in which they learn the best.

The curse of knowledge refers to the fact that increased knowledge about a subject can affect the ability to effectively predict how much knowledge others have. This phenomenon has several important consequences, the most important of which, from an educational point of view, is the difficulty of sharing your knowledge with others [30-32]. There are cases in which the professor who understands very well the subject he teaches, and may also have practical experience in the field, could encounter difficulties in finding a close way of teaching, from the perspective of the student, who, compared to the teacher is usually novice in the field. Therefore, professors can struggle to explain the concept to students. In other words, because the professor knows a concept so well, he has a hard time imagining what it's like not to know it. As a result, he may not present his explanation at the level of detail that would be most useful to your students [31]. As an educator, it is very important to realize *the curse of knowledge* phenomena and to prepare the lesson plan from the perspective of students.

Hindsight bias has implications for student learning and comprehension because it can prevent students from critically analyzing information to foster a more nuanced understanding of why one outcome is correct, and the others are not. Have you ever thought about the outcome of an event and thought "I knew it was going to happen" or "I knew it all the time"? This feeling is known as retrospective bias (retrospective prejudice). It is a psychological phenomenon in which individuals see past events as more obvious than the same future events. This leads to excessive simplification of events (seeing their cause and effect as more predictable than they

were), making incorrect decisions, or developing (and promoting) a unilateral or biased view of events and information [32].

Egocentrism refers to an inability of an individual to consider the perspective of others. As is evident in previous discussions about the curse of knowledge and hindsight bias, being unable or unwanted to analyze and incorporate student perspectives can prevent the teacher from understanding the information in detail. Although the professor's role is to share his knowledge with students, it is important to consider the most effective ways to do this. Thus, the professor is good to encourage students to provide feedback after each course, but also to be actively involved with the information provided and use it to build their own knowledge and reach their own conclusions.

Students are very easy to be distracted from the class, especially within an online teaching environment (Fig. 2). There are two types of motivation that may influence how students can be engaged in learning experience: intrinsic, which refers to the motivations that stem internally; and, extrinsic motivation, which refers to external factors that influence student performance and motivation. Bain [34] identifies numerous research-based strategies that teachers can use to motivate their students. Eight of these strategies are listed in Fig. 3.

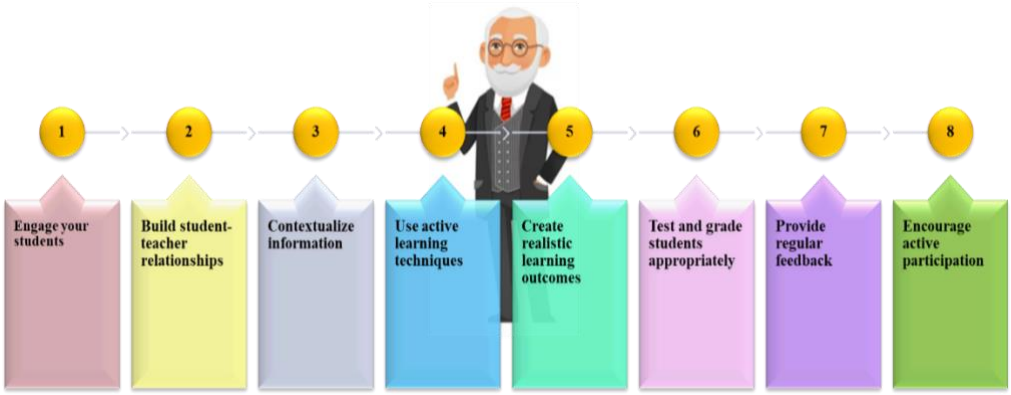

Fig. 3. Strategies used to encourage students' attention, motivation, and performance [34].

4.3. Teaching techniques to improve the recall within online environment

The efficiency of the educational process is also given by the method in which the optimal teaching approach is identified, depending on the students' ability to understand the respective topic. It is also very important to understand how students' learning takes place as a result of the teaching approach that the teacher chooses.

It is important for every educator to be aware that the teaching techniques used must promote better retention and remembrance among your students. In the practice of education, there are three main techniques effect of testing, spacing, and intercalation.

Testing effect. In most cases, tests are normally considered to be a method of periodic evaluation. Periodic testing at the beginning or during class (one-minute paper) helps the professors to understand how well their students have learned the material taught or provided. At the same time, frequent tests and are considered one of the best ways to learn in the first place.

Active and frequent testing helps the memory retention process when learning new information. By actively and frequently testing, encouraging students to regularly remember the information they have recently learned helps them to store the

information in long-term memory, which they can use at a later stage of the learning experience [26]. Active testing can take place at any time during teaching (at the beginning, middle, or end of class) through a one-minute paper, a short questionnaire, a free-answer question, asking them to remember what they learned on that day or the day before. At the beginning of the class, testing is about a previous lesson or what the student is supposed to read for the present class. Middle of class, testing may refer to new topics or information presented during the class. At the end of the class, testing refers to the main ideas, concepts learned during the class. Within an online environment, *questions can be provided via MS Forms, requesting short (one to five minutes) answer*. Tests can be incorporated as a small quiz as well.

Spacing. According to the spacing effect, when a student learns and remembers information over a long period of time, he or she is more likely to retain that information. Educators are encouraged to structure the learning process using the spacing technique. For example, in each course, the professor is called to recapitulate the notions of the previous course, to make the connection with the topic of the current course and the next one. The professor is encouraged that, instead of introducing students to a new topic and its related concepts in a single move, to cover the topic in segments over several lessons [26]. Moreover, try to use the *visual and or sound effect* by adding suggestive cartoons to your lesson's materials, including *short videos*.

Intercalation refers to the technique is when students practice several related skills in the same session. This technique has proven to be more successful than the traditional locking technique (students practice only one skills or competence) in various fields [26]. This technique refers to the combination of knowledge, competencies, and skills previously acquired, in the same course or in preparatory courses (for example during *Financial Management* class, students are called to use the knowledge gained in the *Accounting* and *Micro/Macroeconomics* classes, as financial decisions are based on information from accounting and economic data).

4.4. Learning techniques to improve the recall

As presented above, it is important for every educator to know what techniques he can use to improve the recall of information by students. At the same time, the professor must be aware of the learning techniques that students can use to improve their own memory. According to the students interviewed in this study, but also based on literature review in the field, there are four main techniques: state-dependent memory, schemas, fragmentation, and deliberate practice.

State-dependent memory refers to the idea that being in the same state in which you learned the first information allows you to better remember that information. The state refers to the environment of an individual, as well as to his mental and physical state at the time of learning [35].

Schemes refer to the mental frameworks that an individual creates to help him understand and organize new information. Schemes, graphs, colors act as a cognitive quick command by allowing individuals to interpret new information much faster [36]. Beware, however, that excessive use of schemes can prevent students from learning relevant information that does not fall within the scope of the scheme that was created. Students must be taught how to create a schema, what is the information contained in the schema, and the links between the schema and other information that cannot be included in that schema or does not align with existing beliefs and conceptions on a subject.

Chunking is the process of grouping information together to make retention easier. The grouping of information is very important in the process of learning and teaching. The plan of each lesson must include this technique. The information is delivered in groups. thus, students, instead of remembering each individual topic,

remember the whole group and then can more easily take over each topic in that group [37, 38]. Chunking facilitates better memory recall by separating information into small groups to be easier to remember and help the students to Identify patterns. Understanding patterns and principles will enable retention.

Deliberate practice refers to the act of deliberately and actively practicing a skill with the intention of improving understanding and performance in that skill. By encouraging students to practice a skill continuously and deliberately (e.g., writing a well-structured essay), it will be possible to ensure better support of that skill [26].

4.5. Design learning framework for online teaching

The purpose of learning design is to create flexible learning materials and methods that can be used by a diverse range of students. The universal design for learning framework is meant to support the multitude of ways in which learning takes place. Figure 4 illustrates the three principles upon which it is based.

Multiple means of representation through which information can be presented to students. It is based on the multitude of ways in which students perceive and understand information, due to a variety of physical, cognitive, and psychosocial reasons that exist on a spectrum or continuously. This principle also looks at teaching methods and how best to ensure that all students have access to how concepts and ideas are emphasized, connections are made, and questioning is modeled [39].

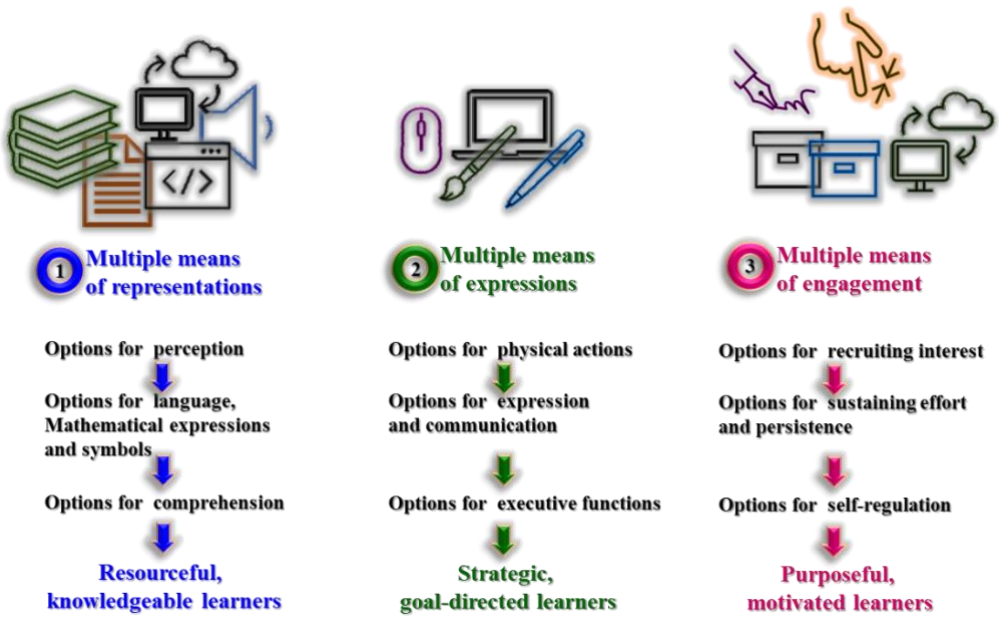

Fig. 4. Principles of designing the learning framework.

