

# Developing Higher Order Thinking Skills (HOTS) through DOTA Online Game: From the Lens of Students

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**Abstract** - *This research was conducted to establish the relationship between the Match-Making Rank (MMR) of the DOTA to students' Mathematics grade. It also probed into the influence of playing DOTA on students' Mathematics academic performance in terms of class participation, hours spent in studying and their absences. This study, anchored on Gardner's theory of multiple intelligences, is a mixed quantitative and qualitative research conducted during the school year 2017-2018 in one National High School on Mandaue City Division, Cebu, Philippines. Correlational research design was utilized in determining the link between MMR of DOTA players and their Mathematics grade, and basic qualitative research using Colaizzi's method of analysis was used in the analysis the influence of playing DOTA on students' academic mathematics performance, from the lens of the students. Results revealed that the MMR of the DOTA Players has slight but significant relationship to their Mathematics grade. The interview data yields the following themes: a) stress reliever; b) fun and entertainment; and c) serves as a pastime. The outcome of the study also showed that playing DOTA has a significant effect on students' academic performance in mathematics particularly in class participation and to the number of hours spent in studying. The researchers recommended to design a DOTA inspired Mathematics Enrichment Learning Material aimed to improve students' mathematics academic performance.*

**Keywords:** *DOTA Players, Mathematics academic performance, phenomenology, Colaizzi's method of data analysis*

## INTRODUCTION

The advancement of technology has taken the world to a whole new experience and a totally different way of living. How youngsters spend their leisure time has changed. In classical times, they used to play outdoor games to enjoy, but nowadays, they are engaged in video gaming as their past time. One of the online games that is popular among teenagers is DOTA or Defense of the Ancient. DOTA is an online video game where strategy and critical thinking are an essential skill that the player must possess, if the player aims to ace the game. The game uses MMR or Match-Making Rank as a determinant of the players' skill and rank. As the player continues to win battles, his or her MMR rank increases. Having a high MMR simply means that the player is adept of the game. This can be construed to mean that the player has equally high aptitude on critical thinking and strategy.

Video gaming proved to be pleasurable to a lot of youngsters but surely has its negative effects. It can easily lead to addiction to anyone who plays it for a long period of time. It has become a phenomenon to teenagers. According to research of Shinji [1], the official tracker of the number of players of DOTA, 800,000 players had been recorded playing the game at the same time across the world. The record greatly shows how youngsters are getting hooked into video games like DOTA. It also found out by Craton, [2], that video games have adverse effects on teenagers' educational aptitude and psychological health. Moreover, a startling observation on Filipino students, reveals that they excel in knowledge acquisition but far considerably low in lessons requiring higher order thinking skills especially in the Mathematics field. This is even highly justified by the result of TIMSS (Trends in International Mathematics & Science Study) in 2013, which showed that out of thirty-eight (38)

participating countries in Math and Science test, the Philippines ranked 34th.

One best scenario of this kind of situation is the addiction of the students in a National High School in Mandaue City Division, Cebu, Philippines, to this particular video game. This case best presents that people of any social status can be firmly attached to DOTA. The game has been a viral activity online which rapidly spreads across the globe. Inclined with this matter, are the factors that are derived by those who are so much into this game, and the advantages and disadvantages it may bring to someone's lifestyle.

It clearly presented the need to address the challenges that Philippine education is facing, particularly the students' Mathematics performance in relation to the time they spent in playing video games. In addition, lack of research focusing on the relationship between the match-making rank of DOTA players and their mathematics academic performance, prompted the researcher to conduct this study.

#### **THEORETICAL UNDERPINNING**

This study is anchored on Multiple Intelligences Theory by Howard Gardner, a professor of education at Harvard University in 1983, who revolutionized how intelligence is understood. This theory proposes that the outmoded idea of intelligence, based on I.Q. testing, is far too inadequate. As an alternative, it recommends eight different intelligences to account for a comprehensive range of human intelligence [3]. These intelligences are: Verbal-linguistic intelligence, Logical-mathematical intelligence, Visual-spatial intelligence, Bodily-kinesthetic intelligence, Musical intelligence, Interpersonal intelligence, Intrapersonal intelligence, and Naturalistic intelligence

