

Learn By Gaming: Critical Thinking

Nathan Falzon

Abstract—The TTM (Traditional Teaching Method) has become dated, students have become less complaisant, and attention is harder to retain. Using technology to draw, retain and sustain attention has become one of the most successful businesses. In this research, a comparison is made between two different teaching styles, TTM and LBG (Learn By Gaming), by testing the students' abilities after exposure to the content. This research proposes that with the use of the Unity Gaming Engine, C-Sharp and a Standard Numerical Scale (0 to 100), students taught by LBG can outperform the TTM.

I. INTRODUCTION

School, to the average student, may seem tedious and unappealing. As generations evolve, more effort is needed to keep the student body's attention. New, mass-produced, online, personal media outlets, such as Skill Share (An online, subscription-based platform that allows people of all ages to learn several skills in their own time), and YouTube tutorials; are currently surpassing the education system in maintaining attention and retaining information [8]. Students continue to evolve and would therefore require different means of education, yet the education system has barely made any changes since the Middle Ages; students must sit and idly listen to a teacher convey information [9]. Although classes have become more technologically advanced; for instance, through interactive boards and projectors, lecturing methods have mostly remained unchanged, even though the system is becoming more academically challenging.

Gaming has moved away from being a trend, to an everyday activity that an estimated 2.7 billion people take part in [4]. Games have become more industrialized, interactive, entertaining, immersive, replay-able, and detailed. The former qualities should be a description for any lecture. Lectures should be produced with maximum efficiency for the general audience, every class should be made interactive; inspiring students to participate in the lessons. A class should not be mundane nor dull, it should be in-depth and can be revisited [10].

As of writing this paper, the world finds itself amid a pandemic that is disrupting daily routines due to social distancing laws. As of April 8th, 2020, 188 countries suspended schools, and over 90% of enrolled students are no longer enrolled [7]. A survey by the Mental Health Charity 'Youth Minds' reported that 83% of participants; who had a history of mental health illness; deteriorated mentally [7]. 8 out of 10 students reported having trouble focusing on school work and avoiding distractions [1]. The current schooling system is doing the best it can to comply with the social distancing law by holding online lectures and recording class sessions so students could revisit the material if they lose focus. Studies have shown that gamers tend to pay more attention and are able to filter

information better [6]. Utilising a gaming medium to teach and train students should in theory, increase the overall attention and enhance performance

The following segment will include the research question followed by the hypothesized answer.

- Which of the two methods was better, and by how much?
 - LBG would out perform TTM by about >10%
- Which of the two methods was more entertaining?
 - LBG would be more entertaining.
- Which of the two methods worked best with respect to paying attention attention?
 - LBG would retain more attention.
- Which of the two methods was overall more efficient?
 - LBG would be more efficient.

II. LITERATURE REVIEW

"Games have been used as a learning tool for centuries. Chess was used to teach strategic thinking as far back as the Middle Ages, and the game of Kreigsspiel was invented in 1812 specifically to teach Prussian officers' strategy. Beyond military strategy, the genesis of Kindergarten in the mid-1800s was Friedrich Fröbel's ideas of learning through play." (G Cahill, 2020) [2].

As in the above mentioned, there have been many instances throughout history where games have been used as a teaching method. Recently, due to the static, unchanging nature of our educational system, various experiments and research have been conducted in order to try and use gaming to improve our educational system.

One such experiment was conducted by Lauren M. Caldas et. Al [3], where an escape room was used to test pharmacy students' knowledge on non-sterile compounding.

The concept of the experiment was as follows: the escape room created a gaming environment, making use of puzzles focused on the advanced topics of non-sterile compounding. To evaluate the efficacy of the experiment, a pre and post assessment was done on all participants and the results were compared.

To assess the students' perceptions of educational escape room gaming, a previously validated survey was modified and administered at the end of the experiment. Possible influencing factors were also identified and noted.