Multiple means of expression take into account different methods by which students express their knowledge and understanding. Because students differ in their (motor) skills and abilities in different areas, it is important to allow them to express themselves through the area with which they feel most comfortable [39].

Multiple means of engagement talk about the different ways in which students may need or choose to become involved in the learning experience. This can be determined by and, in turn, can determine their motivation to learn [39]. This motivation can be internal and external. In this context, there are three general

themes that can determine how much a student is involved in the learning experience: 1. Spontaneity and novelty; 2. Risk and challenge; 3. Dynamism and collaboration.

4.6. Learning techniques to improve the recall

A study conducted under the Erasmus+ program of the European Union defines very clear the active learning understandings. In this regard, active learning is described as an approach to instruction that involves actively engaging students with the course material through discussions, problem-solving, case studies, role plays, and other methods [40].

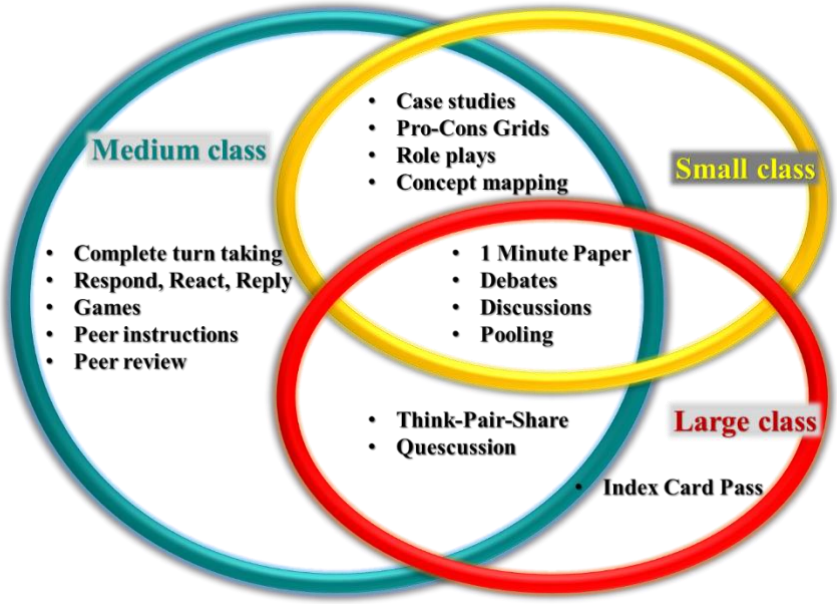

Fig. 5. Teaching techniques for active learning.

In the case of online teaching and learning, depending on the management system used, you can create discussion sub-forums and sort students into teams, smaller groups, and choose different techniques (from those shown below in figure 5) to respond to the assignment within a given period. Once students have summarized their answers, they can post their answers on a larger forum where all students can read and comment on the answers.

The design of the lesson is very important, starting with a short recap, introduction, continuing with the body of the lesson, concluding, and announcing the topics that will be discussed in the next lesson or lessons, and what is the connection between the topics taught. However, lesson design alone is not enough, teaching in the sense of maintaining students' attention and interest in the class is just as important. Involvement, active participation of students is essential to help them understand the topic discussed, to retain it, and to be aware of its importance further. Students are motivated when the notions taught in class are explained with the help of examples from their environment, from situations known or experienced by them, using a range of active techniques.

Certainly, the motivation of the students depends equally on the subject taught and on the way in which the teacher engages the students in the delivery of the lesson. At the same time, the way students are engaged in the teaching process depends on the size of the class - small, medium, large, on the delivery method - face to face, blended or online, as well as their background, or prior knowledge. Examples

related to their knowledge, background, real-life examples, analogies with current cases, storytelling by asking students to solve certain class activities by applying the knowledge gained for sure it may help. Below are some examples of active teaching which can be equally used for face-to-face classes, as well as easy to adapt for blended and online learning.

A variety of software tools allow instructors to ask a question and immediately collect feedback from the entire class. Depending on the software, students can answer a multiple-choice question using a telephone or computer or a portable clicker (also known as a personal answering device). In addition to multiple-choice questions, many online tools allow for different answer formats, including short text input, drawing, and filing (MS Forms for example).

1 Minute Paper. Students are asked to answer a question with a short reflection. The question can be related to the subject previously taught, to the materials required to be covered before class, or to any topic related to the current course. The answers must be concise. The answers are sent in the specified type (1-2 minutes), online, via in-person in class. The answers are collected and commented in class with all the students.

Pooling provides real-time instructor feedback from all students. Asking a question and collecting students' answers takes only a few minutes and can be integrated into any type of course, including lectures. A particularly effective strategy is to ask each student to first answer the question independently, then discuss the question with a neighbor, and then vote again [41].

Some of the most used active teaching techniques aimed at hiring students are certainly discussions and debates. Involving students in discussions and debates encourages them to create their own understanding of the content and connect it to their experiences. Learning is enhanced when students are encouraged to form opinions and develop their own ideas about content [42].

Debates are classroom discussions in which students argue for or against a particular proposal. In doing so, students' knowledge of a given concept is tested by their ability to present a convincing and effective argument. The dynamic, back-and-forth nature of debates gives students the opportunity to improve their critical thinking skills (higher order), as students are asked to make immediate, intellectual remarks in response to arguments from the opposing team or student [43].

The purpose of the discussions is not for students to discuss a topic (as opposed to debates). Rather, the ***discussions*** are meant to encourage students to become meaningfully involved with a concept as a group or an entire class. Through discussions, students can explore a concept in detail and, by sharing their thoughts and opinions, can develop or improve their understanding of the concept in question. Discussions are meant to be a space for collaboration in which students learn from each other [44].

Case studies represents a great activity for students to work on the practical applications of theoretical course materials. This activity provides students with real-world cases to study (news articles, accounts for decisions, videos, or real cases provided by the students, etc.). Cases are analyzed using guidelines and frameworks provided by instructors and can work in teams or individually. The students' analysis is presented to the entire class as individual, or group written answers. In the case of on-class presentation, the discussion should connect the case study with class materials.

Pro-Cons Grids support students in developing analytical and evaluative skills. This technique asks students to go beyond their initial statements and reactions and come up with points of discussion for the other side of the issue. It requires students to weigh the points of competing statements and concerns [41]. The topic is usually given by the professor and students are encouraged to make a list of pros and cons/ advantages and disadvantages for that topic.

Role plays is an active teaching and learning techniques through which students take on and act out roles in a case-based scenario. The role play can be carried out one-to-one (individual role play) or as a group role play with each member in the group taking on a role/character. Roles and rules for a role play are clearly defined in the script [42]. Role plays can help students achieve various learning outcomes, may practice skills such as team player, negotiation, decision maker, employer, supplier, client etc. or take on the role of another person to understand their point of view, or act out a scientific process [45]. In case of role play activity, clear guidelines should be provided by professor.

Concept Mapping is a visual tool used to show the relationship between concepts. The professor provides students with a list of terms or concepts. Students generate a concept mapping by arranging the terms on paper, drawing directional arrows between related concepts, and writing a sentence over each arrow to describe the relationship. Through this process, students enhance their learning and develop, or strengthen, higher order thinking skills.

Think-Pair-Share is an active learning technique which involve three main steps: Think – reflect about the answer to the question, better in writing; Pair – partner up with another student and discuss the response; and Share – discuss the response with the group and then share with the class to conclude the assignment. This technique is recommended to be done in within, face-to-face and online, with clear time for each stage. When encouraging students to share their responses with the rest of the class, it is common for professors to ask students to select one speaker from their pair (or group) to share the response. This gives students practice synthesizing information as well as presenting.

Quescussion refers to a learning technique which involve discussions through questions only. On a topic given, students may only respond or add to the discussion in the form of question. This is a form of informal learning which give the students possibility to actively involve their creativity and their judgment skills. By getting students to ask questions, they are actually invited to generate a variety of thoughts about the topic without them directly stating their own views. With each question students will likely think of answers to the proposed question [41].

Complete turn taking is a technique through which each student is asked to bring a couple of questions to class on a given topic. Questions are in the direction of clarification issues they think were left unresolved, or ideas or positions not yet considered [41]. This activity should involve all students. After all questions were risen, then a class discussion will start. This method allows students to speak and work through some of their concerns.

Respond, React, Reply is a good activity for online class. This is an activity which require a quick response from the students' side based on a given topic, immediately on their own in writing. After each student wrote their answer, the professor will read and share students' response with the group. Each student is encouraged to react to each of the other member's responses. The students also have to reply to each of the reactions to their own response. Within an online environment, the time for each one – respond, react and replay – better to be no longer than 1-2 minutes.

Games based learning refers to the use of *games as a teaching and learning tool in the context of the online learning environment*. Games offer students a fun and exciting way to learn and get involved with a concept or topic. Through elements of scoring, winning and competition (or collaboration), games motivate students to get actively involved and participate in a lesson and, by extension, their own learning [46].

Peer instructions refers to the activity which requires successful students to teach their classmates about certain concepts based on questions or prompts provided by the teacher. After teaching content, a teacher will ask a conceptual question,

known as ConcepTest (multiple-choice questions). Students then have a short period to formulate and provide their answers, often through a survey. Once the results are collected, students are divided into groups and encouraged to share their answers with their peers and, in doing so, convince their peers of the value of their arguments. The aim of this exercise is to provide students with a space to learn from others. This method increases students' understanding and improves conceptual reasoning and problem-solving skills [47].

Peer review is the activity in which the professor is asking students to read, evaluate, and provide constructive feedback on the work of their peers. The aim is for students to engage critically with the work of others and, in doing so, to develop a better understanding of a concept or recognize the gaps in their own knowledge or that of their peers. Peer reviews enable students to gauge or refine comprehension and enhance their ability to analyze, evaluate, and synthesize information [48].

Index Card Pass involve all students' participation. Students are divided into small groups. Each student will write down one question (related to the class) and pass it (online or physically) to another student. Students exchange cards (emails) making at least 4 passes. After that, each student will read the last card (email) received, within their group. The group will decide which question they want to address and then discuss possible answered to the question. This activity encourages students to verify their level of knowledge and at the same time their communication skills.