It is assumed in the study that since students have diverse intelligences, the strategies in teaching Mathematics should cater to their differing ways of learning. This includes innovations such as incorporating electronic games like DOTA for educational purposes. For playing DOTA requires strategy and critical thinking, considered higher order thinking skills (HOTS), that is, higher than mere rote memorization. Higher order thinking skills include critical thinking, analyzing, reasoning, synthesizing, evaluating and creating [4]. Classifies HOTS in three classifications: (1) *transfer* which occurs when something is learn in one situation affects how someone learn or perform in another situation, (2) *critical thinking* which evaluates the accuracy, credibility, and worth of information and lines of

reasoning, (3) *problem solving* which transfers knowledge and skills to address an unanswered question or situation [5].

#### **RELATED STUDY AND LITERATURE**

DOTA 2 is a Multiplayer Online Battle Arena (MOBA) game made by Valve, the video game company branded for classics like Half Life and Portal. This game is played in matches between two squads of five (5) players with each squad conquering and depending their own separate base on the map. Each of the ten (10) players chooses and independently controls individual heroes who all have unique abilities and different styles of play. Players gather experience points and items for their heroes throughout the match. Once the group is strong enough, they attempt to attack the enemy's base and destroy all their strongholds or "ancient" to win the game.

According to study of Smith [6] in his article entitled "Bad & Good Effects of Computer Games on Students" that in the midst of varying effects of video games, there are still researches which studied how these electronic games can be harnessed for educational purposes.

According to Gershgom [7], engaging in this game also prompts the player to mislay his/her temper and values. It's basically because of the different languages cast-off during the game, or what is called "Trash Talk". Trash talk is a form of insult or foul language usually found in sports events, and is used to intimidate the opponents and can really provoke them to lose their temper and values. As a result, both opposing sides will fight each other.

The author of the study "Effects of DOTA to the Students" added that gambling is also present in this game. Money for the DOTA players is not essential so it's alright to waste their cash because for them DOTA is the best past time ever. The satisfaction they acquired from playing this game is tantamount to the satisfaction they get from eating. As a consequence, their bodies' immune systems are getting weaker.

An article of Craton [2] entitled "The Effect of Videogames on Student Achievement, reported that video games can undoubtedly lead to undesirable effects such as social isolation and augmented aggression. Although playing games socially with friends as part of balanced lifestyle seems to have positive effects but engaging into violent games can lead to several negative problems.

In school, no learner can claim that they have not heard nor seen this worldwide hit game for this is

famous most especially among young boys that are experienced and some maybe pros in playing this game. According to a research conducted by Nunez [8] in Mindanao State University in Misamis Oriental, Philippines, the game addiction can make impact on academic performances and students stay in computer shops for hours straight or even whole day just plainly playing this game and they would have even lie to their parents in order to abdicate and play the DOTA 2. This affection for the game also made big deals in academic performances on Math that needs deep analysis in problems solving.

DOTA 2 has also been believed to decrease Mathematical performance due to insufficiency of sleep among students during at night, deficiency of studying by the students because of giving less time in school and home study and having a less time for leisure among students after drowning themselves in playing this game. The game also promotes violence among the young minds of the students and creates conflict between the players that could result to ramble among the children. According to study of Hadi [9] the people who studied the video games showed it does not only make impact on Mathematics performance but also trigger the level of aggression among the students that will soon lead to lack of mental health and decreased academic performance.

However, after having all the negative sides of playing DOTA 2 and its impact on the students' performance on Mathematics, there are also several studies which proved that playing video games can lead to a positive mark on students' academic performance. According to Anand [10] in his article entitled "A study of time management: The correlation between video game usage and academic performance markers", interactive video games can improve and lead to greater school performance. The study established that the usage of video games is causally associated to an increase in visual-spatial skills, which often come in handy in the fields of science, mathematics, technology, and engineering. It is clear that in some ways video games such as DOTA 2 can clearly improve and enhance the performance of students in various fields of academic.

In the study by Mugot [11] entitled "Beyond self-selection in video game play: An experimental examination of the consequences of massively multiplayer online role-playing game" reported that complex games may lead to educational success by engaging players in problem solving, critical thinking,

and creativity in various fields. The real time analysis and problem solving are improved for the students' brain is said to be working such as thinking for another strategy to be made or another combo to take out the enemies' characters.