Thirty students participated in this experiment, completing both assessments and surveys. Of the participants, 3 out of the four teams managed to escape the non-sterile compounding escape room activity. It was noted that previous participation in an escape room of any kind did not statistically alter or interfere with the results and did not give one student group

advantage over another however students with an experience of a prior successful escape were more likely to be successful compared to the other cohort.

From the results, it was noted that this method of teaching improved performance regardless of successfully completing the non-sterile compounding escape room activity, with assessment scores improving significantly.

Overall assessment scores improved from a median of 50% (pre assessment) to a median of 83.3% (post assessment), p-value < 0.0001. Furthermore, it was noted that assessment scores significantly improved after the activity for 3 of the 6 questions that were asked.

On asking the participants, it was reported with a strong majority that this method was overall positively perceived. Students either disagreed or felt neutral that the activity was detrimental to their ability to learn the subject material.

A paper published by Nina Dorfner and Rana Zakerzadeh [5] also emphasizes the importance of games in a teaching environment. It was reported that in order for an academic game to be effective, there must be six essential elements:

- 1) Goals – Defining the learning objectives and outcomes of the game
- 2) Preparation - Designing of the activity
- 3) Tools - Any aids, videos or resources that can be used for the game
- 4) Activity - The actual game and how the activity unfolds. This includes participation
- 5) Monitoring - Checking in and observing to make sure the initial goals are being met
- 6) Assessment – Data is collected from pre, mid and post surveys

The above mentioned is relevant in today's situation. The COVID-19 pandemic impacted a variety of things worldwide, including the classroom setting and the way students engage in a classroom. Due to the spread and measures as a result of said pandemic, the students' engagement in a classroom may have been negatively affected due to the fact that now, there is less interaction with peers. Incorporating gaming into a teaching environment has been recommended as a way to reduce anxiety associated with learning as well as to boost student performance and learning (in this paper, for biomedical engineering courses)

This research makes use of a bingo game as the learning tool, to practice cardiovascular mechanics. In this bingo game, the instructor would choose the appropriate keywords and then, through a bingo card generator, the cards would be created and then put in a shared folder. The students would access the cards and the appropriate instructions as to how the game is played would be distributed as there are many varieties of the same game.

In this experiment, all 38 students were invited to participate with 35 completing the activity and answering the post activity questionnaire. The results revealed that the students had a positive reaction to the game and felt motivated to participate. To replicate this motivation, students were recruited on a

voluntary basis, with no rewards/punishments so as not to persuade or dissuade students to participate.

After the activity, a questionnaire was distributed, asking if students felt more engaged and focused on the material being taught. The Likert Scale was used to represent the students' opinion (1 = strongly disagree, 5 = strongly agree).

The results were as follows:

- 89% of students agreed or strongly agreed that they had fun while playing Bingo
- 72% of students felt that the game instructions were easy to follow and did not distract from course material. In addition to this, participation was present as the students reported that they felt comfortable enough to ask a question on zoom if they had one.
- 68% of students reported that this method of teaching encouraged them to participate more, also taking away from the anxiety of asking questions.
- 94% of participants agreed/strongly agreed that through this method of learning, they felt more focused and stimulated to focus on what was being taught.

In view of the above mentioned survey results, it was concluded by the researchers that learning by gaming increased the overall engagement and participation of students in a classroom setting.

Whilst the system is far from perfect and there is more research and adapting to be done before learning through gaming is adapted into our educational curriculum, research such as the above mentioned give encouraging results and would encourage the development of a new system, one formed through traditional teaching methods combined with modern technology.

III. METHODOLOGY

By using the standard testing method after playing with the interactive game, this paper believes that test marks will increase.

With this research, schooling systems may become more interactive, less mundane and better planned. Students may be better encouraged to pay attention, participate, and understand the subject deeper. To prove this hypothesis this paper will:

- 1) Survey the participants to check for the level of knowledge on the subject.
- 2) Test a control and test group using a standardised Multiple-Choice test. (Tests were composed by Dr. Adrian Richards)
- 3) Evaluate the data gathered and be charted.
- 4) Survey the participants to gather intel on their experience.