4.7. Design learning framework for online teaching

The present study presented a comprehensive analysis of how our students may remain focused and actively involved during the class and after. A variety of teaching techniques were also presented. However, a clear timeline related to all these changes' implementation needs it for sure in any higher education institution.

Contemporaneous higher education researchers [49] from Spain and Peru proposed also an ambitious plan for amending the on-campus teaching and learning to online mode. The timeline proposed (Figure 6) can be developed, but in the present research opinion the timing is too tight, having in a view that the whole study plan has to be adjusted to online mode, and professors, academic staff, and students have to get familiar with new technologies used and amended changes in their study plan (especially on teaching, assessments, and evaluation techniques).

An earlier study conducted by Delfino and Persico [50] presents also the need of improving teaching and learning techniques for online education but emphasize the highly flexible course design and a good balance and strict integration between traditional and online training techniques in the delivery of the course and in the assessment of trainees. The authors suggest integrating the online techniques of professor/instructor training program with the existed traditional one.

The present research agreed that has to be a timeline for implementing technical changes, however, program/course online development requires scheduling, organizing, budgeting and review/reporting, as well as goal and strategy setting and risk management. And more important is a course program review for the last minimum 2-3 academic years (which includes the pandemic times too) taking into consideration students, and professors' feedback [21].

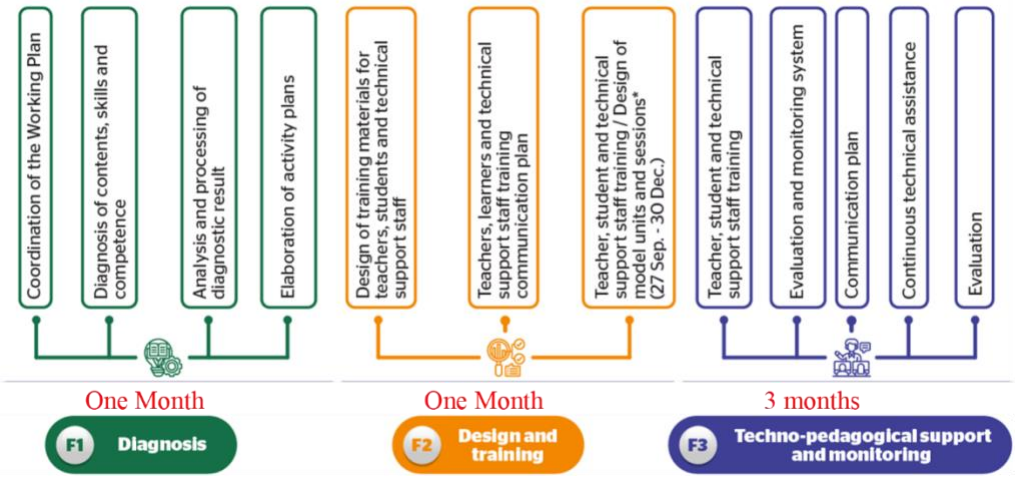

Fig. 6. Timeline to implement the technical changes for online teaching and learning delivery mode [48].

According to with European Commission Analytical Report, the majority of higher education institutions provide support to the teaching and learning process in the form of training and technical support. However, many universities have faced problems with their capacity for delivering online classes in terms of technology, tools, and adapting the curriculum and syllabus to online teaching and assessment mode. Therefore, innovative education techniques such as flipped classrooms, blended learning, adequate assessments with a clear lesson plan, and active teaching and learning techniques should be used to achieve the students' study plan. Mixed methods for teaching and research, together with quantitative data provide qualitative data which help achievements of finance and business administration knowledge and competencies [21]. However, while blended learning in higher education is valued for various reasons such as addressing students' needs for flexibility, blended learning implementation remains a challenging but achievable process for the next academic year [51, 52].

5. Conclusion

Actual movements in socio-economic life around the world impose e-learning and e-presence. Nevertheless, moving digital is more than online teaching, which is changing the environment [53-54]. This research offered an in-depth exploration of the most important dimensions of the teaching and learning techniques, maintaining students' attention and involvement, and challenges facing both, learners, and professors.

As technology continues to reshape industries including the education industry, curriculum, and teaching techniques are looking for ways of optimizing teaching, learning, and assessment. Keeping pace with large-scale digital transformation in a short period of time is challenging for both learners and professors alike. The challenge is not limited to maximizing results, meeting labor market demands for both knowledge, skills, and abilities, but it extends to mastering an entirely new set of technologies to effectively deliver instructions, knowledge, and ultimately competency. Challenges in the online education environment are still persisting and not fading away for both learners and educators. This is particularly true in the face of slow Internet and numerous parts of the world including the developed world as learners struggle to have access to Internet in many developing countries.

Starting from the students' needs and keeping in mind their level of knowledge, in a higher education institution, professors need to create a friendly learning environment in digital learning to be effective in building a rapport [21]. Effective assessment of the knowledge gap between experience, and knowledge of the instructor and students can make a difference in being effective in teaching and achieving learning outcomes.

Professors are encouraged to use different levels of formative assessment to measure students' progress towards learning outcomes. These formative assessments are related to how teachers assess whether their students have mastered content or skills or whether they need additional practice and support. The correct description of students' expectations at each assessment, accompanied by evaluations rubrics, as well as feedback after each assessment makes the learning process transparent, encourages the student to self-evaluate, and requires timely support, and certainly leads to increased academic performance. of the student.

There is something that all of us must not forget: education will always be the primordial need of the entire society. Education brought us and the technology where we are now. We need to continue to find new techniques to maintain a high level of education [16] for all of us in order to be able to face the rapid changes that occurred as a result of digitization and online remote learning and working. The digital age has come with a multitude of promises, in transforming the way people live today, from previous decades. Despite the inequalities in digital-initiated *equality*, developing education systems around the world are coming into contact with digital technology. The previous practice of pedagogues and students is challenged by the new age communication and the educational system based on digital technology [55]. This paper presented teaching techniques that can help overcome the crises that are still living in education by stimulating the active participation of students in the learning process. Now we are moving from traditional academic professors and students to *e*-academic professors and students who conduct all traditional academic activities via electronic means at a virtual higher education institute.

Using active learning and teaching techniques enables the professor to align the learning outcomes with a realistic case study, scenario, and the gap between the minds (professor and student) will be significantly reduced as the gap between theory and practice. However, each professor decides which active learning techniques will use. Nevertheless, the chosen techniques should be suited to the discipline and lesson; aligned with the learning outcomes; encourage all students' participation, collaboration, and critical thinking; allow and promote real-world experience, and be admit or be open to a variety of *correct* answers. Regardless the specialization, using visual, sound effect (cartoons, videos) and games for learning) will always attract students' attention and will help them to understand better the context of the lesson.

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References

1. Mishra, L., Gupta, T., Shree, A.: Online teaching-learning in higher education during lockdown period of COVID-19 pandemic / International Journal of Educational Research Open, 1, pp. 100012 (2020).

2. Ghory, S., Hamayoon, G.: The impact of modern technology in the teaching and learning process / International Journal of Innovative Research and Scientific Studies 4(3), pp. 168-173 (2021).
3. Moşteanu, N.R.: Digital University Campus–Change the Education System Approach To Meet The 21st Century Needs / European Journal of Human Resource Management Studies, 4(4), pp. 79-93 (2020).
4. Lodge, J. M.: Online Education by Design: Using Evidence and Course Analytics to Achieve Best Online Teaching and Learning Practice / Tertiary Online Teaching and Learning, pp. 3-11. Springer, Singapore (2020).
5. Al-Rawi, I.: Teaching methodology and its effects on quality learning / Journal of Education and Practice, 4(6), pp. 100-105 (2013).
6. Zeliff, N., Schultz, K.: Authentic assessment in action: Preparing for the business workplace / Delta Pi Epsilon (1998).
7. Robles, M., Braathen, S.: Online assessment techniques / Delta Pi Epsilon Journal, 44(1), pp. 39-49 (2002).
8. Conrad, D.: University instructors' reflections on their first online teaching experiences/ Journal of Asynchronous Learning Networks, 8(2), pp. 31-44 (2004).
9. Gold, S.: A constructivist approach to online training for online teachers / Journal of Asynchronous Learning Networks, 5(1), pp. 35-57 (2001).
10. Lewis, C.C., Abdul-Hamid, H.: Implementing effective online teaching practices: Voices of exemplary faculty / Innovative Higher Education, 31(2), pp. 83-98, (2006).
11. Zapalska, A., Brozik, D.: Learning styles and online education / The International Journal of Information and Learning Technology, 24(1), pp. 6 (2007).
12. Hung, J.L., Zhang, K.: Revealing online learning behaviors and activity patterns and making predictions with data mining techniques in online teaching / MERLOT Journal of Online Learning and Teaching (2008).
13. Wang, H., Cao, C., Guan, N., Huang, Z.: Evaluation System Design for Application of Innovative Teaching Methods in Major of Construction Management: Case Study in a University of Finance and Economics / Proceedings of ICCREM 2018: Construction Enterprises and Project Management, pp. 157-166. Reston, VA: American Society of Civil Engineers (2018).
14. Moşteanu, N.R.: International Financial Markets face to face with Artificial Intelligence and Digital Era / Theoretical & Applied Economics, 26(3), pp. 123-133 (2019).
15. Moşteanu, N.R., Faccia, A., Cavaliere, L.P.L., Bhatia, S.: Digital technologies' implementation within financial and banking system during socio distancing restrictions–back to the future / International Journal of Advanced Research in Engineering and Technology, 11(6), pp. 307-315 (2020).
16. Moşteanu, N.R.: Education, qualification awareness and social civism to build and sustain a healthy and developed society / Proceedings of 28th European Biomass Conference & Exhibition (EUBCE), Marseille, pp. 6-7 (2020).
17. Jiao, Y., Li, X., Zeng, R.: Finance Course Reform Exploring Based on Financial Technique Background / DEStech Transactions on Social Science, Education and Human Science, (mess) (2019).
18. Anthony, B., Kamaludin, A., Romli, A., Raffei, A.F.M., Phon, D.N.A.E., Abdullah, A., Ming, G.L.: Blended learning adoption and implementation in higher education: a theoretical and systematic review / Technology, Knowledge and Learning, pp. 1-48 (2020).
19. Márquez-Ramos, L.: Does digitalization in higher education help to bridge the gap between academia and industry? An application to COVID-19 / Industry and Higher Education, 0950422221989190, (2021).
20. Yeigh, T., Lynch, D.: Is online teaching and learning here to stay? / Academia Letters, 2, (2020).
21. Moşteanu, N.R. Digitalization and Backward Design take the finance teaching techniques and study plan strategy one step further. J. Digit. Art Humanit., **2**(2), 22-32. (2021). https://doi.org/10.33847/2712-8148.2.2_2
22. Chetty, L: Innovative interpretive qualitative case study research method aligned with systems theory for physiotherapy and rehabilitation research: A review of the methodology / African Journal of Physiotherapy and Rehabilitation Sciences, 5(1-2), pp. 40-44 (2013).
23. Angen, M.: Evaluating interpretive inquiry: Reviewing the validity debate and opening the dialogue / Qualitative Health Research, 10(3), pp. 378-395 (2020).
24. Denzin, N.K., Lincoln, Y.S.: Introduction: The discipline and practice of qualitative research, 3, (2008).