According to study of Anand[10] on the association between video games and students' school performance in IIUM relayed that there are many factors that linked with students' educational performance and some people believe that video games is the sole factor that affects it negatively. The result of the study indicated that there is no relationship between video games and students' academic performance. The study concluded that being a non-gamer does not warranty a student to have high academic performance. In another way, being frequent gamer also does not guarantee student to achieve bad in school.

The study of Posso [12] published in International Journal of Communication entitled "Internet Usage and Education Outcomes Among 15-Year Old Australian Students" narrated that engaging online games increases school performance while using online social media networks reduces academic achievement. Video games theoretically permit students to apply and improve skills learned in school although it is argued that both activities are connected with a great opportunity cost of study.

Video gamers outperform non-gamers on measures of attention and spatial perception, processing speed and working memory according to the study of Bonny, Castanida, and Swanson [13]. In their study, they witnessed a substantial relation between gaming experience and response time on the location memory task. Additionally, the outcomes protracted previous gaming inquiry that recommended that individual differences in gaming experience are correlated with the speed of recalling spatial information from long term memory. The article entitled "Enrichment Effects on Adult Cognitive Development" authored by Hertzog, Kramer, Wilson & Lindenberger, [14] reported that the claims of broad transfer from game training diverge from typical findings in the cognitive training literature on the measures of perception and cognition. Based on the study of Granic, Lobel & Rutger [15] if gamers are recruited to a study because of their gaming experience, they might expect to perform well because of their expertise and can influence performance on measures as basic as visual acuity.

## OBJECTIVES OF THE STUDY

This study aims to determine the relationship between the match-making rank of DOTA players and Mathematics academic achievement of Senior High School students in one National High School in Mandaue City Division, Cebu City, Philippines, for the school year 2017-2018 as basis for a proposed design of Mathematics enrichment learning materials. It also probes into the influence of playing DOTA to students' Mathematics academic performance in terms of class participation, hours spend in studying and their absences.

Specifically, it seeks to describe the profile of the respondents in terms of sex, age, weekly average hours playing DOTA, number of years playing DOTA, match-making rank, and Mathematics grade. It also seeks to determine whether there is a relationship between match-making rank (MMR) of the DOTA players and their Mathematics academic performance. It further aims to determine the benefits of playing DOTA to the student players; the influence of playing DOTA on the students' Mathematics academic performance in terms of class participation, hours spent in studying, and attendance in class.

## METHODS

### Research Design

This study used a mixed method – qualitative and quantitative research design. For the quantitative part, it utilized the descriptive-correlational research design because it targeted to determine the correlation between match-making rank of the DOTA players and their Mathematics academic performance.

For the qualitative part, the study used the simple qualitative design that probes on the experiences of the student DOTA players. After each in-depth interview, the researchers listened to the documented interviews two to three times before transcribing the participant's storylines. The study follows the Colaizzi's [16] analytic method of data analysis. The first procedural step included the extraction of significant statements from the transcripts then formulated meanings were constructed from these. These formulated meanings were grouped into cluster themes then into emergent themes. The results were then put together to come up with a rich description of the lived experiences before they were validated from the participants who in turn confirmed and enriched these descriptions with new or pertinent data.

## Research Respondents

The eligible respondents of this investigation were the students who are DOTA players of one National High School in Mandaue City, Cebu City, Philippines. They were mostly male students coming from Grade 9 and Grade 10 Junior high school students to Grade 11 and Grade 12 Senior high school students. The researchers chose those students who played DOTA at least one hour a day.

The researchers used non-probability sampling method specifically purposive sampling in selecting the respondents of this study - those students who are DOTA players and are willing to cooperate in the study. There were thirty (30) respondents from Grade 9 to Grade 12.