This research proposes to find the following:

- 1) Which of the 2 groups scored higher in average?
- 2) Whether the test group enjoyed being taught in this manner?
- 3) Is this a sustainable way of teaching?

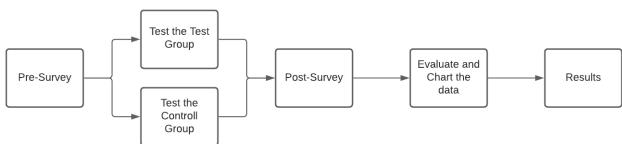


Fig. 1. Research Pipeline

IV. FINDINGS

A. Pre-Survey

As stated in the pipeline, a pre-test survey was conducted to evaluate whether the test subjects have had previous experience with Critical Thinking and if they had ever heard of Learn by Gaming. The below pie charts show their responses. Due to limited time frame and covid, this paper had run its experiment on 10 people, half of which will be the control and half of which will be test. This means that it is not very representative of the general public.

Per the first query, half the subjects were pre-disposed to Critical Thinking classes. As expected, since half of the participants attended MCAST university, and the other half did not. The testers were handpicked. Although this may cause bias results, the reason these candidates were picked was to diversify the results. Having people from different backgrounds and education levels since there was a short number of participants.

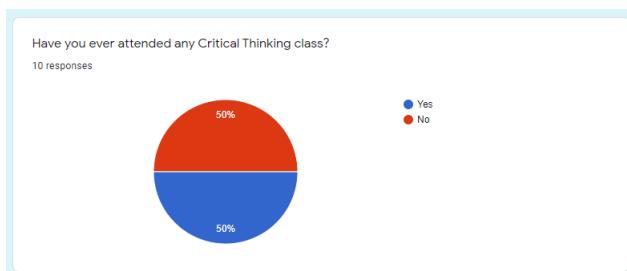


Fig. 2. Pre-Survey Question 1

Majority of the participants have had experiences with academic literature. This may improve the participant's average score. The other 30% had not been to post-secondary education.

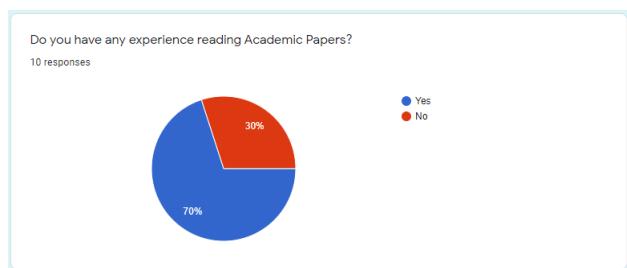


Fig. 3. Pre-Survey Question 2

The majority consensus was that no one had ever heard of Learn by Gaming nor the term Gamification. This brings about a concern that the majority are not aware of different forms of education.

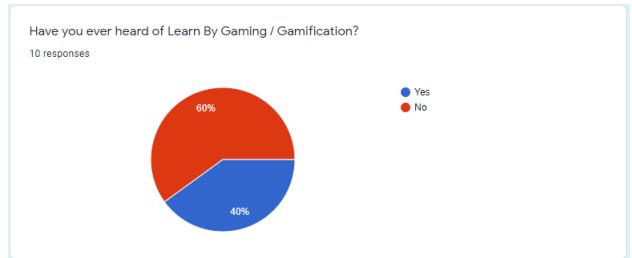


Fig. 4. Pre-Survey Question 3

As of the pre-survey, majority consensus would attempt to be taught in such manner. Participants seem inclined to be educated in alternative teaching methods.

