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Teaching Counting in Mathematics in a Digital Learning Environment, a Case Study in a Private School in Beirut

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ABSTRACT: This research aim sat examining the impact of teaching "counting" in mathematics, through WhatsApp, a social media platform, and the PowerPoint presentations on 22 students in the second year secondary scientific in a private school in Beirut during the corona virus pandemic. It also aims at integrating social media and PowerPoint in the curriculum by presenting "counting" in a digital learning environment. Additionally, it aims at determining the necessity of WhatsApp in this experiment, students' willingness to study a second lesson in the same way and their personal opinions concerning teaching "counting" and other math lessons to students in another classes and levels. This research determines the class average and the percent of students who passed the online exam that was prepared specifically to assess their performance at the end of the experiment. The sample of the study is formed by 22 students in the second year secondary scientific through the purposive sampling technique. For statistics, the researchers used the average, frequencies and percent,bar diagrams and a scatter plot to represent the data of the study. Results of the study show that "counting" can be taught via WhatsApp and the PowerPoint presentations. Most of the participants were positive about this digital learning environment because of the way the lesson was presented through the PowerPoint slides and the teacher-student WhatsApp interaction and collaboration. 54.5% of the participants were willing to study a second lesson in the same way,95.45%of the students passed the exam and the class average turned out to be 16.0455 over 20. The researchers recommend math teachers to leave the bricks of the classes that have been surrounding them for many years, embrace this digital experiment that motivates their creativity and provide their students, who must participate and collaborate with them, with proper online interaction. They also recommend them using the combination of WhatsApp and PowerPoint to create a conceptual field that enables them developing students' learning in complex situations, the "counting" lesson. Finally, they also recommend other researchers to replicate this experiment in other math topics.

KEYWORDS: Mathematics, math teachers, WhatsApp, Microsoft PowerPoint, teaching, social media, interaction, collaboration, digital learning environment.

I.INTRODUCTION

Background of the study: Social media is the new phenomenon and it is no secret that its platforms and networking sites are being used by most people all over the world every day. They enable the users to exchange, share, discuss and comment, not to mention informing others about the latest updates aboutalmost any topic(Devi, Gouthami, & Lakshmi, 2019).

This extremely rapid and massive expansion changed the ways people collaborate and communicate; and because of that, students have to understand that now they have the ability to communicate and collaborate with each other and their teachers, and learn in an unprecedented interactive way(Devi, Gouthami, & Lakshmi, 2019).

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Things do not stop here. Students and teachers have the opportunity to collaborate online in predetermined tasks. Teachers can teach their students through the social media platforms and networking sites, fill their minds up with information and transfer their knowledge to them (Devi, Gouthami, & Lakshmi, 2019).

We might ask why students and teachers should do so. Why teachers and students have to use these platforms and networking sites in teaching and learning? Well, simply because social media enables people determining the type of online relationship they are willing to have with others. They have the will to use their social media for fun with others or create relationships that cement their learning (Devi, Gouthami, & Lakshmi, 2019).

Both teachers and students have to take advantage ofthe social media platforms and networking sites and their diverse features. They have to use them to reach a better learning environment(Devi, Gouthami, & Lakshmi, 2019).

After years of existence, many teachers are still hesitant or against using the social media platforms and networking sites in teaching their own subject material. Nonetheless, social media has been capable of influencingsome educators, just like the researchers here, to go on and experiment its effect in education (Devi, Gouthami, & Lakshmi, 2019).

Unlike any other tech devices, the social media platforms and networking sites present us with the opportunity to collaborate and reinforce our thinking skills from any place at any time. Given a chance to prove its worthiness in education, its potential implications in teaching and learning in the 21st century are huge and should be considered seriously(Devi, Gouthami, & Lakshmi, 2019).

In recent years, usage of the Microsoft PowerPoint presentations has increased significantly in teaching. Unfortunately, no examinations were done to identify the effects of these presentations on students' learning (Nouri & Shahid, 2005).

Evidence about the influence of the PowerPoint presentations is unreliable. Some even say it is still anecdotal (Nouri & Shahid, 2005). Bryant and Hunton (2000) indicated that improving students' learning depends on the types of interactions between them and the presented medium. Nonetheless, these interactions are complex and not easily distinguished and identified (Bryant & Hunton, 2000).

Despite that, Hlynka and Mason (1998) assured that the PowerPoint presentations lead to a better structuring of the content of the lesson or lecture and ease their process (Hlynka & Mason, 1998).

Additionally, Cook (1998) claimed that these presentations have many advantages we should master (Cook, 1998), and Parks (1999) assured that students would be intrigued with the lesson and lecture because of the graphs and outlines presented by the PowerPoint slides that positively influences them (Parks, 1999).Nevertheless, Harrison (1999) was skeptical about that and strongly questioned the impact of the PowerPoint presentations on students' learning (Harrison, 1999).
In 2020, the corona virus took over the world. Schools were closed and teachers were asked to use the online learning as a substitute to teaching in classes. Lebanon is not one of the leading countries in the online learning approach. Many failed in this quest because they were not trained to do so and many students did not take things seriously.

During the corona virus pandemic, we may ask about the effectiveness of WhatsApp and the PowerPoint presentations in teaching a mathematical lesson to students in the secondary level outside the classes. Is it possible to teach the "counting" lesson in mathematics to students in the second year secondary scientific by combining the features of the WhatsApp platform and the PowerPoint presentations? If yes, is this digital learning environment created outside the school effective? With students' collaboration, can we rely on it in teaching mathematics to students outside school?

Theoretical Framework: The Design Thinking is an approach centered on the innovation of humans. It integrates the needs of people, the possibilities of technology, and the requirements for success. This approach assembles what is desirable from humans' perspective with what is technologically achievable and economically viable(Kelley, 2020).

This design permits regular people to be creative and overcome the challenges they are facing through available tools. It relies on humans' intuition and their abilities to construct meaningful and functional ideas(Kelley, 2020).

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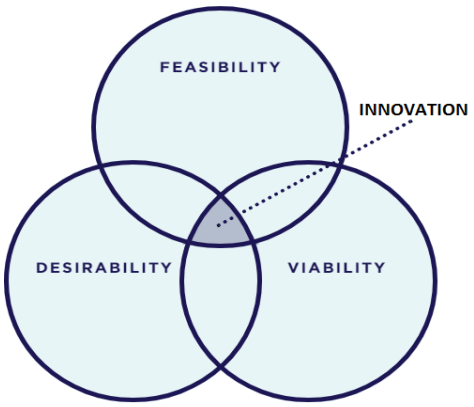

Figure 1: The Design Thinking. (Kelley, 2020)

Innovation is a combination of feasibility, desirability and viability, where feasibility means what is functionally possible within the foreseeable future, desirability represents what makes sense for people, while viability signifies what is likely to become part of a sustainable model(Kelley, 2020).