25. URL: https://bokcenter.harvard.edu/how-memory-works#main-content, last accessed 2021/09/12.
26. Brown, P.C., Roediger, H.L., McDaniel, M.A.: *Make it stick: The science of successful learning* / Cambridge, MA: Harvard University Press (2014).
27. Roediger, H.L., McDermott, K.B.: Creating false memories: Remembering words not presented in lists / *Journal of Experimental Psychology: Learning, Memory, and Cognition,* 21(4), pp. 803 (1995).
28. Epley, N., Waytz, A.: Mind perception (2010).
29. Gray, K., Young, L., Waytz, A.: Mind perception is the essence of morality / Psychological inquiry, 23(2), pp. 101-124 (2012).
30. Birch, S.A., Bloom, P.: The curse of knowledge in reasoning about false beliefs, Psychological Science, 18(5), pp. 382-386 (2007).
31. Nickerson, R.S.: How we know—and sometimes misjudge—what others know: Imputing one's own knowledge to others / Psychological bulletin, 125(6), pp. 737 (1999).
32. Nickerson, R.S.: The projective way of knowing: A useful heuristic that sometimes misleads / Current Directions in Psychological Science, 10(5), pp. 168-172 (2001).
33. Pohl, R.F., Erdfelder, E.: Hindsight bias / Psychology Press, pp. 434-455 (2016).
34. Bain, K.: What the best college teachers do / Harvard University Press (2004).
35. Weissenborn, R., Duka, T.: State-dependent effects of alcohol on explicit memory: The role of semantic associations / *Psychopharmacology*, 149(1), pp. 98-106 (2000).
36. Hullman, J., Kay, M., Kim, Y.S., Shrestha, S.: Imagining replications: Graphical prediction & discrete visualizations improve recall & estimation of effect uncertainty / IEEE transactions on visualization and computer graphics, 24(1), pp. 446-456 (2017).
37. Gobet, F., Lane, P.C., Croker, S., Cheng, P.C., Jones, G., Oliver, I., Pine, J.M.: Chunking mechanisms in human learning / *Trends in Cognitive Sciences,* 5(6), pp. 236-243 (2001).
38. Lipko, A.R., Dunlosky, J., Hartwig, M.K., Rawson, K.A., Swan, K., Cook, D.: Using standards to improve middle school students' accuracy at evaluating the quality of their recall / Journal of Experimental Psychology: Applied, 15(4), pp. 307 (2009).
39. Rose, D., Harbour, W., Johnston, C.S., Daley, S., Abarbanell, L.: Universal design for learning in postsecondary education: Reflections on principles and their application / *Journal of Postsecondary Education and Disability,* 19(2), pp. 1-27 (2006).
40. URL:http://projectalien.eu/wp-content/uploads/2019/04/ALIEN-D2.1-Institutional-Strategy.pdf, last accessed 2021/10/09.
41. URL:https://www.queensu.ca/teachingandlearning/modules/active/12_exmples_of_active_learning_activities.html 2021, last accessed 2021/10/09
42. URL:https://intranet.ecu.edu.au/learning/curriculum-design/teaching-strategies/discussion-and-debate , last accessed
43. Green, C.S., Klug, H.G.: Teaching critical thinking and writing through debates: An experimental evaluation / *Teaching Sociology,* 18, pp. 462-471 (1990).
44. Diamond, M.J.: Improving the undergraduate lecture class by use of student-led discussion groups / *American Psychologist, 27(10),* pp. 978 (1972).
45. Rao, D., Stupans, I.: Exploring the potential of role play in higher education: development of a typology and teacher guidelines, *Innovations in Education and Teaching International,* 49(4), pp. 427-436 (2012).
46. Prensky, M.: The motivation of gameplay or, the real 21st century learning revolution / *The Horizon, 10(1)*, pp. 1-14 (2002).
47. Crouch, C.H., Mazur, E.: Peer instruction: ten years of experience and results / *American Association of Physics Teachers*, 69(9), pp. 970-977 (2001).
48. Sadler, P.M., Good, E.: The impact of self- and peer-grading on student learning / *Educational Assessment*, 11(1), pp. 1-31 (2006).
49. Martín-Cuadrado, A.M., Lavandera-Ponce, S., Mora-Jaureguialde, B., Sánchez-Romero, C., Pérez-Sánchez, L.: Working Methodology with Public Universities in Peru during the Pandemic—Continuity of Virtual/Online Teaching and Learning / Education Sciences, 11(7), pp. 351 (2001).
50. Delfino, M., Persico, D.: Online or face-to-face? Experimenting with different techniques in teacher training / Journal of Computer Assisted Learning, 23(5), pp. 351-365 (2007).
51. Bruggeman, B., Tondeur, J., Struyven, K., Pynoo, B., Garone, A., Vanslambrouck, S.: Experts speaking: Crucial teacher attributes for implementing blended learning in higher education / The Internet and Higher Education, 48, pp. 100772 (2021).
52. Singh, H.: Building effective blended learning programs / Challenges and Opportunities for the Global Implementation of E-Learning Frameworks, IGI Global, pp. 15-23 (2021).

53. Moşteanu, N.R.: Digital Campus–a future former investment in education for a sustainable society / International Conference on Innovation, Modern Applied Science & Environmental Studies - E3S Web of Conferences, EDP Sciences, 234, pp. 00029 (2021).
54. Moşteanu, N.R.: Assessment of teaching and learning techniques for online environment. How to maintain students' attention and achieve course learning outcomes in a virtual environment using new technology. *International Journal of Innovative Research and Scientific Studies*. Forthcoming December 2021
55. Al-Zaman, M.S.: Digitalization and transformation of teaching and learning in Bangladesh / In Challenges and Opportunities in Global Approaches to Education, IGI Global, pp. 56-77 (2020).

The effects of different genres of music on passersby

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Abstract. Music preferences reflect both experience and societal or cultural influences. The characteristics of the music genre include both structural style and societal connotations. This study investigated reactions to different types of music. The behavior of passersby was observed as music from two stereotypically "opposite" genres, hip-hop and classical, was played by the researcher while jogging past them. It was hypothesized that due to societal stereotypes and reputations of these genres' participants would react negatively toward hip-hop and favorably toward classical. As the study was conducted, participants were observed during six different outings over a three-week period. The researcher jogged at the same time of day and over the same route with either hip-hop or classical music playing. Passersby were observed on their facial expressions, any changes in behavior, and their body language to determine their overall reaction to the music, as being "positive", "negative", or "neutral." The results indicate that older passersby responded negatively to hip-hop and positively to classical music. Younger age groups often had opposite reactions. This study provides insight into different populations' responses to opposite genres of music and how societal stereotypes may have affected these responses.

Key words: music, genre, hip-hop, rap, classical, preference, digital music, community-based, outdoor venue.

1. Introduction

Music is an abstract art form that draws upon the ideals and feelings of the artist to elicit strong and powerful emotions in the listener. Throughout history, music has constantly been altered and shifted based on the cultures and traditions prevalent and popular during various time periods. The most popular type of music usually changes every decade, and the perspectives about these genres also often change, creating distinct viewpoints about the genre. Currently, hip-hop is considered the most dominant genre [1].

Over the years, hip-hop has gained a negative reputation, cited as being loud and associated with acts of violence and anger [2]. These beliefs most likely stem from the emergence of hip-hop. Originating in largely African-American and Latino communities, hip-hop evolved from the cultural traditions of these ethnic groups [3]. Jamaican Reggae music, for example, affected the genre, especially in the emphasis both hip-hop and reggae place on drums and percussion. These communities used this form of music as a way to blend their traditional cultures with their new lifestyles. However, many of these neighborhoods were impoverished [3,4], and this poverty, combined with the anger about the injustice they perceived when compared to white communities, often led to crime and violence. As hip-hop grew, the music came to be associated with these activities [3].

Many people continue to view hip-hop as an embodiment of these negative activities even though hip-hop has come to transcend its "gang culture" origins. An important distinction to make is the difference between hip-hop and rap. Hip-hop is the broad genre of music that contains rap, which consists of often fast-paced lyrics

in a staccato rhythm and rhyme scheme. Since rap is a major part of hip-hop, both have identical societal connotations and stereotypes that allow a focus on hip-hop's origins and its stereotypes.

Elements of rap lyrics, such as aggressiveness, sexual misconduct, and violence, may suggest that the musicians and listeners' characters are represented by the lyrics [2,4]. Although these negative connotations are heard in a large majority of hip-hop, the issue lies in the stereotyping of individuals involved in this genre of music, causing many to be unable to separate an art form from the personalities of the artists and audience. The process of making the music may also have a role in its reception, as hip-hop music tends to be made more digitally, using digital synthesizers and effects on a computer, such as autotune, giving it a more artificial, yet modern feel. However, genres, such as classical music, employ strictly tangible, "real" instruments, with little digital musicality, promoting a more authentic sound. Furthermore, stereotyping does not exist solely in hip-hop, as many associate pop music with conformism and a struggle with acceptance, while heavy metal is said to reflect depression, self-harm, and suicidal ideation [2].