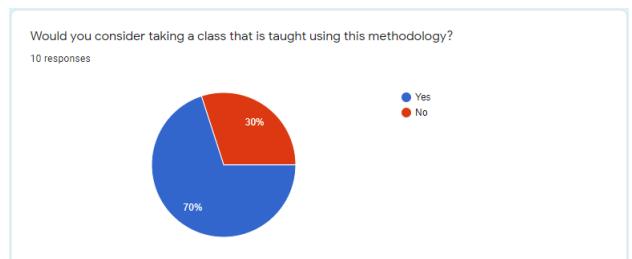


Fig. 5. Pre-Survey Question 4

B. Preparation

To prepare both groups, they were given one week to go through the given notes. Per the notes the two subjects were given different styles of notes. The control was given traditional notes, via a PDF document. The test were given the application. The application is a more interactive version of the notes. Clicking and interacting with the material would reveal more information as to why a particular phrase was Formally Place, Grammatically Correct, Relevant to today's findings and whether it was Technical. Testing that a small change, such as adding interactivity, can enhance understanding.

C. Testing

Along with the notes, the participants were given the exam they must take. The exam was explained and answered. The results were unexpected. Per the hypothesis, the test scored higher the control by around 10%. The results however, were an average of 45.4% for the control and 55% for the test.

D. Post-Survey

Two separate surveys were conducted for the post-survey. One for the control and one for the test.

1) *Control*: The control was asked to comment on the simplicity of the provided notes. The majority of the participant found it to be confusing. This may be due to the formatting and / or due the nature of non-interactivity. As the participants had no control, nor had any interactivity with the notes they may have found it hard to retain/understand the information provided

How did you find the notes?

5 responses

Confusing

A little confusing but managed

I thought I understood

Okay

I got confused

Fig. 6. Post-Survey Control Question 1

The control was asked to rate the level of understanding. As hypothesised the level of understanding was found to be low. This finding may be due to either having formatting and / or lack of interactivity

Rate your level of understanding.

5 responses

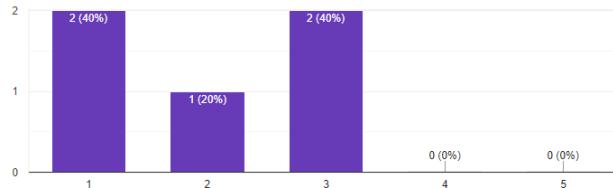


Fig. 7. Post-Survey Control Question 2

2) *Test*: The test were given similar questions as the control. When asked to comment on the application the participants would have preferred if the learning part was more entertaining or more vibrant. The notes were found simple due to their interactivity.

How did you find the app?

5 responses

Could have been more fun

Interesting, could be more entertaining

Great idea, needs improvement

I didn't understand

Pretty cool

Fig. 8. Post-Survey Test Question 1

When asked to rate their level of understanding there was a small increase compared to the control. This may be due to the format, being easier to traverse through the notes and filter through the information.

How did you find the notes?

5 responses

Confusing

A little confusing but managed

I thought I understood

Okay

I got confused

Fig. 9. Post-Survey Test Question 2

In addition the test group was asked whether they would attempt Learn by Gaming again. 3 out of 5 had agreed that they would. Although the sample size is small, it does portray Learn by Gaming in a sustainable and interesting method of Learning.

Would you attempt this again?

5 responses

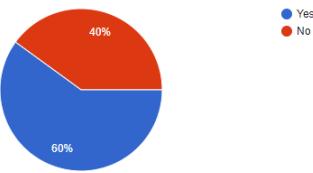


Fig. 10. Post-Survey Test Question 3

V. CONCLUSION

This research has shown concluded that Learn by Gaming can outperform the Traditional Teaching Method of allocating notes and explaining the material. Although the sample size is small, this paper highlights the possible potential of a more interactive, entertaining methodology of teaching. The participants had struggled to pass the final exam. This may be to the lack of leniency during the correction, as all of the correct options had to be chosen to be allocated to earn a mark rather than a mark per correct choice.