These combined three elements of the "Thinking Design" form an iterative approach we can try out and adapt to for it to suit our needs(Kelley, 2020).

To interpret the Design Thinking model according to our need in this study, it could be possible employing WhatsApp and the PowerPoint presentations for education. Their employment makes sense because of their features. They are economically affordable by students and teachers, they might suit our needs and we might as well adapt to them in teaching and learning.

Thus, if proven successful in teaching and learning, WhatsApp and the PowerPoint presentations might become sustainable to use for online teaching.
According to the Thinking Design model and its elements, employing WhatsApp and the PowerPoint presentations for education could be framed, new ideas could be inspired according to teachers and students' needs, and breakthrough ideas could become obvious.

Refining these ideas through experiments and feedbacks could make this employment tangible and inspirable for other teachers to do the same.

Based on that, students in the second year secondary scientific might be taught the lesson "counting" through WhatsApp and the PowerPoint presentations.
Purpose of the Study: This study has aimed, through the literature, at enlightening on the possibilities of teaching through social media and the Microsoft PowerPoint Presentations. More importantly, during the corona virus pandemic, this study has aimed at creating a digital learning environment outside the class for 22 students in the second year secondary scientific. It has aimed at determining if the lesson "counting" in mathematics could be successfully taught through WhatsApp and the Microsoft PowerPoint slides. Finally, through its online exam, this study has aimed at determining the percent of students who scored at least 10 over 20 to pass it and the class grade average. More importantly, it has aimed at integrating social media and PowerPoint in the curriculum by presenting "counting" in a complete digital learning environment.

Significance of the Study: By creating a digital learning environment outside the school, this study has added to the practice according to its findings on the impact of teaching "counting" in mathematics to 22students in the second year secondary scientific in a private school in Beirut.

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Research Questions
According to students' answers in the second year secondary scientific:

1. In a digital learning environment created outside the school, was the lesson "counting" successfully taught through WhatsApp platform and the Microsoft PowerPoint presentations?
2. Can the lesson "counting" be completely taught to other students in the same way in other schools and classes?
3. Was the students-teacher online interaction and collaboration, through WhatsApp, necessary for the successful completion of this digital learning experience?
4. Is it possible teaching other math lessons via WhatsApp and the PowerPoint presentations to students in other classes and levels?
5. After this experiment, what percent of students are willing to study a second lesson in mathematics via the WhatsApp platform and the Microsoft PowerPoint presentations?

According to the results of the "counting" online exam:
6. What percent of students passed the exam?
7. What was the class grade average?

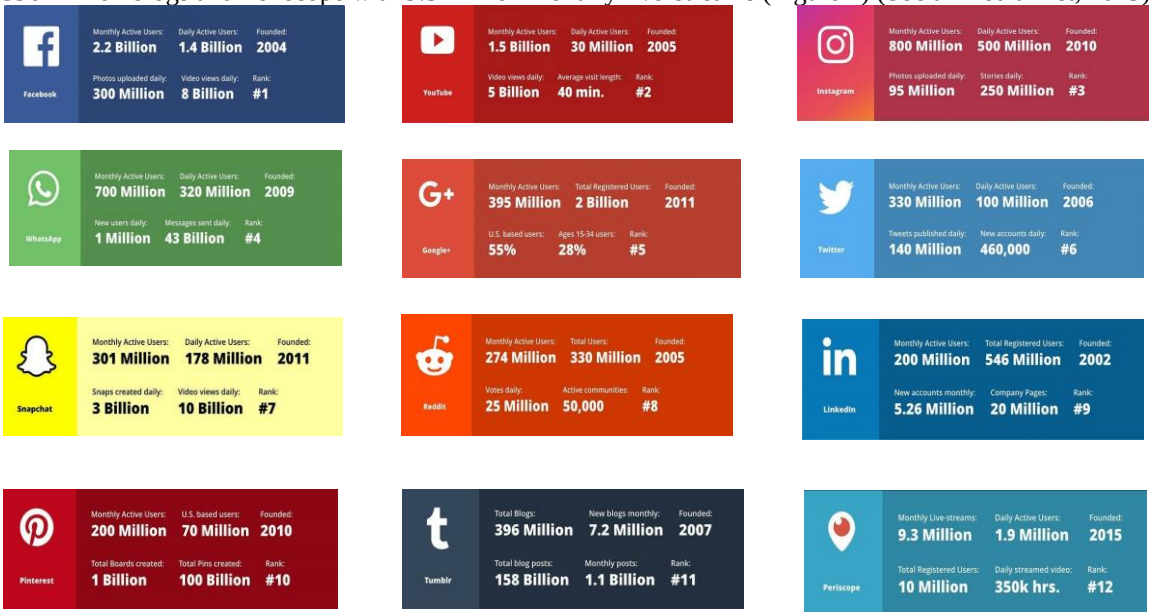
Limitations of the Study: This study has had one limitation to deal with. The corona virus was taking over the world. It was not feasible for the researchers to replicate teaching "counting" in the same way to students in other schools.

Delimitations of the Study: The 22 students in the second year secondary scientific, in a private school in Beirut have extremely collaborated with the researchers. As a result, this collaboration has positively impacted the accuracy of the results of the study.

II. LITERATURE REVIEW

Gradually, social media is taking its place at the top of the most important tools for people's interaction. Everybody can send, share, exchange, comment, blog and discuss diverse topics online, andit is not shameful to admit that social media has changed the communications landscape (Syamala Devi, Lakshmi, & Gouthami, 2019).

By time, social media became very popular to use. The General Social Media Statistics in 2019 revealed that Facebook was ranked first with 2.2 billion monthly active users, YouTube with 1.5 billion, Instagram with 800 million, WhatsApp with 700 million, Google+ with 395 million users, Twitter with 330 million users, Snapchat with 301 million users, Reddit with 274 million users, LinkedIn with 200 million users, Pinterest with 200 million users, Tumblr with 396 million blogs and Periscope with 9.3 million monthly live-streams (Figure 2) (Social Media List, 2019).



*F*igure 2 : Social Media' s Monthly and Daily Most Active Users. (Social Media List, 2019)

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In education, it is notable that the effect of social media on the learning environment is growing year by year. In higher education, social media has positively influenced the discussions, thinking skills, construction of knowledge and collaborations among many students (Syamala Devi, Lakshmi, & Gouthami, 2019).
Teaching through social media can be very useful for education. Social media presents us with modern learning, something we are not accustomed to. Modern learning is about students collaborating, planning, sharing ideas, progressing and working in groups through social networks (Watanabe-Crockett, 2020).

Teaching through social media has two facets. It can be alluring or repulsive. Why? Because it depends on our understanding of it and for sure our experience with it. Nonetheless, with the will to do so, teaching through social media can become easy to adopt (Watanabe-Crockett, 2020).

