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Keywords: learning styles, video game genres, differentiation.

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Is there a Connection between Learning Style Preferences and Video Game Genres?

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I. Introduction

Studies have indicated that those who play video games have more developed executive brain functions (Homer et al., 2018). The executive functions of the brain are the set of skills required to plan, monitor, and control cognitive processes of higher order thinking (Homer et al., 2018). Recent findings about executive brain function have prompted scholars to work out different ways for video games to promote education, despite the pushback from opposing sides (Adachi & Willoughby, 2017). With all this information and the continuous use of learning style preferences in differentiation, the question remains if there is a correlation between learning style preferences and video game genres. More to the point, nine learning style preferences could result in a correlation with a video game genre and no more than 10 different genres of video game exist (Ballabio & Loiacono, 2019; Garzon et al., 2016; Hon, 2017; Rismanto et al., 2018; Salvini et al., 2016; Stanesu et al., 2016; Tomai, 2018; Thompson & Lavender, 2017). If a relationship exists, it will provide teachers more differentiation strategies to utilize.

Despite gamification's growing popularity, the classification and meaning of the elements of gamification are a growing concern (Hernandez-Fernandez et al., 2020). According to Hernandez Fernandez et al., if some similarities can be identified among known teaching practices and known elements of video games, then teachers would be more comfortable in using and understanding the classifications of gamification. If a significant correlation between learning style preferences and video game genres exists, then teachers will have a better understanding of the classifications within gamification therefore giving them more strategies for differentiation with using gamification in the classroom. Students would more likely persist in completing the learning exercise because it is presented as a game.

Different developers, game analysis and the video game fanbase, who attempted to classify different genres of video games looked at the taxonomic vocations or the logistical formation of the games, but these attempts lacked consensus (Vargas-Iglesias, 2020). Due to the absence of a consensus, previous studies resorted to a certain randomness in the selection of variables in the way of categorizing video games and loosely classifying them (Vargas-Iglesias, 2020).

According to Vargas-Iglesias (2020) the failure to reach a consensus can be traced to those who used factors, such as statistics and structure, to classify them. Any gamer will attest that using statistics and visuals is not the correct way to classify video games (Vargas-Iglesias, 2020). The classification led to a divide between those in the scholarly community who examined video games and those in the scholarly community who play video games. Due to logistical issues and historical phenomenon, a classification system has been rendered useless to scholars of video game genres (Vargas-Iglesias, 2020).

The genres used in this research were a mixture gleaned from scholarly writings and those of gamers and developers. The game genres were: (a) First-person shooter, (b) Role-playing game (RPG), (c) Massive multiplayer online (MMO), (d) Sports simulator, (e) Racing simulator, (f) Life simulators, (g) Platformer, (h) Fighting game, (i) Strategy games, (j) Survival games (builder games), and (k) Action-adventure.

In simpler terms, the student may just prefer the content presented in a certain way, not that they will not necessarily comprehend another way it is presented. Unlike learning styles, the concept of learning style preferences has scientific research support, and an assessment has been made that tests a person's preferred style that has also been proven reliable (Wong & Chin, 2018). Learning style preferences are broken up into eight basic parts: (a) visual, (b) aural, (c) reading/

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writing, (d) kinesthetic, (e) multi-model, (f) VARK type 1, (g) VARK type 2 and (h) VARK transition (Meyer et al., 2016).

II. Background

Differentiation or differentiated instruction has been the subject of numerous studies and is mostly regarded as one of teachers' essential tools to teach content at any level (Karatza, 2019). Differentiation is one of the main strategies to aid children with the individualization of teaching in the classroom today (Sakellariou et al., 2018). The term differentiation means to change or adapt teaching to meet the needs of the many students in a teacher's classroom (Sakellariou et al., 2018). One of the main elements of differentiation is the teacher needs to differentiate content by utilizing the four primary learning style preferences, which are (a) visual, (b) auditory, (c) reading/writing, and (d) kinesthetic (Evans-Hallman & Haney, 2017). Teachers are only knowledgeable of the four basic learning style preferences, and they may not be aware that there are additional learning style preferences to utilize (Evans-Hallman & Haney, 2017).