Table 1. Distribution of Respondents

Grade Level	Male	Female	Total	Percentage
9	4	0	4	13.3%
10	3	0	3	10.0%
11	8	1	9	30.0%
12	13	2	14	46.7%
Total	27	3	30	100%

## Research Procedure

A written permit was secured by the researchers with the approval of the principal to allow the researchers to conduct a study and collect data inside the premises of the school. The researchers reassured confidentiality for the respondents' safety purposes. The researchers personally gave the questionnaire to the respondents and gave them 5-15 minutes to answer. As soon as the respondents finished answering the questionnaires, the researchers directly proceeded to the collection and tabulation of data.

## Ethical Considerations

The respondents of this study were explained and informed about the attributes and objectives of the study. An informed consent was presented to the respondents to make sure that they agreed willingly to participate in the conduct of the study.

## RESULTS AND DISCUSSION

Based on Tables 1 and 2, the majority of the students who play DOTA are males, between 17-18 years old, play DOTA for an average 3-4 hours weekly, and have been playing DOTA for more than four years.

**Table 2. Profile of the Respondents**

Variable	Category	F	%
Age	Below 17	7	23
	17-18	20	67
	Above 18	3	10
Variable	Category	F	%
Average Hours Playing DOTA	Below 3 hrs.	8	27
	3-4 hrs.	19	63
	Above 4 hrs.	3	10
Years of Playing DOTA	Below 3 yrs.	9	30
	3-4 yrs.	8	27
	Above 4 years	13	43
MMR	Below 2000	12	40
	2000-3000	8	27
	Above 3000	10	33
Math Grade	Below 80	10	33
	80-90	15	50
	Above 90	5	17

**Table 3. Match-Making Rank of the DOTA players and their Math Academic Performance**

Variable	$\bar{x}$	sd	r	p-value
<b>Grade 10</b>				
MMR	2,257.14	1308.76	-0.181	0.699
Math Grade	81.00	4.51		
<b>Grade 11</b>				
MMR	2,559.44	992.97	0.257	0.505
Math Grade	83.11	4.51		
<b>Grade 12</b>				
MMR	2,694.21	1458.77	0.580	0.030*
Math Grade	86.64	5.00		
<b>Overall</b>				
MMR	2,551.80	5.17	0.363	0.048*
Math Grade	84.27	1269.28		

\* significant at  $p < .05$

As shown in Table 3, the positive value of Pearson ‘r’ affirms that as the DOTA player gets a higher match-making rank, the higher the possibility that he or she has a better performance in Mathematics, than those who are not getting higher ranks.

**Benefits of playing DOTA.** The results yielded the following themes:

**Theme No.1: DOTA is a stress reliever and a help to forget the problems**

The participants shared:

“It is my stress reliever.” (P1)

“Para pawagtang sa problema ug sa stress.” (P5)  
 “To relieve stress, to forget problems, to have fun, and to spend time with friends.” (P6)  
 “Para malingaw ug stress reliever.” (P7)  
 “Para pawala sa stress.” (P10)  
 “Because it take my problem and relax me.” (P22)

Some of the respondents or 6 out of 30 said that they played DOTA to relieve their stress and to forget their problems.

This result concurred with the study of Gause [17] states that the gamers reported that game play was pleasurable largely due to the fact that it helped them to alleviate stress they were experiencing in different areas of their lives. Along the same lines, their significant others also recognized the benefits of the gaming as an outlet to relieve tension and stress.

**Theme No.2: DOTA is just for fun and entertainment**

The participants shared:

“Para malingaw ug di malaayan sa kinabuhi kung walay buhaton” (P2)  
 “For fun, para kalingawan lang gud” (P4)  
 “Maoy kasagaran duwa sa amo ug lingaw sad magduwa ba kay challenging” (P8)  
 “For fun, pampalipas oras” (P13)  
 “Lingawlingaw ra” (P15)  
 “Para malingaw ra sir” (P16)  
 “I just want to play Dota and I just want to have fun with this game” (P30)

Another group of participants said that they played DOTA just for fun and entertainment. This reveals that this particular computer game was mainly played due to the pleasure of entertainment it had brought them. It serves as an outlet for the players to divert their attention and have something fun to do in their leisure time.

This outcome concurs with the study of Swayne [18] who remarked that video online gamers do not only enjoy playing interactive and entertaining games but also treasured them at an immeasurable and more meaningful level.