For teachers who are willing to widen their connections with their students, social media presents them with a tremendous opportunity. Nonetheless, they should do their research about employing it before diving with their students into a digital learning environment (Watanabe-Crockett, 2020).

These teachers might ask themselves at first many questions. Like, why am I going to give social media a shot? Will its integration in my teaching methods make any difference for me and my students? Are students going to be more engaged and benefit more? What subjects suit better the social medial platforms? Can it be used for all subjects? Will I need help and guidance to find my way to integrating social media in teaching? What will be my next step if integrating social media in my teaching methods turned out to be successful? (Watanabe-Crockett, 2020).

It is normal to ask these question simply because social media has it pros (positives) and cons (negatives). As for its positives, social media platforms are great at increasing students' engagement and enhancing their collaboration. It can make learning enjoyable for them. It enables teachers to stay connected with their students and parents at any time outside the learning sessions. Not only that, but social media links students with professional people or other schoolmates to consult with for school projects (Watanabe-Crockett, 2020).
As for its negatives, social media is extremely distracting for students. They can neglect doing their homework. It persuades them to join large groups for entertainment. Students' behavior might be negatively affected and they might lose their abilities in the face-to-face communication and interaction. Though, all of these negatives depend on students' misusage of their social media platforms and networking sites (Watanabe-Crockett, 2020).

Teachers can benefit from the diversity of the social media platforms and networking sites. They can direct their students to using the popular blogs for posting important information in different topics. Students can become more sophisticated by posting online (Hayton, 2019).

Things with blogs do not stop here. Teachers can build a class blog in which students can post on topics they are interested in and their colleagues can comment about them. Though, teachers should remain supervising everything due to the fact that things might become out of control. Why? First because usage of social media is very hot among young people, like students. Second, because this blog represents an educational institution and most students are not accustomed to blogging about educational topics and not stepping once outside the line (Hayton, 2019).

By taking advantage of this social media feature, students can exercise their creativity, they can solve exercises for others by blogging (figure 3). Not only that, but it can ameliorates the performance of their brain, solidifies their self-confidence, improves their communication skill (Thomson, 2018).

Figure 3: Blogging. (Thomson, 2018)

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Even though social media was initially created to enable humans creating their personal profiles and presenting them in public to stay socially connected with others, it is believed by many that social media can be potentially valued in teaching and learning (Syamala Devi, Lakshmi, & Gouthami, 2019).

While it is believed that wikis, blogging, videos and podcasts are valuable for teaching, many are under the impression the social media can additionally improve the interaction and collaboration between the people for learning (Moran, Seaman, & Tinti-Kane, 2011).

For students who suffer from poor and false understanding in many materials, social media presents them with the opportunity to create an army of friends through online groups, use their assistance and fill in their gaps. Thus, social media is seen as a solution for their problems in learning (Silius, Tervakari, & Miilumäki, 2009).

Facebook presents many students with the opportunity to post their questions after school and get answered about them through online groups. Twitter allows the teachers to inform their students about important events or remind them about the dates for submitting their projects. They can also provide them with new information or the ones needed for their assigned researches. Teachers can use the Instagram to publish pictures about students' work. As previously said, a picture is worth thousand words. Publishing these pictures can showcase students' hard work in public and provide interesting details about them to the masses (Syamala Devi, Lakshmi, & Gouthami, 2019).
Good things about social media do not stop here. It is ideal for teachers to use for the flipped classrooms. Teachers can post personal videos, YouTube videos, documents, links, images and other resources for students to access and use before an upcoming session. This way, students will have an idea about the content of the next learning session before actually attending it(Syamala Devi, Lakshmi, & Gouthami, 2019).
Though social media, teachers can create a new climate in which students become active. In this climate, teachers become supportive and leave the front seat for students to take the lead. Nonetheless, students hold their own share of responsibility in turning things a success for themselves and their teachers (Syamala Devi, Lakshmi, & Gouthami, 2019).
Students might find it weird at first, however collaborating with their teachers is extremely rich for their education. For that, at first, teachers should set the right tone and encourage them to communicate, discuss, contribute, develop and construct new knowledge (Figure 4). Additionally, it is extremely beneficial for students to allow their students put their own marks in this collaborative learning experience (Syamala Devi, Lakshmi, & Gouthami, 2019).

Figure 4: Social Media Interaction and Collaboration. (Dreams Time, 2019)

Finally, social media enables teachers creating the proper scaffolding for students. It can become incredibly beneficial for didactics, from transferring to acquiring knowledge, interaction and collaboration between groups of students alone or with teachers outside the time assigned for the learning session inside the class (Syamala Devi, Lakshmi, & Gouthami, 2019).

Beside social media, the PowerPoint Software was originally a part of the Information and Communications Technology (ICT) program developed by the Microsoft company (Gambari, Yusuf, & Balogun, 2015). It was designed and first released in July 1987 to facilitate and enhance the visual presentations through its slides (Dreams Time, 2019).

It is said that people learn differently because they have different styles to do so. Some learn by just listening, others learn best through visual presentations, while some learn by exercising and practicing the concepts. Nonetheless,

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despite not being initially developed for education, the Microsoft PowerPoint found its way in education (Figure 5) (Childress, 2019).

Figure 5 : Education PowerPoint Presentati on. (Childress , 2019)

PowerPoint presents its users with the opportunity to use visual effects and auditory aspects in their presentations. It is regarded as a good instructional medium that can facilitate students' learning because of its ability to cover the content of any material in an easy way and a much lesser time than the traditional teaching approach (Gambari, Yusuf, & Balogun, 2015).

Additionally, many believe that it can grab students' attention and hold on to their interest during the presentation much longer that the classic teaching method. Despite that, some believe that it is not that much useful as an instructional medium because it focuses on the format more than the content and limits the amount of details of the presented content. Others label it as a teacher-centered instructional tool because it is controlled by the teacher who is just presenting the content of the lecture or lesson differently (Gambari, Yusuf, & Balogun, 2015).

This argumentative issue is due to the theories about the work of humans' memory system, in the ways human gather, encode, retrieve and use information. Humans' brain is constructed of three major storage structures: the sensory system, the short-term memory and finally the long term memory (Nouri & Shahid, 2005).

The sensory system registers the stimuli and holds to them briefly until we recognize them as self- stimuli or they are lost by time. The short-term memory has a limited capacity. It receives information from the sensory system, holds on to it for a longer period of time by rehearsal and repeated recycling. The long-term memory is the permanent storage of humans' knowledge. It receives information from both the sensory system and the short-term memory (Nouri & Shahid, 2005).

Researches showed that attention plays is an important factor and plays a huge part in determining the "when and how" further the information is transferred from the sensory system to the short-term memory to the long-term memory. Why?Because if there was no attention, then the information would be quickly lost at the sensory stage (Nouri & Shahid, 2005).