Undoubtedly, these stereotypes common in modern society are detrimental to overall attitudes toward music. In recent years, despite the large amount of music available digitally, many listeners limit themselves to two or three genres and have become "unable to tolerate music outside their preferred taste" [5]. Societal identities associated with certain genres have been cited to even impact the way people listen to music; specifically, some people tend to prefer classical because it's associated with intelligence, or rock music because they wish to rebel against the system [2].

The aim of this research was to analyze responses to contrasting genres of music. By conducting this study in real time, the researcher hoped to accurately analyze the responses to vastly contrasting genres when the participants heard the music. The participants had a wide age range, and the genres used—hip-hop (rap) and classical—are considered to have opposite emotions associated with each. The study hoped to determine if presumed stereotypes connected with music types affected participants' responses and behaviors, and if so, how large were these effects.

2. Methods and Data

The research was an observational, qualitative study that examined the reactions of visitors to a local park to contrasting genres of music (Fig.1). The study took place over a three-week period in November 2020 in a neighborhood located southwest of Houston, TX. As the researcher, a 17-year-old male of South Asian descent, jogged around the neighborhood, he played two distinct genres of music out loud: hip-hop and classical orchestral music. Passersby were observed on how they reacted to the music from their facial expressions, changes in behaviors, and body language.

The study was conducted six times over a three-week period on various days of the week between 4:30 and 5:30 p.m. Each type of music, hip-hop and classical music, was played for thirty minutes at a time and the time slot in which they were played was changed each outing to eliminate any bias. For example, if hip-hop were played from 4:30 to 5:00 and classical from 5:00 to 5:30 one day, the next day classical would be played from 4:30 to 5:00 and hip-hop from 5:00 to 5:30. The researcher took the same route each outing to eliminate any discrepancies, and this path included the busiest areas of the neighborhood and the trail around the neighborhood lake (Figure). The route was also chosen so that the researcher could complete two rounds of the path in around thirty minutes, so the distance travelled for both genres of music was the same. Each subject was encountered only once; all encounters included music.

Fig. 1. Jogging route taken by the researcher during study.
Source: the authors' creation using Google maps (https://maps.google.com)

The genres of music chosen were hip-hop and classical due to their contrasting stereotypes and overall societal reputations [2]. However, a distinction had to be made when choosing the specific songs, since both of these genres cover such a vast variety of music. The hip-hop songs chosen was mostly "old-school" type of rap, a subgenre that focuses on lyricism and is more known for its "rapping" (rhythmic talking) when compared to melodic and trap rap that have elements of singing and pop woven in. This rap subgenre is more associated with the aggressive and "grimy" connotation stereotypically given to hip-hop, while the latter subgenres may be confused with pop music and were not used as often as they could change the reactions of the participants. Similarly, the classical music used was chosen for its calm atmosphere as well as its orchestral distinction that is usually associated with orchestral music, such as baroque music [6]. The researcher did not use modern orchestral music such as movie soundtracks due to other musical genres' potential influence. The researcher played the music through a digital format, using the music software Spotify (https://www.spotify.com) and YouTube (https://youtube.com) to access the songs. Finally, the volume of the music was kept around the same for both genres at a decibel level of 100 to 115 (a leaf blower operates at around 115 decibels).

The data for this study were collected during each outing. As the researcher jogged by, he took note of the estimated age and ethnicity of the participants as well as their facial expressions, body language, and any changes in behavior, specifically movements. The researcher broke down each passerby interaction with the music as positive, negative, or neutral using uniform criteria, e.g., smiling and eye contact would be a positive response, no eye contact or no change would be a neutral response, and unfriendly body language and frowns would be a negative response. Additional observations included whether the bystanders moved to the side, stopped, or continued walking, and if they moved to the side, how far and how fast. Their facial expressions were also considered, recording movements and variances in their eyebrows, mouths, and noses to gauge their emotions [7]. The researcher attempted to make eye contact to better observe the facial readings of the participants and to keep observation consistent. Last, any change in body language was noted, such as

holding their children tighter or crossing their arms [8]. One important characteristic of body language is positioning; an inviting and open person will often point his or her body and feet toward the other person, while someone more closed will tend to point away [8]. These methods were used to effectively allow the researcher to draw educated guesses about the participants' true reactions to the different genres of music.

The differences between gender, age groups, and ethnic/racial groups were analyzed using Fisher exact tests. P values ≤ to 0.05 were considered statistically significant.

3. Results

This study included 39 subjects (22 males and 17 females). The estimated ages included 18 subjects less than 40 years old and 21 subjects older than 40 years. The ethnicities are reported in the Table. Nine passersby had positive responses to music, 13 passersby had neutral responses, and 17 passersby had negative responses.

The response to classical music differed significantly between men and women (p=0.0162) (Table 1). About 41.7% men had a positive response to classical music; 0% of women had a positive response (p=0.040). The response to classical music differed significantly between passersby < 40 and those ≥ 40 years old. About 41.7% of those ≥ 40 years old had a positive response, while 0% of those < 40 years old had a positive response (p=0.001). In addition, people from different ethnic groups differed significantly in response to classical music (p=0.002). For example, people from South Asia differed significantly from those in the other groups (p=0.005), and only about 6.7% of the people from South Asia had a positive response, while the percentage was 57.1% for the other groups combined (p=0.021). There was no evidence that the response to hip-hop (rap) music differed among the age, gender, and ethnicity groups. Table 1 summarizes the responses to classical music and hip-hop music. There are significant differences within the subgroups to classical music but not to hip-hop music.

Table 1. Responses to classical music and hip-hop music

	Classical music responses				**Hip-hop music responses**			
	Positive	Neutral	Negative	P value	Positive	Neutral	Negative	P value
Gender								
Male	5	5	2	0.0162	4	1	5	0.074
Female	0	3	7		0	4	3	
Age								
<40	0	2	8	0.001	3	1	4	0.320
≥40	5	6	1		1	4	4	
Ethnicity								
Caucasian	2	0	0		0	0	1	
African-American	1	0	0	0.002	1	0	0	0.337
South Asian	1	5	9		0	3	3	
East Asian	1	3	0		3	2	4	

Source: Self-development by the authors.

Tables 2 and 3 include more information about individual responses to hearing music in the park. For example, two separate passersby stared at the researcher for a considerable amount of time with a look of wonder, often smiling, when they heard the classical music.

Table 2. Results when hip-hop music played

Description of participant	Changes in behaviors and movements	Facial expressions	Body language	Other factors
40-50-year-old woman of South-Asian descent	Kept walking straight; did not change pace or move	Put head down, avoided eye contact	No significant change in body language	--
30-40-year-old man of African-American descent	Moved to the side, but this can be attributed to the two dogs he was walking	Made eye contact, smiled	No significant change in body language	Was walking two large dogs
20-30-year-old East Asian couple	Moved to other side of the street when researcher approached; after the researcher also crossed the street, the couple once again crossed back	Did not make eye contact	Walked faster	Wearing masks, avoidance could be attributed to COVID-related fears
40-50-year-old woman of South-Asian descent	No significant change	Made eye contact, smiled	No significant change	--
40-50-year-old East-Asian man	No significant change	Glaring eyes	Hands behind his back, uninviting demeanor	--
Mother (40) and daughter (15-18) of South-Asian descent	Stopped walking, moved to the side	Avoided eye contact, no other change	Body language signified avoidance, faced away from researcher	The pair stopped walking and gave way to the researcher around 10 yards in advance
7-12-year-old East-Asian males (2)	Stopped their activity- basketball	Intrigued, curious; staring, open mouths	Stopped activity, but otherwise no significant change	Were playing basketball in their driveway
40-50-year-old woman of East-Asian descent	No significant change	No eye contact, kept looking straight	No significant change	--
40-50-year-old woman of South-Asian descent	No significant change	No significant change (Was looking down before, continued to do so)	No significant change	--
60-70-year-old man of East-Asian descent	Slowed down walking	Made eye contact, smiled	Body language seemed friendlier than most participants, opened up to the researcher	Used a cane and consistently stopped when walking
30-40-year-old Caucasian man	No significant change	Made eye contact, and smile, but very briefly	Unfriendly body language,	Seemed to be in a rush
40-50-year-old South-Asian man	Turned away and moved away from researcher	Disgusted: scowl, wrinkled nose	Crossed arms	Not on the sidewalk, but in his yard with his family (wife, elderly woman, and three children) nearby
40-50-year-old East-Asian man	Slowed down walking	Glaring eyes, frown; continued to stare at researcher after he passed	Unfriendly, pointed away	--
14-18-year-old East-Asian male	No significant change	Brief eye contact	No significant change	Riding electric scooter

Table 2 reports the responses to hearing hip-hop music.

Table 3. Results when classical music was played

Description of Participant	Changes in behaviors/ movements	Facial Expressions	Body language	Other factors
40-50-year-old East-Asian woman	No significant change	Looked down	No significant change	-
40-50-year-old woman with daughter (15-18), South-Asian	Walked closer together, moved to the side	Looked away	Uninviting body language, turned away	-
60-70-year-old man of South-Asian descent	Walked faster	Made eye contact, smiled	No significant change	-
50-60-year-old Caucasian man	Waved	Smiled, made eye contact	Open, friendly body language, waved, positioned towards researcher	Walking small dog
40-50-year-old East-Asian man	Stopped activity (watering plants)	Stared, but facial expressions showed surprise/awe	No significant change	Was watering plants in his garden, stopped as researcher ran by
13-20-year-old South-Asian male group around (5)	Did not move at all, taking up entire sidewalk	Condescending demeanor: smirks, stares, laughter once researcher passed	Seemed to have more confident/ arrogant body language: louder, puffed up chest, appeared bigger	--
40-50-year-old South-Asian man	No significant change	No eye contact, or smile	No significant change	Was putting up Christmas decorations
40-50-year-old Caucasian man	Abruptly halted walking	Stared, but facial expressions showed surprise/awe: grinning, made eye contact, smiled	Continued to stare after researcher had passed	--
60-70-year-old African-American Man	No significant change	Smiled, made eye contact, friendly	Open and inviting	Spoke to researcher, "Hi, how are you doing"
40-50-year-old South-Asian woman	Moved to the side	Avoided eye contact, kept talking	No significant change	--
2 40-50-year-old South-Asian men	Moved off the sidewalk to the road	Made eye contact, did not smile	Were not friendly, but also were not rude	--
7-12-year-old East-Asian males (2)	No significant change	No significant change	No significant change	Were riding bikes
30-40-year-old South-Asian man	Moved closer to children, more wary of kids	Smiled, made eye contact	Closed, uninviting body language, but did not seem rude	With wife and 2 children
40-50-year-old woman of South-Asian descent	Walked faster	Put head down, avoiding eye contact	No significant change	--
15-18-year-old South-Asian male	Walked by faster	No eye contact, condescending/snotty facial expression: smirk, slightly squinted eyebrows	No significant change	Using phone

Source: Self-development by the authors.