Many teachers struggle with the difficulty of using differentiation within the classroom, due to the strict program requirements and the curriculum that teachers must follow (Every Student Succeeds Act of 2015). Teachers find the differentiation skills that they were taught in college are not flexible enough for modern curriculum (Sakellariou et al., 2018). Differentiated instruction is designed for all individual students; however, many academics have found that gifted or talented students, along with English Language Learners (ELLs) and struggling students often lack the support they need for continuous differentiated instruction (Simmons, 2018). In many classrooms, students differ even on the most basic learning styles; this includes how they learn content and their developmental rates (Simmons, 2018). Thus, differentiation is needed to teach students the skills and strategies they need to progress to the next level of education (Simmons, 2018). According to Simmons (2018) many teachers use the terms differentiation and individualization interchangeably. Teachers use the two terms interchangeably as they do not fully understand the meaning behind the two (Simmons, 2018). Differentiation is defined as a means of adapting or the presentation of content to the needs of the students, as a whole (Simmons, 2018). The term individualization is defined as adapting to the needs of a singular student (Simmons, 2018). It is the difference between understand meaning with a group and a singular student that the teachers can not differentiate between the two terms (Simmons, 2018).

Using technology in the classroom gives not only teachers but students a multipurpose tool for learning content; using the mechanics from video game genres in gamification can be used for all students and be individualized towards each student in some way. Technology as a resource allows teachers to generate reports, charts, graphs, and plan assessments, which allows them to collect data on instruction (Parsons & DeLucia, 2005). Technology offers teachers a way of looking at student achievement in real time, as well as refining instruction to meet the needs of both the groups and individual students (Parsons & DeLucia, 2005). The issue is that many teachers do not know how to use or even were to look to gain this technology (Parsons & DeLucia, 2005).

Video games, as of the past 4 decades, have become one of the fastest-growing fields in education, human behavior, and psychology (Adachi & Willoughby, 2017). Scholars have been looking into adapting video games into educational settings, utilizing them for gamification, and deploying them as a template to create educational tools, and training purposes beyond basic education (Barr, 2017). Teachers need to be educated on how to develop strategies that implement the nine learning style preferences as well as coordinating them with the appropriate video game genres and develop as evaluation tool to assess its effectiveness. Researchers have been examining video gaming from a non-biased standpoint (Adachi & Willoughby, 2017). Scholars have continued discussing how technology, including video games, would enhance learning in the 21st century (Adachi & Willoughby, 2017).

III. Research Question

The research question was:

RQ1: Is there a relationship between a person's preference of video game genre and that of an individual's preferred learning style preference?

Ho: There is no relationship between a person's preference of video game genre and that of an individual's preferred learning style preference.

Ha: There is a significant relationship between a person's preference of video game genre and an individual's preferred learning style preference.

IV. Method

The purpose of this research was to determine if a correlation exists between video game genres and learning style preferences. A quantitative study was conducted utilizing the method of convenience sampling (Bennett et al., 2018). Sampling was conducted using survey posted online (Bennett et al., 2018). Convenience sampling was chosen because the online forum was for gamers, the target population for the study. The survey was organized into two parts, with the first part being a questionnaire by VARK Learn Limited (2020). The second part consisted of questions on

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participants' preferences of video game genre. The questions asked the participant how often they play video games in that genre using the following response options: (a) *consistently*, (b) *often*, (c) *seldom*, and (d) *never*.

The first half of the survey consisted of a VARK Learn Limited (2020) questionnaire to discern which learning preference(s) they had. Participants' results of the VARK questionnaire were given to them along with a summery that described their preferred learning style preference(s). Once all the data was collected, a crosstab analysis with a Chi-Square test was conducted to find any significant correlation between the two categorical variables (Kumar & Girotra, 2017). The two variables observed were learning style preferences and video game genres. The independent variable was learning style preferences, while the dependent variable were the video game genres.