This reality cements Reynolds and Baker' findings (1987). The researchers found out that presenting content through computers increases students' attention and learning. Additionally, the found out that learning increases as attention increases (Reynolds & Baker, 1987).

Things do not stop here for the PowerPoint software. Paivio's (1986) dual coding theory of memory and cognition, a theory considered by many to be very effective in improving humans' memory, suggests that humans' information processing consists of the imagery and verbal systems. The imagery system processes information about nonverbal objects like images, animations and colors, while the verbal system is associated with verbal vocal communications and speeches(Paivio, 1986).

According to Paivio's (1986), a person can expand his learning with verbal aids, visual imagery, or even both. When it comes to humans' mind, information can be represented visually or verbally. They are processed differently along distinct channels to create separate representations for information in each of the two channels (Paivio, 1986).

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Mentally, the incoming visual and verbal information are stored, organized and coded. They can be used later on for recalling just like with the case of retrieving information about a dog. It can be done either through its definition (verbal information), its image (visual information) or both simultaneously (Paivio, 1986).

Additionally, Peek (1987) indicated that humans' retention of information improves when they are presented with a text embedded in a picture. Dwyer and Lamberski (1983) concluded that colors should be the center of any presentation because they make students pay more attention and improve their learning. Thus, colors could be considered as a stimulus for memory as indicated by Hanna and Remington (1996) (Nouri & Shahid, 2005).
Based on that, since topics are presented through the PowerPoint with colors, animations and images, then it should arouse students' imagery system and positively contribute to their understanding, short term and long term memories. They should help them retrieving information during an exam, organize their answers during an assignment, like an essay, and perform better in assigned educational tasks (Nouri & Shahid, 2005).

In their study Nouri and Shadid (2005) found out that PowerPoint positively influences students' attitude towards the instructor and the content presented. It may also improve their short-term memory, nonetheless it depends on the topic presented for discussion and the representation style favored by the students(Nouri & Shahid, 2005).

More importantly, they found that poor PowerPoint presentation negatively affect students' attitude and learning, which reflects the importance of a well-constructed and organized slides for a presentation. They also did not find any significant effect of PowerPoint on the long-term memory. Though, they did request examining the impact of well-constructed PowerPoint slides on other students and a larger sample for stronger claims on the impact of PowerPoint on the short and long-term memories (Nouri & Shahid, 2005).

Based on those indications and findings, we find ourselves intrigued to examine the impact of integrating WhatsApp and PowerPoint on students' "counting" learningand exam performance.

III. METHODOLOGY

Design of the Research: For their study, the researchers used the purposive non probability sampling technique(Crossman, 2019). This technique was used to select the class formed of heterogeneous students for the experiment.

The researchers were examining the impact of the WhatsApp platform and the PowerPoint presentations in teaching "counting" for students with different needs and skills in the second year secondary scientific in a private school in Beirut. For that, they have opted to use the maximum variation/heterogeneous type of the purposive sampling.

Additionally, a quantitative research of descriptive design does not start with hypotheses. The researchers hypothesize after collecting and analyzing the data (CIRT;, 2015).Therefore, this research, through its quantitative approach, has sought at determining the possibility of teaching the "counting" lesson to 22students in the second year secondary scientific in a private school in Beirutthrough the WhatsApp platform and the PowerPoint presentations.

Research Instruments:

First Instrument: For their study, the researchers have prepared the lesson "counting" according to the objectives illustrated in the curriculum as follows:

- Identify an arrangement with or without repetition.
- Model situations by arrangements
- Recognize a permutation.
- Use the formulas to find the number of permutations with or without repetition.
- Model situations by permutations.
- Identify a combination of elements of a finite set.
- Calculate the number of combinations of p elements of a set of n elements $(p \leq n)$.
- Identify a combination of p elements of a set of n elements $(p \leq n)$ as a part of this set formed of p elements.
- Determine, in simple cases, all the combinations of p elements of a set of n elements $(p \leq n)$.

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- Know and use the formula giving the number C_n^p of all the combinations of p elements of a set of $n.(p \leq n)$.
- Model situations by combinations.

The researchers divided the lesson "counting" into seven PowerPoint presentations as follows:

- The first PowerPoint was composed of two activities. The first activity enabled students counting the possible outcome couples (Figure 6), while the second activityenabled them counting the possible outcome triplets through a tree (Figure 7).

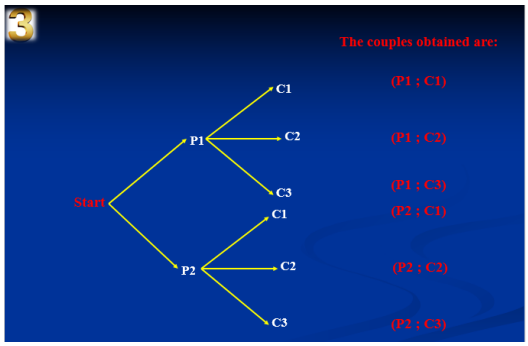

Figure 6 : Tree of the First Activity

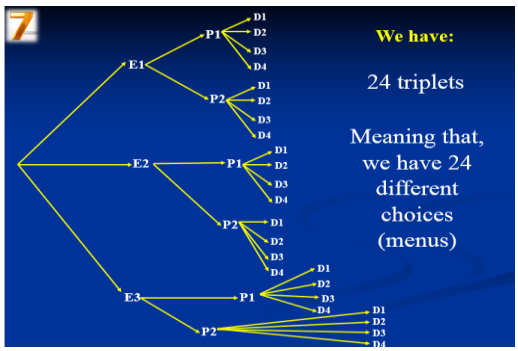

Figure 7 : Tree of the Second Activity

- The second PowerPoint was composed of five activities. These activities were designed to enable students counting the anagrams, words with a meaning or not, formed of a selected letters, and the numbers formed of a selected digits, including zero or not.

- The third PowerPoint has tackled the epistemology of counting and factorial n, noted n!, through the role of the mathematicians Al-Khalil ibn Ahmed (716-786), Thabit ibn Qurra (836-901), Ahmad Ibn Mun'im (died in 1228), Muhammad ibn Muhammad ibn al-Hasan al-Tūsī, also known as Nasir al-Din Tusi (1201-1273), Ibn al-Banna al-Marrakushi (1256-1321), François Antoine Arbogast (1759-1803) and Christian Kramp (1760-1826). In addition to using the Stirling formula to calculate good approximations of factorial n for large values of n.

- The fourth PowerPoint has introduced the mathematical definition of the factorial n, noted n!. In addition, it has introduced the mathematical definition of the permutation without repetition. Examples and remarks were introduced as well as a set of exercises for students to practice. Solutions of these exercises were later on sent to the students by the researchers.