Table 3 reports the responses to hearing classical music.

4. Discussion

This study included 39 individuals who unexpectedly heard loud music when visiting a local park. These individuals were characterized by gender, estimated age, and assumed ethnicity. They were exposed to either classical music or rap music, and the responses were rated as positive, neutral, or negative. Men and older individuals had positive responses to classical music. South Asian individuals had negative responses to classical music. There was no statistically significant pattern of response to rap music when analyzed by gender, age, or ethnicity. The researcher's hypothesis that rap would elicit more negative responses and classical music more positive responses seemed to hold fairly true for older passersby but not for younger passersby. These contrasting results can best be explained by the time period in which each generation grew up. The music people listen to in their adolescent years probably affects their music tastes throughout life [5]. The younger passersby had very likely grown up with this rap music and were unaffected and even enjoyed it, but they stereotyped classical music as boring and uninteresting [2]. Although the older passersby did not necessarily grow up with classical music, the music of the 70s and 80s more closely resembles this music, and these individuals often have negative reactions to modern rap's vulgarity [2].

The ethnicities of the passersby may have had a significant role in the interpretation of music. The majority of participants were Asian, but the responses to music were not uniform in these 2 groups. The sample size for African-Americans and Caucasians was small, but most of these individuals seemed to have positive responses. In fact, these ethnic groups had the most amicable reactions with one man waving and another talking to the researcher. None of the other participants portrayed this sense of comfort and friendliness to the researcher.

Examining the demographics of the passersby who reacted to the music, there were clear differences in ethnicity. The most common ethnicity was South-Asian, described primarily as people from India, Sri Lanka, Nepal, Afghanistan, Pakistan, Bhutan, Myanmar, and Bangladesh. The second largest ethnic group was East Asian--China, Mongolia, North and South Korea, Japan and Taiwan. The preponderance of Asians as compared to the number of Caucasian and African-American participants can be attributed to the locality and neighborhood. This area southwest of Houston is quite diverse. The local high school demographics skews 42% Asian students with 21% White students [9].

This difference in neighborhood ethnicity may have altered the results of the study. The Caucasian and African-American participants seemed to have overall more positive responses, and the large majority of Asians may have contributed to the large number of negative and neutral responses seen in the study. This could be because hip-hop/rap originated in America and in countries with a large African population, such as Jamaica, and is widely appreciated in North America. However, this genre has only recently been gaining popularity in Eastern countries, such as India, China, and South Korea. It is still not accepted nor appreciated completely in these countries, potentially contributing to the negative connotation associated with it [10].

Other studies have used somewhat similar methods to investigate responses to music. Susino and Schubert at the University of New South Wales in Sydney (UNSW), Australia, studied emotional responses to genres commonly associated with negative emotions, specifically heavy metal and hip-hop [11]. Their study monitored the emotional responses of 238 participants as the researchers played 8 different excerpts of heavy metal, hip-hop, and a control genre, pop. The participants responded to hip-hop and heavy metal vastly differently from pop, claiming that the former genres incited feelings of anger and disgust while the latter induced happiness as well as sadness [11]. This study used pop music as a control to contrast with hip-hop and heavy metal music; however, pop as a genre itself has similarities to hip-hop,

especially for older adults, thus this comparison may not provide an adequate control for comparing the responses to the music [2]. In addition, the participants in the study were all students of UNSW, resulting in a narrow age range that could possibly skew the data. Last, the participants were not observed or tested in real time; participants reported their own emotional responses, which could be subject to bias, and reported these responses "on their own time" after the music was listened to, creating results that may not be completely accurate [11].

This study demonstrates that ethnicity has a very clear association with music preference. The most obvious explanation for this involves a cultural background of ethnic groups. When individuals have a limited acquaintance with a particular music genre, their attitudes are likely neutral at best. However, if the music genre is associated with certain social activities, then the individual may have a stereotypical uninformed response to the music. These differences in attitude and understanding lead to important social questions.

Rabinowitch and others have discussed the potential for music to effect social change [12]. He notes that music and language co-evolved as methods to communicate emotionally and provide a foundation for social interaction. In addition, he notes that music is often used to resolve conflicts. Consequently, he suggested that groups and communities should use music as a basis to improve social interaction and consequently social cohesiveness. Various approaches to this process could include community events in which music is played and discussed and community events in which participants dance and or create music. The evolution of digital technology has provided excellent methods for processing and storing music; digital devices are extremely convenient for use in social activities, educational programs, and research projects.

This small project demonstrates that there are easily available opportunities to use music as a vehicle for social change. Reactions to rap music and classical music fell into predictable categories based on age: older passersby favored classical music while younger participants reacted positively to rap music. In this case, music served to divide a community rather than providing a shared experience. Constantin Koopman of the Amsterdam School of the Arts suggests (2007) a program of "community music" designed to educate a diverse population on a variety of musical genres [13]. He maintains that community music provides a collective experience, promotes the wellbeing of participants, and allows for personal growth. Koopman points out that although many people in a community may not have experience in music-making, programs and activities can be tailored to appeal to a diverse population. He insists that there is a direct connection between musical values and individual and social development, "Social skills can increase as people collectively collaborate in challenging musical environments…there will be much interaction, exchange of ideas and experiences, [and] substantial and ongoing discussion" [13].

The potential value of music as a method to establish social connections has been considered in film and in literature. "The Visitor", an award-winning movie starring Richard Jenkins (2007), illustrates the effect community-based music has on an introverted professor. Walter Vale is a White, middle-aged widower who teaches in a small college in Connecticut while maintaining an apartment in New York City. Scheduled to speak at a conference in the city, he discovers that his apartment has been clandestinely rented to an immigrant couple. Tarek, a drummer from Syria, and his girlfriend Zaineb, a jewelry designer from Senegal, are in the United States illegally and are understandably concerned that they will be turned over to the police. Walter, however, invites them to stay, at least temporarily. Although from diverse backgrounds, the three settle into an amiable friendship. Tarek teaches Walter to play the drums; they join a multicultural "drum circle" in Central Park where Walter discovers joy in the kind of collective music-making Koopman promotes.

Alexander McCall Smith presents a similar experience in his novel La's Orchestra Saves the World (2008). Lavender moves to rural Suffolk to escape the London Blitz but feels unmoored and isolated within her new locale. Her love of music prompts her to organize a community orchestra, bringing together young and old, men and women, from not only her small village but also from several surrounding farms and a nearby military base. "Music was her refuge. There was madness abroad…Reason, beauty, harmony: these were ultimately more real and powerful than any of the demons unleashed by dictators." [14]. She reassures reluctant participants that "Nobody in this one will be any good" and scrounges for instruments. Eventually the motley group gives concerts, prompting a reviewer to gush, "They may be amateurs, but they are determined. And what spirit they have!" [14]. After Victory in Europe Day, La and her orchestra play a Victory Concert to commemorate not only the end of WWII but also to remember the various orchestra members who lost their lives in combat. Years later, one former member tells her that her orchestra "saved the world" by bringing hope and comfort to a community under duress. As Koopman maintains, "…a group of community musicians is more than the sum of the individuals taking part." [13].

5. Limitations

Due to COVID-19 restrictions as well as a lack of resources available to the researcher, only one neighborhood was studied. While this does produce data pertinent to the community and surrounding localities, the results may not reflect human reactions to various genres of music as a whole.

One major shortcoming was the small sample size of participants. Due to the pandemic, the multiple outings by the researcher resulted in only 39 encounters total. The number of people walking outside was lower than normal, and the dropping temperature (the average high was 73ºF, the average low was 62ºF) further contributed to fewer passersby. A larger sample size would have increased confidence and accuracy in the results. Furthermore, the social distancing standards during the pandemic may have also had led to some misrepresentation in the data. A few of the observations showed participants clearly avoiding the researcher multiple times, as in the "young East-Asian couple" in the supplementary tables. Although their avoidance action was interpreted as an adverse reaction to the music, this may have been a precautionary measure taken due to the pandemic.

The timeframe for study observations may have affected the research. The researcher was jogging, and crossing of the paths between the researcher and the participant happened for a few seconds, which may not be enough time for all participants to accurately assess the music and react to it. Furthermore, the participants were not informed about this study to prevent priming of any stereotypes, so many "neutral cases" may have been the participant ignoring the music, or, once again, not completely registering the genre and effectively reacting to it. Another factor that could have affected the research is the researcher himself, a 17-year-old South Asian male. This could have affected the ways in which passersby reacted. The aggressiveness and violence of rap music has a stronger connection to teenage and young adult males more so than to females, potentially contributing to the reactions observed. The responses may have been different if the researcher had been a female or an older male.

6. Conclusions

This study demonstrates the effect that different music genres can have on the public and identifies diversity in music preference. Furthermore, a fundamental result

was the often-contrasting reactions from different age groups. This creates more discussions on how the culture of the participants and the music popular during their adolescence can affect their tastes and reactions to music [5]. The specific differences in various ethnic groups pose intriguing questions about how background and childhood experiences can impact reactions to different music genres.

The study provides a simple approach for identifying music preferences and community perception of music and how culture can affect discernment. Music preferences, in part, reflect cultural diversity, and organizing community events to hear and discuss different music genres could provide an approach to better understand cultural diversity and improve social interactions.