Interactivity can improve understanding. For improvement, focus more on making the material easier to traverse through, more vibrant, and more entertaining and lenient method of teaching.

VI. SUPPORTING MATERIAL

REFERENCES

- [1] Covid-19: Student survey, Oct 2020.
- [2] Gavin Cahill. Why game-based learning?
- [3] Lauren M. Caldas, Heidi N. Eukel, Abigale T. Matulewicz, Elena V. Fernández, and Krista L. Donohoe. Applying educational gaming success to a nonsterile compounding escape room. *Currents in Pharmacy Teaching and Learning*, 11(10):1049–1054, 2019.
- [4] J. Clement. Number of video gamers worldwide in 2020, by region (in millions), Jan 2021.
- [5] Nina Dorfner and Rana Zakerzadeh. Academic games as a form of increasing student engagement in remote teaching. *Biomedical Engineering Education*.

1) Technical: Proper name of the virus
 2) Relevant: There are over 107 million registered cases of COVID-19 worldwide.
 3) Relevant: Malta currently has a low transmission rate, with an average of less than 10 cases per day.
 4) Relevant: Malta has had a total of 36,500 confirmed cases.
 5) Relevant: Malta has 30,000 recoveries and 417 total deaths.
 6) Relevant: The current response to public health measures and regulations set by the public health authorities has significantly managed to bring down the active cases in Malta.
 7) Formal: The first reported case of the COVID-19 virus was in Wuhan, China. Since then, there have been over 107 million registered cases worldwide.
 8) Relevant: There are more than 167 million registered cases worldwide, with 3.4 million deaths and 140 million recoveries.
 9) Relevant: Malta has had a total of 36,500 confirmed cases, with 30,017 recoveries, 72 active cases and 417 total deaths.
 10) Formal: The public health measures set by the authorities have been highly efficient, bringing down the active cases in Malta from 3000+ to 72 per few weeks.
 11) Relevant: Technical Properties for the procedure stated beforehand. Not despite mitigation measures taken, the number of cases has increased.
 12) Relevant: Technical Properties for the procedure stated beforehand. Not despite mitigation measures taken, the number of cases has increased.
 13) Grammatical: Was grammatical error.
 14) Relevant: As stated, only about arrived and symptomatic patients were admitted. Later, this was extended to account for local transmission.
 15) Relevant: Secondary schools have already reopened.
 16) Relevant: Universities are still opting for an online method of teaching.
 17) Relevant: People can meet in groups of 4.
 18) Relevant: Technical: Malta has invested in many ventilator machines in preparation for a predicted surge of COVID-19 cases. Furthermore, more ICU beds were added and further ICU's were opened to account for the predicted increase.
 19) Relevant: Plans for a prefabricated hospital were in place; these were later scrapped.
 20) Relevant: There are 7 testing centres, in Pembroke, Bid Faruq, Mater Dei Hospital, Qormi, St. Luke's Hospital, St. Paul's Hospital and the National Referral Hospital.
 21) Formal: Relevant: To book your test or call the Public Health Helpline on 111 or +356 21340000. The operators will take care of your personal details and you will be given an appointment to make it closer to your place of residence.
 22) Relevant: These measures were all undertaken to reduce the transmission rates in the Maltese islands.