- The fifth PowerPoint has introduced the mathematical definition of the arrangement without repetition as well as the one with repetition. Usage of the calculator was presented. The formula and properties of the arrangement were given. Students were asked to send through the WhatsApp platform the solution of a given activity. Finally, a set of exercises for students to practice was given at the end.

- The sixth PowerPoint has introduced the mathematical definition of the combination. Usage of the calculator was presented. The formula and properties of the combination were given. Finally, a set of exercises for students to practice was given at the end.

- The seventh PowerPoint introduced the seven exercises assigned for the chapter and their complete solutions. These exercises were validated by experts in teaching mathematics in the secondary level.

Exercise 1

A bus holds 20 seats. 6 persons took that bus. In how many ways can these persons sit?

Exercise 2

Three girls and four boys want to sit on a bench. In how many ways they can sit if:

1) No order is imposed?
2) The girls want to sit next to each other?

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3) There are neither boys next to each other, nor girls next to each other?

Exercise 3
The entrance of a building is formed of a code of five distinct elements as follows:three digits followed by two letters.

1) What is the number of possible codes?
2) How many codes begin with zero?
3) How many codes begin with zero and end with z?
4) How many codes contain the digit zero and the letter z?

Exercise 4
We want to form a word of five letters, having a sense or no, by using the letters of the word ' GREEN '. Each letter can be used once.

1) How many words can we form?
2) How many words admit N as the third letter?
3) How many words admit E as the third letter?
4) How many words begin and finish by the same letter?

Exercise 5
Dima and Samer are two members of a group of 17 men and 12 women. We want to choose 6 of these members to form a committee.

1) How many committees can we form?
2) What is the number of committees which :
   a. Contain Dima and Samer?
   b. Do not contain neither Dima nor Samer?
   c. Contain Dima or Samer?
   d. Contain Dima only?
   e. Contain Dima only or Samer only?

Exercise 6
How many numbers of four distinct digits can we form with 0, 1, 2, 3, 4, 5, 6 and 7?

Exercise 7
An urn contains 4 red balls, 5 white balls and 3 black balls.
Part A
We draw simultaneously three balls from the urn.

1) What is the number of possible drawings?
2) What is the number of drawings of :
   a. Three white balls?
   b. Three balls with the same color?
   c. No red balls?
   d. At least one red ball?
   e. One black ball only?
   f. Three balls of three different colors?
   g. At least two white balls?
   h. At most one red ball?
   i. At most two red balls?

Part B
We draw successively and without replacement three balls from the urn.

1) What is the number of possible drawings?
2) What is the number of drawings of:
   a. Three white balls?

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b. Three balls with the same color?
c. No red balls?
d. At least one red ball?
e. The first ball is the only black ball?
f. Only one black ball?
g. One red ball, one black ball and one white ball in this order?
h. Three balls of three different colors?
i. At least two white balls?
j. At most one red ball?

Part C

Repeat the questions in Part B using a **successive drawing with replacement**.

Second Instrument: Synthesis of arrangement and / or combination application

In addition to the seven PowerPoint presentations, the researchers have created a Microsoft Word document in which they specified when students have to use the arrangement and when they have to use the combination. In addition, they were reminded about the difference between the permutation and the arrangement.

We use the combination if:

- We want to form a group of people without labels, a team, a committee without labels, a group of objects, letters, animals, etc....
- We want to answer questions.
- We want to draw balls simultaneously.
- Play the Lotto game.

We use the arrangement with repetition or not, or the permutation if:

- We want to form a committee, a group or a team of people with labels.
- We want to form a word having a sense or not.
- We want to form a code.
- We want to form a number.
- We want to draw balls successively with or without repetition.
- We want to place people on chairs, on a round table, in a line or on a bench.
- We want to arrange books, objects, etc….

Recall:

- The permutation is a part of the arrangement.
- In the arrangement we use *p* elements out of the given*n* elements.
- In the permutation we use all of the given *n* elements.

Third Instrument: After each PowerPoint sent to students, time was given for them to study them and prepare their questions. A WhatsApp group was formed. After done studying and becoming ready to ask, each student was capable of interacting through the WhatsApp platform with one of the researchers at asynchronous times.

Fourth Instrument: The researchers have prepared an online summative exam to assess students' performance at the end of the experiment. The exam was formed of 20 independent questions, each marked for 1 point, and validated by experts in teaching mathematics in the secondary level.Even more, the exam answers keys were sent to the students through the WhatsApp platform at a later stage.

Content of the summative online exam

The table below contains the questions proposed in the summative online exam.
The exam was constituted of 20 independent questions. Each question had three answers a, b and c, and only one of them is correct.

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	Answers		
	a	**b**	**c**
1. $\frac{\frac{6!}{3!} - 4! \times 3!}{3!} =$	4	-4	12
2. If $n! + (n-1)! + 2 = 2(n!) + (2n)!$, then n =	1	2	3
3. $\frac{(n+2)!}{(n-2)!} =$	(n+2)(n+1)(n)	(n+2)(n+1)(n)(n-1)	(n+2)(n+1)(n)(n-1)(n-2)
4. In how many ways can n peoplesit around a round table?	n ways	n! ways	(n-1)! ways
5. How many numbers of 4 distinct digits can you form using 0, 2, 4, 5, 6,8 and 9?	840	720	35
6. How many numbers of 4 distinct digits, that contain the digit 6, can we form using 0, 2, 4, 5, 6, 8 and 9?	420	120	840
7. A microbus has 5 seats. 3 people took this microbus. In how many ways can they sit?	5	10	60
8. We want to form a word of fiveletters, an anagram with a meaningor not, using the letters of the word 'LEBANESE', where each letter can be used only once. How many words can we form?	6720	40320	8
9. We want to form a word of 5 letters, an anagram, using the lettersof 'BOOKKEEPER'. each letter can be used only once, how many words start and end with the same letter?	16800	403200	3628800
10. An urn contains 10 balls. If 3 balls are drawn simultaneously, then the number of drawings of 1 red ball is:	90	45	20
11. An urn contains 6 red balls, 4 white balls and 2 black balls. If three balls are simultaneously drawn from the urn, then the number of drawings of three balls of the same color is:	24	120	144
12. An urn contains 6 red balls and4 white balls. If three ballsare simultaneously drawn from the urn, then the number ofdrawings of at least one red ball is:	696	24	116
13. An urn contains 6 red balls and4 white balls. If we drawsimultaneously three balls from the urn, then the number ofdrawings of at least two red balls is:	240	120	80
14. An urn contains 6 red balls and4 white balls. If three balls are drawn successively without replacement from the urn, then the number of possible drawings is:	720	10	120
15. An urn contains 6 red balls and 4 whiteballs. If three balls are drawnsuccessively	36	72	216