The online survey used consisted of gamers, as they make up a large and incredibly diverse community (Haaranen & Duran, 2017). The survey had two questions asking whether the individual filling out the survey is 18 years of age and older and the second question asked if they played video games for 4 or more hours a week. The answer to either question is *YES* or *NO*. If the answer is *NO* to either question, then that survey ended and not be counted in the data for this study. If the individual is under the age of 18, they would not be counted due to ethical restraints. If a person does not play video games, they would not understand the different nuances among the many genres of video games available (Evans-Hellman & Haney, 2017). An online survey and a pre-structured VARK questionnaire to determine learning style preference. Unlike in the past, where learning style preference had remained in organizations, VARK Learn Limited (2020) does not view these preferences as the only way a person learns. VARK Learn Limited (2020) recognizes the possibility that a person may have a mixture of the four basic learning style preferences. Therefore, among the 16 questions, a person can choose more than one of the multiple-choice answers (VARK Learn Limited, 2020). The questionnaire than calculates the participants' responses and formulates their learning style preference based on their answers, thus counting as one data entry point (Wong & Chin, 2018). When the participant completes the VARK questionnaire, it displays the questionnaire results, and it also produces a summery description of the results. The second half of the quantitative study was created to ask more about the results of the VARK questionnaire. The participants indicated their results based on the eight responses, (a) visual, (b) aural/auditory, (c) reading/writing, (d) kinesthetic, (e) multimodal, (f) VARK type 1, (g) VARK type 2, and (h) VARK transition. Once the participant had indicated the VARK questionnaire results, the survey asked how often the individual played each video game genre by selecting from one of four responses: (a) *consistently*, (b) *often*, (c) *seldom*, and (d) *never*.

A cross-tabulation and Chi-Square test to find the relationship between two categorical variables (Ong & Puteh, 2017). The nature of this study was to find the correlation between two categorical values, a cross tabulation (crosstab) was used to analyze the data (Kent State, 2020b). Crosstab is a type of frequency analysis that produces summary measures for categorical variables (Kent State, 2020a).

Table 1: Learning Style Preference Chart

Multiple Preferences		Single Preferences	
VARK Type 2	22.9%	V	4.0%
VARK Transition	5.1%	A	8.8%
VARK Type 1	7.4%	R	9.0%
VRK	2.4%	K	14.2%
VAK	4.1%		
VAR	1.1%		
ARK	5.2%		
VR	1.2%		
VA	0.8%		
VK	2.9%		
AK	6.2%		
RK	2.5%		
AR	2.2%		
Subtotal	64.0%		36.0%

From How Do I Learn Best? By VARK Learn Limited, 2020, p. 4 (Source: https://vark-learn.com/wpcontent/uploads/2019/07/How-Do-I-Learn-Best-Sample.pdf).

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According to VARK Learn Limited (2020), the descriptive statistics shown in Table 1 detail the percentages of both singular learning preference style and a multiple combination of the styles. Table 1 shows the subtotal percentage is higher in the multi preference, with a 64% response compared to the 36% in single preferences (Fleming & Bonwell, 2019). The multiple combinations of the learning style preferences indicate that VARK type 2 is the most common, with a 22.9% response (Fleming & Bonwell, 2019). As for singular learning preference style, kinesthetic is the most common, with a 14.2% response (Fleming & Bonwell, 2019). The data percentages could be used to show a rough baseline for what the data collected in this study could have shown.

V. Results

Posting the survey on Twitter, Facebook and LinkedIn, the survey had received 214 responses. However, almost half did not fit the two inclusion criteria for this study: 18 years or older and play video games for more than 4 hours a week. In addition, 10 were excluded due to missing data. The analysis proceeded with n = 100 participants who responded to all VARK questions, and the game genre questions.

The VARK questionnaire consist of 16 questions where respondents could choose multiple answers to all questions. The game genre question was a simple "Do you play <genre>?", which was used because researchers have reported that classifying different types of video games was nearly impossible (Vargas-Iglesias, 2020). Possible closed-ended responses for the genre questions were: (1) *consistent*, and or *E*, (0) *seldom,* and or *never*.

Figure 1 presents the frequency distributions of VARK types in the current study.