**Theme No.3: DOTA serves as a pastime**

The participants shared:

“Pampalipas oras ra sir” (P9)  
 “Para malingaw ug pampalipas oras” (P11)  
 “Pananglitan walay assignment sir moduwa kog DOTA, or bored ko sa balay or wala koy trabahuon” (P14)  
 “Because I’m so bored that’s why I’m playing DOTA” (P28)

Based on the data gathered, the respondents have said that playing DOTA serves as their pastime. This shows that the respondents find the game DOTA as an anti-boredom one. People have played DOTA due to the fun they experienced while playing with it.

The results agree with the revelation of one online gamer in the article of Nark [19] "Online Gaming More Than Pastime for Some Gamers" stated that video gaming permits players to do different things. Gamers performs an extension of somebody's imagination when play video games. It's like reading a book but setting yourself in the first-person storyline where players become the one actually dealing with things.

#### **Question 4: What is the influence of playing DOTA on students' mathematics' academic performance**

The results yielded the following themes:

##### **Theme No.1: We keep on talking and thinking of DOTA during class**

The participants shared:

*"Murag Oo sir kay usahay mag-istorya anay ras mga klasmates ug DOTA" (P3)*

*"Oo kay kung naa sa skwelahan magsige ra estorya ug DOTA dili maminaw sa discussion so dili ka participate" (P5)*

*"Naay gamay na epekto, nagsige hunahuna sa DOTA ug sige storya about DOTA" (P7)*

*"Naa, kay murag kog magtama" (P12)*

*"Naa wui kanang dili ko ka participate kay sige rako hisgot ug DOTA" (P15)*

*"Naa kay dili ka focus sa klase kay sige hunahuna sa DOTA" (P16)*

The respondents said that DOTA has a particular impact in their class participations. The negative effect of DOTA is that it made the respondents lose their concentration for their minds are preoccupied about the game. The attentions of the students were diverted for they cannot effectively participate in class due to much discussion about DOTA.

These findings strengthened the study of Eskasasnanda [20] which stressed that too much time spent on playing video game can create players having hallucinations. Daydreaming while moving fingers like holding a mouse and keyboard are the comments of the parents to their students who are playing video games. They occasionally come to a fantasy like far-sighted creatures that actually does not exist.

##### **Theme No.2: Less time to study**

The participants shared:

*"Yes, kay bisan nay test padung DOTA gihapon kay wa man naanad ug study" (P2)*

*"Gamay, kay kung magtuon ka nindot man hinuon iduwa ug DOTA" (P3)*

*"Epekto kaayo kay dili mn ka maka-tuon" (P5)*

*"Yes, I prefer to play than to study" (P6)*

*"Kana naay epekto ky dili na man ko magtuon ky magsige ra duwa DOTA" (P9)*

*"Naka-epekto ky usahay dili nkoka concentrate kay sigera hunanhuna unsaon padako imong rank sa DOTA" (P10)*

*"Naay epekto kay dili ko ka-study tungod sa DOTA" (P11)*

*"Naay wui kay dili nako magstudy kay mag sige rako duwa ug DOTA" (P15)*

*"Dili na man ko magtuon kay magsige ra duwa sa DOTA" (P16)*

*"Yes, because the time in studying, is spent on playing sometimes" (P18)*

*"Yes, because playing Dota will consumed more time even I study, but when I started to study, my mind should concentrate of what I am studying right now" (P30)*

Majority of the participants revealed that playing DOTA made the students fully consume the time to play it instead of using it for studying or reviewing for the exams. At times, it drove the students to skip their classes. This shows the respondents' getting addicted to playing DOTA made them skip classes.

These findings corroborate the study of Hadi [9] which narrated that the respondents was seen playing online video game most of the time especially during their unrestricted period at the computer shop during the sixty (60) hours of observation.