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without replacementfrom the urn, then the number of drawings of one red ball is:			
16. An urn contains 6 red balls and4 white balls. If three balls aredrawn successively without replacement from the urn, thenthe number of drawings of at most one red ball is:	240	96	40
17. An urn contains 6 red balls and4 white balls. If we draw successively with replacement three balls from the urn, thenthe number of possible drawings is:	120	720	1000
18. An urn contains 6 red balls and4 white balls. If we draw successively with replacement three balls from the urn, thenthe number of drawings of twored balls exactly is:	432	144	96
19. An urn contains 6 red balls and4 white balls. If we successivelydraw with replacement three balls from the urn, then the numberof drawings that the first ball isthe only white ball is:	120	432	144
20. An urn contains 6 red balls and4 white balls. If we draw successively with replacement three balls from the urn, thenthe number of drawings of threeballs of the same color is:	144	280	13824

Answers keys

1. Answer: -4.
2. Answer: 1.
3. Answer: (n+2)(n+1)(n)(n-1).
4. Answer: (n-1)! ways.
5. Answer: $A_6^1 \times A_6^1 \times A_5^2 = 720$ or $6\times 6\times 5\times 4 = 720$.
6. Answer: $A_1^1 \times A_6^3 + A_5^1 \times A_1^1 \times A_5^2 + A_5^1 \times A_5^1 \times A_1^1 \times A_4^1 + A_5^1 \times A_5^2 \times A_1^1 = 420$

Or $1\times 6\times 5\times 4 + 5\times 1\times 5\times 4 + 5\times 5\times 1\times 4 + 5\times 5\times 4\times 1 = 420$.

7. Answer: $A_5^3 = 60$.
8. Answer: $\frac{8!}{3!} = 6720$.
9. Answer: $\frac{2\times 8!\times 1 + 2\times 8!\times 1 + 3\times 8!\times 2}{2!\times 2!\times 3!} = 16800$.
10. Answer: $C_{10}^2 = 45$.
11. Answer: $C_6^3 + C_4^3 = 24$.
12. Answer: $C_{10}^3 - C_4^3 = 116$ or $C_6^1 \times C_4^2 + C_6^2 \times C_4^1 + C_6^3 = 116$.
13. Answer: $C_6^2 \times C_4^1 + C_6^3 = 80$.
14. Answer: $A_{10}^3 = 720$.
15. Answer: $A_6^1 \times A_4^2 \times \frac{3!}{1!\times 2!} = 216$.

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16. Answer: $A_6^1 \times A_4^2 \times \frac{3!}{1! \times 2!} + A_4^3 = 240$.
17. Answer: $10 \times 10 \times 10 = 1000$.
18. Answer: $6 \times 6 \times 4 \times \frac{3!}{1! \times 2!} = 432$.
19. Answer: $4 \times 6 \times 6 = 144$.
20. Answer: $6 \times 6 \times 6 + 4 \times 4 \times 4 = 280$.

Fifth Instrument

After the online exam, the 5-points likert scale survey shown below was filled by the 22 students in the second year secondary to answer the research questions on a scale from 1 to 5 where 1: strongly disagree, 2: disagree, 3: undecided, 4: agree and 5: strongly agree.

		Answers				
Nb	Question	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	In a digital learning environment created outside the school, the lesson "counting" was successfully taught through the WhatsApp platform and the Microsoft PowerPoint presentations.					
2	The lesson "counting" can be completely taught to other students in the same way in other schools and classes.					
3	The students-teacher online interaction and collaboration, through the WhatsApp, was necessary for the successful completion of this digital learning experience					
4	It is possible teaching other math lessons via WhatsApp and the PowerPoint presentations to students in other classes and levels.					
5	After this experiment, I am willing to study a second lesson in mathematics via the WhatsApp platform and the Microsoft PowerPoint presentations.					

Exam Evaluation According to Anderson's Taxonomy

For evaluation, the online exam was examined according to Anderson's taxonomy.
Understanding: question 1.
Applying: questions 2, 3, 10, 14, 17.
Analyzing: questions: 4, 5, 6, 7, 8, 9, 11, 12, 13, 15, 16, 18, 19 and 20.
There were keywords in each question related to the analysis level, as shown in the followingtable:

Question	Keywords
4	around a round table
5	distinct, the given numbers including zero
6	distinct, contain the digit 6, the given numbers including zero
7	microbus, seats
8	anagram with a meaning or not, once
9	anagram with a meaning or not, once, start, end
11	simultaneously, same color

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	12	simultaneously, at least one
	13	simultaneously, at least two
	15	successively without replacement, one
	16	successively without replacement, at most
	18	successively with replacement, two exactly
	19	successively with replacement, first, only
	20	successively with replacement, same color

IV. Data Collection Procedure: The 22 students filled the online survey through a link on WhatsApp. In addition, the researchers have collected their scores after submitting to the online exam.

Data Analysis

After filling the survey and submitting the online exam, the researchers have collected the data,imported it from the Excel Spread Sheet into the Statistical Package for the Social Sciences (SPSS) for analysis.

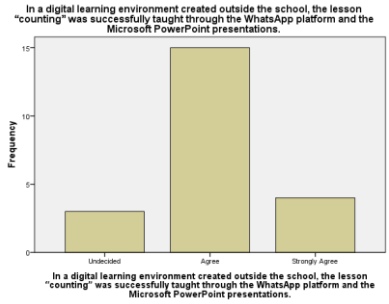
Each of the tables 1, 2, 3, 4 and 5 represent the frequencies and percent of each of the research questions

Table 1: Descriptive Statistics for the First Research Question (Frequency and Percent)

In a digital learning environment created outside the school, the lesson "counting" was successfully taught through the WhatsApp platform and the Microsoft PowerPoint presentations.					
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Frequency	0	3	0	15	4
Percent	0%	13.6%	0%	68.2%	18.2%

Concerning the first research question, the table above has showed that "counting" can be taught to other students in other schools via WhatsApp and the PowerPoint presentations as 68.2% agreed and 18.2% strongly agreed about it.

Chart 1: Bar Diagram for the First Question of the Survey



According to the above diagram, the majority of students believed that "counting"was successfully taught through the WhatsApp platform and the Microsoft PowerPoint presentations in the digital learning environment created outside the school.

Table 2: Descriptive Statistics for the Second Research Question (Frequency and Percent)

The lesson "counting" can be completely taught to other students in the same way in other schools and classes.					
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Frequency	1	6	2	10	3
Percent	4.5%	27.3%	9.1%	45.5%	13.6%

Concerning the second research question, the table above has showed that, 31.8% disagreed, 9.1% are undecided and 59.1% agreed about the possibility of teaching the lesson "counting" completely to other students in the same way in other schools and classes.