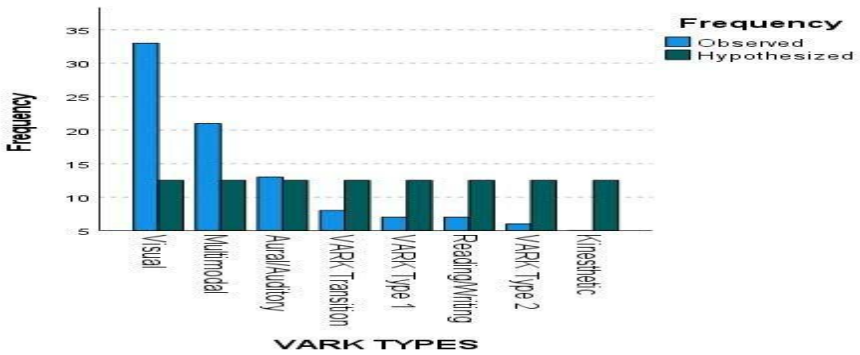

Figure 1: Frequency of Each VARK Type Category of 100 Participants

A statistical Chi-square Goodness of Fit Test was used to assess differences in observed vs. expected frequencies. The Chi-square test of independence could not be used because the data violated the assumption that no more than 20% of cells can have expected counts below 5. As a result, the Fisher-Freeman-Halton Exact Test (FFHET) was run. The null hypothesis stated that each VARK type had an equal probability of being played. The null hypothesis was rejected by the Chi-square goodness of fit test [x^2 (1) = 53.76, $p < 0.001$]. As evident in Figure 1, Visual, Multimodal, and Aural/Auditory were the most characteristic VARK types of the 100 participants in this study.

The results of the cress-tabulation showed that the most frequently played video game genre was the Action/Adventure with 83% of respondents playing it often and consistently. Other genres such as Strategy Games (78%), First-Person Shooters (FPS) (74% consistent/often), Role-Playing Game (RPG) (73%), Fighting (64%), Sports (58%), Platformers (56%), Racing & Massive Multiplayer Online (MMO) (55% each) did not show a significant correlation with a VARK type. Two of the genres did show a correlation and they were Life Simulators (61% played consistently/often) and Survival Games (72%).

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Table 2: Learning Style Preferences in the Current Research Compared to Data from VARK Website.

	Current Study		2018 Data		
	Freq	Pct	Freq	Pct	P-value
Visual	33	33.0	11120	4.0	<0.0001
Aural/Auditory	13	13.0	24464	8.8	0.1383
Reading/Writing	7	7.0	25020	9.0	0.4847
Kinesthetic	5	5.0	39476	14.2	0.0084
Multimodal	21	21.0	79508	28.6	0.0927
VARK Type 1	6	6.0	20572	7.4	0.5928
VARK Type 2	7	7.0	63662	22.9	0.0002
VARK Transition	8	8.0	14178	5.1	0.1876
Total	100	100	278000	100	

Fisher-Freeman-Halton Exact statistic was again used because the 20% rule was violated: FFHET = 30.182, p = 0.024. Here, the null hypothesis was rejected ($p < 0.05$); therefore, the alternative was accepted. A statistically significant relationship exists between the eight VARK types and frequency of playing life simulator games. To assess the pairwise comparisons that contributed to overall statistical significance, post hoc, pairwise comparisons of column proportions were run with z-tests using a Bonferroni adjustment for alpha. SPSS calls this statistical post hoc analysis the "column proportions test" (IBM Corporation). For instance, for the Multimodal learning type, all the cells contain the letter "a" indicated none of the categories are statistically significantly different from each other. However, for VARK Type 1 the category of "Never" 22.2% (2/9) was statistically significantly different from "Often" at 0% (0/41). The remaining two cells in that row had two different subscript letters (a and b) indicating these proportions did not differ significantly from the proportions that contained either letter "a" or "b." Similarly, for VARK Type 2, 22% (9/20) who never played the game were statistically significantly different from 0% (0/30) who seldom played. Nonetheless, there were only seven participants who were classified as VARK Type 1 and six as VARK Type 2.