##### **Theme No.3: Some never got absent just because of DOTA**

The respondents shared:

*"No, I only play every weekend" (P1)*

*"No, kung mo-absent koka di pud DOTA angrason, kuan kanang masakit ra ug churva" (P2)*

*"Wala epekto kay dili ko mo-absent tungod ra sa DOTA" (P7)*

*"Wala epekto kay ni skwela jud ko maayo" (P9)*

*"Wala ky dili ko mo-absent, mo-skwela jud ko" (P10)*

*"Walay epekto kay moduwa rako ug DOTA kanang free time nako" (P11)*

*“Wala kay pirmi rako mo-skwela dili ko mo-absent” (P12)*

*“No, because I don’t want to have absences in class just because I play Dota” (P30)*

However, there are 12 among 30 respondents who shared that they never made any absences or skipped classes just because of DOTA. Some have said that they only played DOTA during weekends or their free times. This shows that DOTA did not influence the students negatively with regards to their class attendance

This result concurred with the study of Mozelius [21]. In that study, a student shared that he always takes care of his studies and never missed anything important since without other hobbies he never been short of time.

#### **Question 4: Does playing DOTA contribute a positive mark in the students’ mathematics academic performance?**

##### **Theme: Improves the skills of calculation and estimation in Math**

The respondents shared:

*“Murag naa, kanang, pag.calculate kung asa modagan ang kontra” (P3)*

*“I think yes, my problem-solving skills becomes better and also through logic, I guess” (P6)*

*“Wala. Murag naa sa pagcalculate” (P7)*

*“Naa, ang calculation ni invoker” (P10)*

*“Yes, kay kinahanglan man sad ka mo estimate sa skills” (P19)*

*“Yes, because playing Dota you should calculate faster, so that your enemy cannot kill you faster and you can improve your skills in this game and many more” (P30)*

From the data gathered, 6 out of 30 respondents have said that playing DOTA helps in improving their calculation and estimation skills. Calculation was improved through estimating the distance the enemy have covered up or they might run. These are just some of the skills that can be learned in playing DOTA that are somehow useful in Mathematics.

These findings strengthened many studies regarding the positive effect of online games. Jackson, Zhao, Kolenic, Fitzgerald, Harold & Von Eye [22] established that the usage of video games is causally associated to an increase in visual-spatial skills, which often come in handy in the fields of science, mathematics, technology, and engineering. Complex games may lead to educational success by engaging

players in problem solving, critical thinking, and creativity in various fields.

#### **CONCLUSION AND RECOMMENDATION**

Based on the findings of the study, the researchers conclude the following: The reasons why the respondents played DOTA are: (a) It serves as a stress reliever; (b) It gives fun and entertainment; and (c) It is a good pastime. The benefits in playing DOTA are: (a) It gave them fun; (b) developed values about teamwork, cooperation, multi-tasking, and the skills of problem solving, and (c) made them earn money. The influence of playing DOTA on students’ Mathematics academic performance in relation with class participation is that it made them shift focus from the class topic to talk and think about DOTA during class time. Meanwhile, playing DOTA lessen the hours spent in studying. The effects of playing DOTA on the Mathematics academic performance of the students in relation with attendance in class is mixed: some students made absences in class because of playing DOTA while others never got any absences. As a whole, playing DOTA also had some positive contribution in the students’ Mathematics academic performance, as it improves the skills of calculation and estimation in Mathematics. The researchers recommend that DOTA players, parents and teachers recognize the positive and negative aspects of playing video games. It is important that learners and teachers need to be aware of the dangers of excessive gaming. A balance in time and activities of DOTA players is an important part of a healthy life. They also recommend that a DOTA inspired Mathematics Enrichment Learning Material may be developed to improve students’ skills of calculation and estimation.

The findings of the study affirmed the wisdom of not outrightly excluding electronic games in the roster of pedagogic innovations such as DOTA-inspired learning activities, which have a potential positive mark on the students’ Mathematics performance. If planned and designed well, these activities and learning materials can help sharpen students’ critical thinking, calculation, estimation skills, and contribute to make learning Mathematics engaging, fun and exciting. It can help develop students’ higher order thinking skills.

The study concurred with Gardner’s theory on Multiple Intelligences that recognizes that some students, who are technologically savvy, with visual-spatial intelligence, may prefer pedagogic innovations that integrate electronic games in education, especially in Mathematics.

Due to limitations of time and resources, the sample size of the study was quite limited. It is recommended that a further study be conducted using a bigger sample size with students from a private school to validate the initial study. Furthermore, a follow-up study on the effects of educational and non-educational games influencing the Mathematics academic performance of the students may also be conducted.

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