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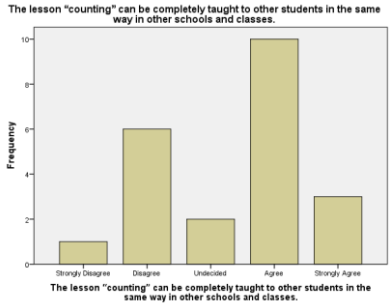
Chart 2: Bar Diagram for the Third Question of the Survey



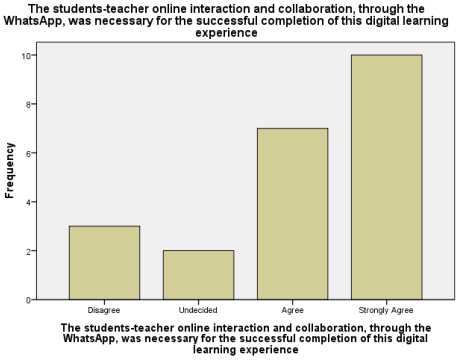
According to the above diagram, not eve ibility of teaching the lesson "counting" completely to other students in the same v e were skeptical while others were under the impression that it could not be achieved.

Table 3: Descriptive Statistics for the ThirdResearch Question (Frequency and Percent)

The students-teacher online interaction and collaboration, through the WhatsApp, was necessary for the successful completion of this digital learning experience.					
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Frequency	0	3	2	7	10
Percent	0%	13.6%	9.1%	31.8%	45.5%

Concerning the third research question, the table above has showed that,most students backed up and supported the importance and the necessity of the students-teacher online interaction and collaboration, through the WhatsApp, for the successful completion of this digital learning experience.

Chart 3: Bar Diagram for the Third Question of the Survey



According to the above diagram, most students believed that the students-teacher online interaction and collaboration, through the WhatsApp, was necessary for the successful completion of this digital learning experience.

Table 4: Descriptive Statistics for the Fourth Research Question (Frequency and Percent)

It is possible teaching other math lessons via WhatsApp and the PowerPoint presentations to students in other classes and levels.					
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Frequency	1	2	6	9	4
Percent	4.5%	9.1%	27.3%	40.9%	18.2%

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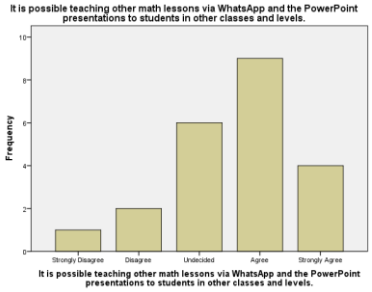
Concerning the fourth research question, similar to the second research question, the table above has showed that, 13.6% disagreed, 27.3% are undecided and 59.1% agreed about the possibility of teaching other math lessons via WhatsApp and PowerPoint to students in other classes and levels.

Chart 4: Bar Diagram for the Fourth Question of the Survey



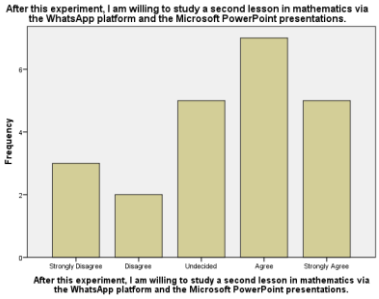
According to the above diagram, not everyone was favorable about the possibility of teaching other math lessons via WhatsApp and the PowerPoint presentations to students in other classes and levels. Some were skeptical while others were under the impression that it could not be achieved.

Table 5: Descriptive Statistics for the Fifth Research Question (Frequency and Percent)

After this experiment, I am willing to study a second lesson in mathematics via the WhatsApp platform and the Microsoft PowerPoint presentations.					
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Frequency	3	2	5	7	5
Percent	13.6%	9.1%	22.7%	31.8%	22.7%

Concerning the fifth research question, the table above has showed that 22.7% disagreed, 22.7% are undecided and 54.5% agreed about studying a second lesson in mathematics via the WhatsApp platform and the Microsoft PowerPoint presentations.

Chart 5: Bar Diagram for the Fifth Question of the Survey



According to the above diagram, not everyone was willing to study a second lesson in mathematics via the WhatsApp platform and the Microsoft PowerPoint presentations after this experiment. Some were skeptical about it, others were against it, while 54.5% endorsed it.

Table 6: Descriptive Statistics for the Sixth Research Question (Percent)

According to the results of the "counting" online exam:	Percent
What percent of students passed the exam?	95.45%

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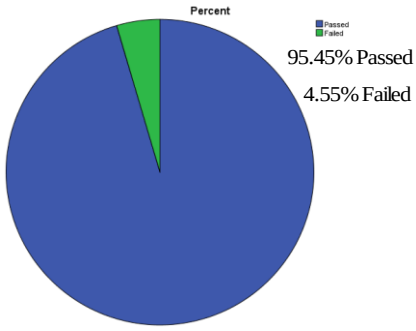
Concerning the sixth research question, 21 students out of 22 have passed the exam, while only one student failed it. Meaning that 95.45% of the participants have passed the "counting" online exam,while only 4.55% failed it.

Chart 6: Pie Chart for the Sixth Research Question



The "Counting" Online Exam Pie Chart

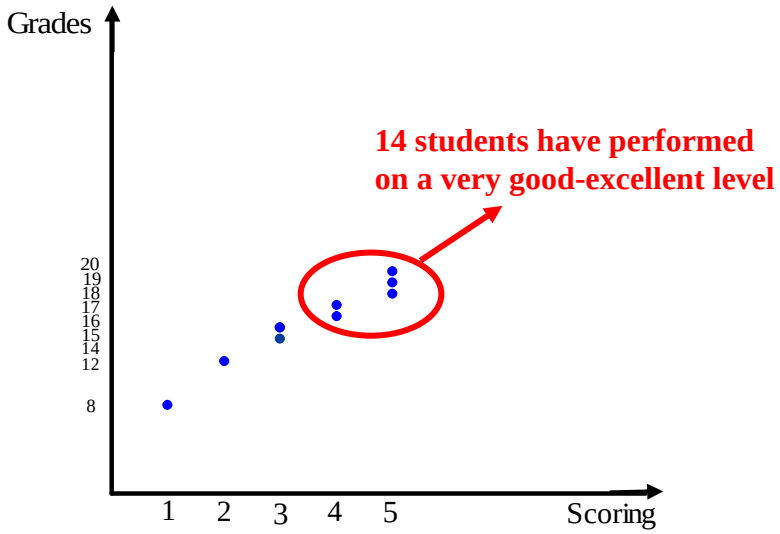
According to the above chart, 95.45% of the participants passed the "counting" online exam, while only 4.55% failed it.

Table 7: Descriptive Statistics for the Seventh Research Question (Mean)

According to the results of the "counting" online exam:	Mean
What was the class grade average?	16.0455

Concerning the seventh research question and according to the results of the "counting" online exam, 16.0455 was the class grade average. Meaning that students' performance in the online exam was very good (Campbell, 2020).