Fig. 11. Screenshot of PDF Version of the Notes

1) Technical: Proper name of the virus
 2) Relevant: There are over 107 million registered cases of COVID-19 worldwide.
 3) Relevant: Malta currently has a low transmission rate, with an average of less than 10 cases per day.
 4) Relevant: Malta has had a total of 36,500 confirmed cases.
 5) Relevant: Malta has around 72 active cases.
 6) Relevant: Malta has 30,000 recoveries and 417 total deaths.
 7) Relevant: The current response to public health measures and regulations set by the public health authorities has significantly managed to bring down the active cases in Malta.
 8) Formal: Relevant: The first reported case of the COVID-19 virus was in Wuhan, China. Since then, there have been over 107 million registered cases worldwide.
 9) Relevant: There are more than 167 million registered cases worldwide, with 3.4 million deaths and 140 million recoveries.
 10) Relevant: Malta has had a total of 36,500 confirmed cases, with 30,017 recoveries, 72 active cases and 417 total deaths.
 11) Formal: Relevant: The public health measures set by the authorities have been highly efficient, bringing down the active cases in Malta from 3000+ to 72 per few weeks.
 12) Relevant: Technical Properties for the procedure stated beforehand. Not despite mitigation measures taken, the number of cases has increased.
 13) Grammatical: Was grammatical error.
 14) Relevant: As stated, only about arrived and symptomatic patients were admitted. Later, this was extended to account for local transmission.
 15) Relevant: Secondary schools have already reopened.
 16) Relevant: Universities are still opting for an online method of teaching.
 17) Relevant: People can meet in groups of 4.
 18) Relevant: Technical: Malta has invested in many ventilator machines in preparation for a predicted surge of COVID-19 cases. Furthermore, more ICU beds were added and further ICU's were opened to account for the predicted increase.
 19) Relevant: Plans for a prefabricated hospital were in place; these were later scrapped.
 20) Relevant: There are 7 testing centres, in Pembroke, Bid Faruq, Mater Dei Hospital, Qormi, St. Luke's Hospital, St. Paul's Hospital and the National Referral Hospital.
 21) Formal: Relevant: To book your test or call the Public Health Helpline on 111 or +356 21340000. The operators will take care of your personal details and you will be given an appointment to make it closer to your place of residence.
 22) Relevant: These measures were all undertaken to reduce the transmission rates in the Maltese islands.

Fig. 12. Screenshot of PDF Version of the Notes

COVID-19 panic, solidarity and equity—the Malta exemplary experience

(SARS-CoV-2)
Proper name of the virus

Abstract
Author Information: Author's Name, Author's Position, Author's Institution, Author's Address
This article has been cited by 1 other article in PMC.

The coronavirus COVID-19 pandemic is a global crisis, with more than 2 million of the world's population infected. Public health authorities across the world are working endlessly to contain the situation. The small nation of Malta has been applied by the World Health Organization (WHO) Regional Director for Europe for the first time to receive the Health Emergency Declaration. This article aims to give a comprehensive summary of the COVID-19 situation, measures, legislations and initiatives for containment and addressing and safeguarding the Maltese nation due to the crisis.

Subject and method
A literature search was conducted using the Google search engine and Maltese online newspapers.

Results
From 1st March (22nd April 2020), the COVID-19 situation in Malta is a total confirmed cases of 444, of which 276 are active cases, 165 have recovered and there were three deaths. Various measures were taken early on, from travel restrictions to the closure of schools and three person gatherings, backed up with penalties. Both public and private sectors are working together to ensure containment and provision of services to the population. Solidarity has spread across the country.

Conclusion
A number of timely measures have been taken. However, it is down to the nation to continue to follow the

The Sentence Is:
 Formal Grammatically Correct Relevant Technical

Fig. 13. Screenshot of Application Version of the Notes

Contraceptive Use in Malta
Charles Savona-Ventura

Abstract
Temporal surveys of family control methods being used within the Maltese population carried out in the 1970's and 1990's had shown a definite shift towards the more effective methods of contraception. The present study was carried out on a mixed gender population of 211 individuals with a strong bias towards the highly educated sector of the population. The respondents reported a higher rate of family control than in previous studies with a greater reliance on the effective methods particularly the barrier method, hormonal manipulation, and sterilization. The latter appeared to be an option limited to the older age groups rather than in the young. There has been a further significant decrease in reliance on the natural methods of contraception including the rhythm method supported by the Roman Catholic Church and coitus interruptus. The study further confirms the increasing secularisation and distancing from traditional values that is occurring in the Maltese population.