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References

1. Milano, B.: What Did 2010s Music Do For Us? Behind A Transformative Decade. UDiscover Music. (2019, December 6). www.udiscovermusic.com/stories/2010s-music-history/
2. Horning, R.: Stereotyping Musical Genres. PopMatters. (2018, February 25). www.popmatters.com/stereotyping-musical-genres-2496131174.html
3. Milliman, H.: The Complete History of Hip Hop. PrepScholar. (2019, May 9). blog.prepscholar.com/hip-hop-history-timeline
4. Gross, T.: A 'Forgotten History' Of How The U.S. Government Segregated America. NPR. (2017, May 3). www.npr.org/2017/05/03/526655831/a-forgotten-history-of-how-the-u-s-government-segregated-america
5. Pauley, A.: Why Are People so Judgmental About Music Taste? (2018, December 13). Achona. www.achonaonline.com/features/2018/12/why-are-people-so-judgmental-about-music-taste/
6. Michelle, L.: The Evolution of Classical Music: A Brief Overview. Medium, Mozart For Muggles. (2016, May1). www.medium.com/mozart-for-muggles/the-evolution-of-classical-music-a-brief-overview-d15b009c7b0
7. Hung, D., Kim, H.: Project Deidre (II). Animating Human Facial Expressions. Cornell University. (1996, April 20). people.ece.cornell.edu/land/OldStudentProjects/cs490-95to96/HJKIM/deidreII.html.
8. Cherry, K.: How to Read Body Language and Facial Expressions. Very Well Mind. (2019, September 28). www.verywellmind.com/understand-body-language-and-facial-expressions-4147228.
9. U.S. News & World Report. How Does Stephen F. Austin High School Rank Among America's Best High Schools?. www.usnews.com/education/best-high-schools/texas/districts/fort-bend-independent-school-district/stephen-f-austin-high-school-19066.
10. Osumare, H.: Beat Streets in the Global Hood: Connective Marginalities of the Hip Hop Globe. Journal of American & Comparative Cultures. 24(1-2), 171–181 (2001).
11. Susino, M., Schubert, E.: Negative Emotion Responses to Heavy-Metal and Hip-Hop Music with Positive Lyrics. Empirical Musicology Review. 14(1-2) (2019). www.emusicology.org/article/view/6376/5447
12. Rabinowitch, T.C.: The Potential of Music to Effect Social Change. Music and Science. 3, 1-6, (2020). https://doi.org/10.1177/2059204320939772
13.Koopman, C.: Community music as music education: on the educational potential of community music. International Journal of Music Education. 25(2), 151-163 (2007). https://doi.org/10.1177/0255761407079951
14. Smith, M, A.: LA's Orchestra Saves the World. Anchor Books (2008).
https://doi.org/10.1111/j.1537-4726.2001.2401_171.x.

Existing in Etherium: The autographic ontology of the non-fungible token artwork

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Abstract. This paper examines the concept that legitimate autographic identity may be granted to digital images created as a non-fungible token (NFT). The blockchain technology coded permanently into minted NFT's keep track of the legitimacy of authorship and ownership, keeping them from being duplicated and removing them from the realm of allographic art. Questions arise of what 'legitimacy' and 'ownership' for a digital image—which are so easily reproduced and circulated—even look like. The main question that must be answered is whether the backend coding of a digital file is sufficient to alter its ontology into a token of one-of-a-kind autographic work, or if it only what is visible to the viewer of the image matters for its replicability and allographic ontological nature.

Keywords: Digital art, non-fungible token, blockchain technology, digital image, authorship, ownership, crypto art, digital artwork, allographic.

1. Introduction

The idea of authorship and ownership has been an important subject of discourse in the world of art and aesthetic theory for centuries, complicated by the introduction of the printing press and the ability to recreate two dimensional images with precision, ease, and anonymity. The creation of digital images further complicates this idea in several ways. A piece of digital art is immaterial, existing in an entirely different phenomenological realm than its creator or owner, creating a separation that is further distanced by the digital piece's complete and irreversible release into the realm of the 'world wide web' (www). Furthermore, a piece of digital art, like anything that can appear on a screen, exists as code and corresponding visual components made up of pixels or 'bits.' These can be copied, pasted, and 'owned'—or at least displayed—on any screen, to anyone with access, typically free of charge. These copies being visually indistinguishable and unable to be 'forged' (each copy is just as legitimate as the last) puts digital artwork into the allographic classification. However, given the recent attention to the apparent monetary value of certain digital works, it seems legitimate to question what exactly makes one iteration of potentially infinite digital copies special, meriting true transactions of valuable capital between artist and owner. In this paper, I will argue that legitimate autographic identity may be granted to digital images created as a non-fungible token (NFT). The block-chain technology coded permanently into minted NFTs keep track of legitimacy of authorship and ownership, removing them from the realm of allographic art. The coding intrinsic to the NFT file, distinguishing it from other types of digital image file a JPEG or PNG, make it a different kind of being than that which can be easily copied in the conventional way of downloading or saving the image. I will seek to analyze whether the backend coding of a digital file is sufficient to alter its ontology into a token of one-of-a-kind, autographic work, or if it only what is visible to the consumer of the image matters for its replicability and allographic ontological nature. To set up my argument, I will first compare the constituencies that make an artwork either autographic or

allographic, and demonstrate why digital images artworks are classified as allographic. Then, author will examine what makes an NFT unique from other, replicable digital images, as well as fungible tokens, and show how these distinctions transform these particular digital files into autographic art forms.

2. Traditional Autographic/Allographic Distinction

The systematic classification of allographic art began with Nelson Goodman, who is said to be the father of the term 'allographic' (Kovacs 2020, 47). The history of defining artworks as either autographic, meaning that an artist has created a particular work of art that is original and unique from other duplicates by the causal relationship of that particular object being created by that particular artist during the particular time that it was created, or allographic, meaning that the artwork is a particular notational representation that can be duplicated with authenticity as long as it is true to the original notation, was first critically examined by Goodman in his 1968 book *Languages of Art: An Approach to a Theory of Symbols.* In this book, he offers many explanations and qualifications of this distinction, the most succinct being, "Let us speak of a work as autographic if and only if the distinction between original and forgery of it is significant; or better, if and only if even the most exact duplication of it does not thereby count as genuine" [6]. This would indicate that created artworks that can be replicated with as much authenticity as the first instance of it would be considered allographic. Some common examples of this would be musical performances based off a notational score, or novels and other written works that are presented by a manuscript and adhere to the notational structure of its first instance.

The concept of notation, that allographic works are considered genuine if they adhere to a certain notational structure, is challenged when it comes to images and other visual works, which I will expound upon in a later section. But it is important to recognize that a works identity largely relies on recognizability, which may be accepted to adhere to a notational structure even while permitting some differences. For example, consider written letters and words a type of allographic entity; they rely on visual recognition and adherence to a predetermined structure in order to be considered the letters and words that they are meant to be. However, they can look very different from each other based on different fonts, different handwriting styles, whether it is "drawn in the sand or scribbled in the margins of a book" [10]. Each word is considered genuine as long as it is recognized, and this kind of legitimacy becomes critical when considering images of varying sizes or visual quality that are still ultimately the same image.

The distinction provided by Goodman is typically accepted, although there are some contrary ideas such as those of Christy Mag Uidhir, who argues that artworks cannot be abstract entities, based on a strict ideology of the causal relationship between authors and artworks (Mag Uidhir 2013). These ideas from his book *Art and Art-Attempts* are successfully rebuked in Nurbay Irmak's recent paper *Authorship and Creation*, where he uses a "modal notion of ontological dependence that explains how abstract works of art depend on concrete objects, events, *and* authorial intentions for their existence" [7]. Irmak's rebuttals are reassuring that "obscure philosophical principles" need not be relied on to determine the relationship between the creator of an artwork, the artwork itself, and the work *being* art [7]. This is especially important when regarding digital images, which do not necessarily present themselves physically, and are typically not regarded in immediate relation with their creator. Further, digital images, which are certainly abstract objects by Mag Uidhir's definition, would be considered non-spatiotemporal entities that cannot ontologically stand in direct relation to their artists [7]. However, Mag Uidhir uses the word 'creation' equivocally, leading to the conclusion that pure abstracta cannot be created, rather

only 'discovered' (2021, 2-3). He contrasts this with 'concrete' works of art such as paintings and sculptures, where the 'agent' or artist can be said to "stand in a causal-intentional relationship with the work itself"—that is, the work existing concretely and the work being art (2).

Applied to my argument, the computer screen or optical fiber network would constitute the 'concretum' of the digital artwork and have a secondary relationship to the digital artwork itself, which is the image itself that was made by an artist. But although digital images may be considered abstracta, there is no doubt that they were made by somebody at some time, albeit through the medium of technological commands and actions that result in a visual entity existing on a screen, rather than the literal hands-on method of painting or sculpting. The relationship between creator and object is a nuanced one even in the most straightforward of cases, but author believe it has been successfully determined that digital artworks are at the very least a created entity that ontologically depended on their creator for their first instance of existence. Because of their unique type of existence and easily replicable nature, it is slightly more difficult to determine where they fall under the autographic/allographic distinction, but there is a clear case for them being classified as allographic.

3. Digital Images as Allographic Artworks

Digital images are allographic art works because they are phenomenologically identical in every instance that they occur properly. This is not to say that they only look the same; one could argue that a well-done photocopy of the Mona Lisa and the original work look the same as well. But they are not identical in every instance that they occur properly—the Mona Lisa only properly exists as a single painting that was created by Leonardo da Vinci in the year 1503. Digital artworks exist as a file format that produces visual stimuli on a physical screen, and can be downloaded, uploaded, saved, and be transferred between devices. There may be particular types of screens on which certain images occur most properly; for example, an image meant for a modern desktop computer screen would not occur properly on the screen of a Nokia phone. But without obscure outliers, *most* digital images can be represented on *most* screens identically, the same way the television section of an electronics store might display the same video across all of the television models.

The slight variations between identical digital images need not disqualify them from allography. Because they are not physical images, they rely almost entirely on their visual appearance for their identity. John Zeimbekis describes the allography of digital images despite possible slight differences from a strict notational structure in *Digital Pictures, Sampling, and Vagueness: The Ontology of Digital Pictures.* He says that digital images may be phenomenally identical, even with variations of certain objective properties such as light intensities, sizes and shapes that exist below sensory discrimination thresholds [10]. He elaborates on the discriminatory thresholds in a later paper, saying, "Pictures are designed by means—and convey information for end-user systems—that use finite discrimination capacities," that end-user system being human vision [11].