Chart 7: Scatter Plot for the Seventh Research Question



On the scoring axis, 1 is for failure, 2 is for an average performance, 3 is for good performance, 4 is for a very good performance and 5 is for an excellent performance.
According to the scatter plot, as the scoring values increase, students' grades increase, which indicates a strong positive linear relationship between them?

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V. OPEN-ENDED INTERVIEW

An open-ended interview is used to gather information from different people. In this type of interviews, the focus is usually on the interviewees' thoughts and feelings (Thibodeaux, 2019).

In a final step, the researcher has gathered the answers of the 22 participants in the study.

Concerning the first research question, most students were satisfied. They thought that WhatsApp and the PowerPoint presentations were capable of delivering the information in a proper and simple way.

They were able to understand the content in the slides because of the way the lesson was constructed and delivered. The animation, images and colors were an essential part in grabbing their attention. In addition, they were able to review it multiple time for better understanding.

Plus, the WhatsApp was the perfect platform used to interact with the teacher. Through it, they were able to ask questions as much as they needed.

Despite that, three persons disagreed simply because they still prefer the traditional teaching inside the classroom. They were accustomed to indoctrination by the teacher in person.

Concerning the second research question, 1 student strongly disagreed about it while 6 disagreed and 2 were skeptical. These students believed that this lesson can be completely taught to other students if they are willing to collaborate with the teacher. In addition, they believed that the teachers must have the will and abilities to do so. They have to be willing to move into an interactive digital learning environment.

The remaining 13 students believed that it can be taught to others because students in this class are usually aware of what benefits them and willing to collaborate.

Concerning the third research question, 3 students disagreed and 2 were undecided. Their rejection was also due to the traditional environment they grew up accustomed to since early classes.

The remaining 17 students believed that WhatsApp were extremely essential for the successful completion of this learning environment because they had many questions to ask at the end of the slides and WhatsApp was their way to do so.

Concerning the fourth research question, 1 student strongly disagreed, 2 disagreed and 6 were skeptical. These students believed that the hardiness of other math lessons will definitely be an immovable block to avoid. According to them, not all chapter can be taught because of the specificity of some math lessons.

The remaining 13 students believed that it can be done if the lessons are divided and gradually presented. In this way, we can avoid the hardiness of any lesson, especially with the presence of WhatsApp for direct interaction with the teacher.

Concerning the fifth research question, 3 students strongly disagreed, 2 disagreed and 5 were skeptical. Reason behind it was that they were supportive of the traditional teaching in class. In their opinion, teaching is the responsibility of the teacher and he should be the one delivering the content in person not digitally.

The other 12 students were willing to study another lesson because of the formidable way "counting" was presented and because WhatsApp will be there for any needed future interaction.

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VI. CONCLUSION AND HYPOTHESES

Conclusion

Results of the study conformed to Moran, Seaman and Tinti-Kane (2011), Syamala Devi, Lakshmi and Gouthami (2019) and Watanabe-Crockett (2020).

Teaching the lesson "counting" WhatsApp and the PowerPoint presentations was successful. Though, achieving this success put a lot of pressure on the reseaerchers, and it should be the same for those who are going to construct the slides for well-designed presentations.

Many elements interfere in the success or failure of any experiment. The teacher must be patient, skilled and with deep knoweledge in the lesson to properly construct it in the PowerPoint slides.

In addition, students must take things seriously, interact and collaborate in a way that serves everyone.

In simple words, as elaborated about by Syamala Devi, Lakshmi and Gouthami (2019), the teachers and their students share a common responsibility in any digital learning environment. Both of them make it a success and evading responsibility by any of them will for sure turn it into a huge failure.

Hypotheses

Based on the answers provided by the answers of the 22 interviewees in the online survey andthe results of the online, the researchers can hypothethize that:

H_1: In a digital learning environment created outside the school, the lesson "counting" can be successfully taught through WhatsApp platform and the Microsoft PowerPoint presentations.

H_2: Teaching "counting",to other students in the same way in other schools and classes, depends on students' complete participation andteachers' skills and willingness to move on from the traditional teaching approach inside the class to a digital one.

H_3: The students-teacher online interaction and collaboration, through WhatsApp, is necessary for the successful completion of this digital learning experience.

H_4: Teaching other math lessons via WhatsApp and the PowerPoint presentations to students in other classes and levels depends on students' complete participation and teachers' skills and willingness to move on from the traditional teaching approach inside the class to a digital one.

VII. RECOMMENDATIONS

For the teachers

- Teaching online is all about innovation. It presents us the opportunity to develop new skills and become innovative(Nielson, 2011).In hard times like during the corona virus pandemic,teachers should not be stuck in the old structured classes. They have to leave the bricks that have been surrounding them for many years. Online teaching is not only about delivering the content to students, for that teachers should be creative in their ways of presenting it.

- Teachers have to realize that many students, like those in Lebanon, are used to sit down and be indoctrinated during the learning sessions. They are accustomed to seeing the teacher in person while he is delivering his content. They are used to listen and write down many notes on their copybooks. That is why online learning can be difficultfor many students because they have not grown accustomed to since their early classes. In this case, the online student-teacher interaction is extremely important. Teachers should keep on interacting with their students by using what is available and economically affordable to do so, like WhatsApp, for the successful completion of this digital learning experience.

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- Teachers are advised to use the same combination of WhatsApp and PowerPoint in teaching "counting". In this way, they can invest the work done in "counting" in favor of the lesson "probability". By them doing so, they create a conceptual field, cognitive theory that occupies aims at creating a consistent framework and some basic principles to study the development of learning in complex situations(Bessot, 2015), the "counting" lesson here.

- In her article, Nielson (2011) recommended those who are associated with the online world to learn a lesson from social media. Online learning become more relevant if we are able to connect a larger number of students and teachers. In this way, learning become interesting and richer with the online interaction provided by their presence (Nielson, 2011). Thus, teachers have to provide their students with the proper interaction that eases students' online learning experience, especially for those who are used to the traditional schooling.

- Due to the success of the current digital experiment, teachers of different materials may replicate it. Nonetheless, they have to be aware that constructing the slides in a way that fits all students as much as possible and interacting with them later on are fundamental elements for the success of this learning experience.

For the students

- For many students, for a number of reasons, learning at home is not viable for them. They are used to sit in class where the teaching and learning take place. They have to realize that a digital environment flourishes because of their participation and collaboration, while their opposition and resistance shall definitely demolish it.

For the researchers

- It is not easy to teach mathematics to students. Through the years,many suggestedways to use social media in education (Figure 8)(Chesser, 2013; Wallace, 2019). This research has integrated WhatsApp with the PowerPoint to teach students "counting" digitallyand not one single paper was used by the researchers. It is advised forfuture researchers to use this integration and examine its impact in teaching other math topics like function and 3D geometry.

Figure 8: Social Media An Awesome Tool for Education. (Chesser, 2013)

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