Introduction
The Maltese population traditionally follows Roman Catholicism and has been permeated by the church since its formation. This influence was well reflected by a survey carried in 1971 which showed the contraceptive attitudes of the Maltese population. This showed that only about 10% of the population were using an effective method of contraception, while 80% were using natural methods of family control. The latter included the rhythm method. The subsequent decades have seen a trend where the community favours more liberal sexual attitudes and values. This has been associated with changes in contraceptive practices. This present study sets out to assess the current contraceptive practices used by the Maltese population.

Methods
The study was conducted as an anonymous, [https://www.surveymonkey.com/r/3KJLWZD](#) survey. In order to obtain the online survey and questionnaire, information about the survey was sent electronically among medical practitioners, and among the personnel working within the government health (using [https://www.surveymonkey.com/r/3KJLWZD](#)). The survey was also sent to the general public via email. An invitation was sent to the respondents to circulate this invitation to participate among their email contacts. The respondent population numbers 211 individuals, with a male to female ratio of 105:106. Besides information related to marital status, gender, age, and ethnicity, the survey also asked for information pertaining to the respondents' age, marital and educational status. The data were mainly processed using descriptive statistics. The population was subsequently divided into two groups by age and the reported

Fig. 14. Screenshot of PDF Version of the Notes

Underline where the sentence is or is not. Tick the circle(s) that are the most relevant.

1. If / is NOT
 - Formal
 - Grammatically Correct
 - Relevant
 - Technical
2. If / is NOT
 - Formal
 - Grammatically Correct
 - Relevant
 - Technical
3. If / is NOT
 - Formal
 - Grammatically Correct
 - Relevant
 - Technical
4. If / is NOT
 - Formal
 - Grammatically Correct
 - Relevant
 - Technical
5. If / is NOT
 - Formal
 - Grammatically Correct
 - Relevant
 - Technical
6. If / is NOT
 - Formal
 - Grammatically Correct
 - Relevant
 - Technical
7. If / is NOT
 - Formal
 - Grammatically Correct
 - Relevant
 - Technical
8. If / is NOT
 - Formal
 - Grammatically Correct
 - Relevant
 - Technical

Fig. 15. Screenshot of PDF Version of the Notes

Contraceptive Use in Malta
Charles Savona-Ventura

The Title...

Abstract

Temporal surveys of family control methods being used within the Maltese population carried out in the 1970's and 1990's had shown a definite shift towards the more effective methods of contraception. The present study was carried out on a mixed gender population of 211 individuals with a strong bias towards the highly educated sector of the population. The respondents reported a higher rate of family control than in previous studies with a greater reliance on the effective methods particularly the barrier method, hormonal manipulation, and sterilization. The latter appeared to be an option limited to the older age groups rather than in the young. There has been a further significant decrease in reliance on the natural methods of contraception including the rhythm method supported by the Roman Catholic Church and coitus interruptus. The study further confirms the increasing secularisation and distancing from traditional values that is occurring in the Maltese population

The Sentence Is:

Formal Grammatically Correct Relevant Technical

Finish

Fig. 16. Screenshot of Application Version of the Notes

- [6] Matthew WG Dye, C Shawn Green, and Daphne Bavelier. The development of attention skills in action video game players. *Neuropsychologia*, 47(8-9):1780–1789, 2009.
- [7] Joyce Lee. Mental health effects of school closures during covid-19. *The Lancet Child and Adolescent Health*, 4(6):421, Apr 2020.
- [8] Paula Magalhães, Diogo Ferreira, Jennifer Cunha, and Pedro Rosário. Online vs traditional homework: A systematic review on the benefits to students' performance. *Computers Education*, 152:103869, 2020.
- [9] Riché Pierre. *From the Sixth through the Eighth Century*, pages 126–127, 282–298. University of South Carolina Press.
- [10] Rick Reis. Designing and delivering effective lectures.