It is important to remember that this identity is still belonging to a digital image or artwork, which is created through the instrument of technology and exists within technology only. The relationship between the creator and the digital file is less important when there is nothing necessarily relating the two beyond its first creation. It may have been created by a specific person at a specific time in history, but the fact that it can be easily duplicated by anyone at any time thereafter refutes the argument that someone could carefully engineer a new, phenomenologically indistinguishable instance of a historical painting, as posed by Jason D'Cruz and P.D. Magnus in *Are Digital Images Allographic?* As they themselves say, "copies of a digital image are made by copying the file and displaying them on an appropriate device,

not by transcribing the displayed digital picture from the screen" [3]. Digital images in a copyable format are instantly removed from their creator once they are made, because the process of duplicating that exact image is a completely anonymous process that creates an identical copy without any of the process that went into creating the first instance.

Author has now demonstrated that the allographic nature of digital images relies not only on phenomenal identity and visual indistinguishability, but the ontology of the digital file itself—that is, a type of image that is created and exists in a format that can be anonymously copied and duplicated without compromising any part of the original image. A digital picture on any networking device can be sent, saved, copied, pasted, screen-captured, or otherwise replicated in a myriad of ways, maintaining an allographic classification despite minute differences in screen and color quality, and file size. These types of image files are instantly removed from their original context of creator, time and place by the ability to replicate them exactly by any person and any time and place. A digital image file that is able to keep its original context or 'proof' of having been specifically made by an artist or creator, such as a non-fungible token (NFT) would no longer have the same replicable ability as other digital images, removing them from the allographic classification.

4. A Case for Autographic Digital Images

In order to defend a case that certain tokens of an allographic type could stand out as autographic, principles intrinsic to the object beyond visual stimuli and replicability will have to be examined and shown to be distinct in a way that proves that "even the most exact duplication of it does not thereby count as genuine" [6]. Since duplicates of a digital image can be visually indistinguishable, the difference must lie in what is not seen—the file type or the "back-end" coding of the image object. A file with a permanent blockchain record such as an NFT are unable to be forged or duplicated. Exact duplications of the visual image do not count as genuine duplications of the NFT, because no other file will ever share the same unique coding and blockchain record.

The file coding of an image, although invisible to the viewer, is an intrinsic part and characteristic principle of the object. According to Goodman, the possibility of distinction even in principle between objects is an important consideration for a work's being autographic [3]. A non-fungible token, as indicated by the term 'non-fungible,' is "not inherently interchangeable with other digital assets" (Chohan 2021, 1). This is an important distinction from other crypto-assets such as Bitcoin, which is 'fungible' in the sense that you can exchange one for another of the same value (2021, 2). However, that is not to say you could re-create or duplicate a Bitcoin to an infinite possibility of value. That's because Bitcoin and NFTs use blockchain technology, where, after a verified transaction, "a new block is added to the existing blockchain, in a way that is permanent and unalterable" (Blockgeeks 2021). The permanent and unalterable characteristic of these digital objects results from the same process that makes it nearly impossible to forge or hack: a 'decentralized system' of computers that create the network that is secured by mathematical functions or 'hash functions' (Chevet 2018 ,9). The Bitcoin blockchain network is just one example of secure, decentralized blockchain systems. Another example is Etherium, with which NFTs are created.

Both fungible and non-fungible tokens have traceable authenticity with the blockchain, but authenticity is not enough to prove that NFTs can be autographic rather than allographic in nature. For example, certain NFTs are created as a part of a series, where there may be a finite number of a specific token available for purchase. Each token of this kind, while authenticated on the blockchain with what is essentially a digital signature from the creator and a unique proof of ownership for the buyer (Chevet 2018, 33), would still be classified as allographic the same way that several

prints made from the same printing block are authentic but allographic. While acknowledging that allographic NFTs are possible in the case of a limited-edition series, this paper focuses rather on single-edition NFTs that are autographic in their unique nature, ontologically separating them from other digital images.

Single-edition NFTs, also called 'one-off editions' or 'standalone works,' are considered unique works of art [8]. Just like physical artworks with proven authenticity, they have scarcity and monetary value, and can be purchased at demand-driven prices the way any other rare and desirable collectible assets can be. Perhaps the most noted example would be *EVERYDAYS: THE FIRST 5000 DAYS* created by Mike Winkelmann; an artist known as Beeple. The work, over ten years in the making, was minted on February 16, 2021, and sold at a Christie's auction for 69,346,250 United States dollars on March 11, 2021 [2]. This is one strong indication that NFTs are autographic digital assets—they have scarcity and value whereas a JPG or PNG file of the same image would not. In addition to those that have gathered attention for the high price at which they were sold, there are countless other single-edition NFTs that become autographic by the process of being minted.

Minting an NFT is the process of turning a digital image into 'crypto-art,' where it gets a unique ID, a digital contract, which acts as its certificate of authenticity. NFTs are created through the Etherium blockchain, which alters the digital coding of the file into a traceable ID that will keep track of every transaction of the work on a public digital ledger. This ID is permanently linked with the artwork, henceforth changing its ontology from replicable, allographic image to unique, autographic artwork. There are no two in the world that are alike, as "the artwork becomes part of the ID and the ID becomes part of the artwork. 'They are one in the same'" [5]. This hylomorphic view of the artwork and its relationship to the blockchain demonstrates that, as a unified object, the NFT is set apart from other visually identical tokens by means of the coding that permanently holds the record of provenance, the artist's digital signature and every transaction the work has gone through since being minted. As Zeimbekis said of the ontology of digital pictures, "any defense of the value of certain tokens over others […] would have to restrict itself to pointing out differences in the historical properties of distinct tokens, since each copy would token exactly the same representational properties" [10]. The work keeps track of its own history, the record being built into it as it progresses. Therefore, the NFT cannot be replicated in any way that would count as genuine because no two could ever share the same blockchain ID. It is impossible to forge the authenticity of ownership that is automatically and permanently written into the object with each transaction, as well as the artist's signature that is an intrinsic part of the digital makeup of the artwork.

5. Conclusion

Digital art has been classified as allographic by criteria set by the initial indicator of an allographic/autographic distinction, Nelson Goodman. This classification since has been analyzed and verified by a number of scholars in the twenty-first century. Essentially, what makes an artwork or type of artwork to be allographic is that meets the criteria for authenticity through representational correctness, as well as a historical tie to the original creator. Replications that fit the criteria count as genuine versions of the work.

Digital images are classified as allographic because they are able to be reproduced and remain phenomenologically identical, and digital images have little to no tie to their original creator because they typically have an infinite capacity for copy and distribution in the digital realm. The specific file type plays an important role of the allographic nature of digital images, seeing that a JPG file can be copied and exist as a completely identical JPG file. If the file was of an artwork, there would then be two identical, genuine JPG files of the artwork. However, crypto-artworks existing as

an NFT cannot be copied or duplicated. Different file versions of the visual image may be copied, but that would not count as a genuine version of the NFT. NFTs exist on a blockchain, which gives them a unique digital existence that impossible to replicate, forge, or change. The blockchain coding, which is intrinsic to the artwork object, acts as proof of authenticity from the creator as well as a certificate of genuine ownership to the person who purchases the work.

The blockchain makeup of the NFT artwork makes it ontologically different from other digital artwork in that it can only exist autographically, as it can never be copied or duplicated in a genuine way. Each transaction of ownership is written permanently into the blockchain. So, just like images of well-known masterpieces, anybody is able to view what it looks like, but there is only one genuine version and it is owned by a particular entity. NFTs are therefore genuine, unique, and autographic digital artworks.

References

1. "Blockchain Infographics." 2021. *Blockgeeks* (blog). 2021. https://blockgeeks.com/blockchain-infographics/.
2. Davis, Noah. 2021. "Everydays: The First 5000 Days." *Christie's* (blog). March 11, 2021. https://onlineonly.christies.com/s/beeple-first-5000-days/beeple-b-1981-1/112924.
3. D'Cruz, Jason, and P.D. Magnus. 2014. "Are Digital Images Allographic?" *The Journal of Aesthetics and Art Criticism* 72 (4): 417–27.
4. D'Cruz, Jason. n.d. "Preserving the Autographic/Allographic Distinction." *The Journal of Aesthetics and Art Criticism* 73 (4): 453–57.
5. Duque, Alex. 2021. "Non-Fungible Tokens (NFT) Talk." Lecture Slideshow, Lynn University, April 12. https://spiral.lynn.edu/cgi/viewcontent.cgi?article=1000&=&context=commdesign_lectures&=&sei-redir=1&referer=https%253A%252F%252Fscholar.google.com%252Fscholar%253Fhl%253Den%2526as_sdt%253D0%25252C23%2526q%253Dminting%252Bprocess%252Bof%252Bnft%2526btnG%253D#search=%22minting%20process%20nft%22.
6. Goodman, Nelson. 1968. *Languages of Art: An Approach to a Theory of Symbols*. Indianapolis: Bobbs-Merrill Company.
7. Irmak, Nurbay. n.d. "Authorship and Creation." *Journal of Aesthetics and Art Criticism*. 2021. https://doi.org/10.1093/jaac/kpab004.
8. Jhala, Kabir. 2021. "A Grey Single-Pixel 'work' Sells for $1.3m at Sotheby's Maiden NFT Sale." *The Art Newspaper*, April 15, 2021. https://www.theartnewspaper.com/news/sotheby-s-voyage-nft-sale-nets-usd16-8m.
9. Mag Uidhir, Christy. 2009. "Unlimited Additions to Limited Editions." *Contemporary Aesthetics*. https://contempaesthetics.org/newvolume/pages/article.php?articleID=527.
10. Zeimbekis, J. Digital Pictures, Sampling, and Vagueness: The Ontology of Digital Pictures. *The Journal of Aesthetics and Art Criticism* 70 (1): 43–53. 2012.
11. Zeimbekis, J. Why Digital Pictures Are Not Notational Representations. *The Journal of Aesthetics and Art Criticism* 73 (4): 449–53. 2015.

Aims and Objectives

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