Table 3: VARK Types by Life Simulator Games

			Life				
			Never	Seldom	Often	Consistently	Total
VARK	Visual	Count	2a, b	15b	14a, b	2a	33
		% within Life	22.2%	50.0%	34.1%	10.0%	33.0%
	Aural/Auditory	Count	2a	2a	6a	3a	13
		% within Life	22.2%	6.7%	14.6%	15.0%	13.0%
	Reading/Writing	Count	0a	2a	3a	2a	7
		% within Life	0.0%	6.7%	7.3%	10.0%	7.0%
	Kinesthetic	Count	0a	1a	2a	2a	5
		% within Life	0.0%	3.3%	4.9%	10.0%	5.0%
	Multimodal	Count	1a	5a	9a	6a	21
		% within Life	11.1%	16.7%	22.0%	30.0%	21.0%
	VARK Type 1	Count	2a	3a, b	0b	2a, b	7
		% within Life	22.2%	10.0%	0.0%	10.0%	7.0%
	VARK Type 2	Count	2a	0b	1a, b	3a, b	6
		% within Life	22.2%	0.0%	2.4%	15.0%	6.0%
	VARK Transition	Count	0a	2a	6a	0a	8
		% within Life	0.0%	6.7%	14.6%	0.0%	8.0%
Total		Count	9	30	41	20	100
		% within Life	100.0%	100.0%	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Life categories whose column proportions do not differ significantly from each other at the .05 level.

Because the expected value assumption underlying the chi-square test of independence was violated, the Fisher-Freeman-Halton Exact Test was used (FFHET = 36.894, p = 0.002). The post hoc comparisons between column proportions for VARK Type 1 revealed a statistically significant differences between 7.7% (2/26) who played consistently to 50% (1/2) who never played this type of game. For VARK Type 2 there was also a statistically significant with 23.1% (6/26) who played the game consistently compared to 0% (0/49) who played the game often.

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Table 4: VARK Types by Survival Genre

			Survival				
			Never	Seldom	Often	Consistently	Total
VARK	Visual	Count	0a	12a	17a	4a	33
		% within Survival	0.0%	46.2%	37.0%	15.4%	33.0%
	Aural/Auditory	Count	0a	2a	6a	5a	13
		% within Survival	0.0%	7.7%	13.0%	19.2%	13.0%
	Reading/Writing	Count	1a	2a	3a	1a	7
		% within Survival	50.0%	7.7%	6.5%	3.8%	7.0%
	Kinesthetic	Count	0a	1a	3a	1a	5
		% within Survival	0.0%	3.8%	6.5%	3.8%	5.0%
	Multimodal	Count	0a	3a	13a	5a	21
		% within Survival	0.0%	11.5%	28.3%	19.2%	21.0%
	VARK Type 1	Count	1a	4a	0b	2a, b	7
		% within Survival	50.0%	15.4%	0.0%	7.7%	7.0%
	VARK Type 2	Count	0a, b	0a, b	0b	6a	6
		% within Survival	0.0%	0.0%	0.0%	23.1%	6.0%
	VARK Transition	Count	0a	2a	4a	2a	8
		% within Survival	0.0%	7.7%	8.7%	7.7%	8.0%
Total		Count	2	26	46	26	100
		% within Survival	100.0%	100.0%	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Survival categories whose column proportions do not differ significantly from each other at the .05 level.

VI. Discussion

The gamers in this study had predominantly more Visual style learning preferences compared to the people that filled out the VARK questionnaire in 2018 as reported by the developers on their website. Nonetheless, it is reasonable that Visual style learners would be attracted to computer games, which typically require careful visual attention to moving objects on a computer screen. It is also noteworthy that statistically significantly fewer VARK type 2 participants were in the current study compared to the data from 2018. According to Fleming and Bonwell's website (2021) VARK type 2 people are ". . . not satisfied until they have had input (or output) in all of their preferred modes. They take longer to gather information from each mode and, as a result, they often have a deeper and broader understanding." Perhaps VARK type 2 gamers are rare, especially when games require quick action with limited information, like Action/Adventure games which were the most popular games played by the study participants.

Upon first observing the results one could surmise that there might be a correlation between visual learning style preference and video game genre, the truth is far from that opinion. Similarly, it is not possible to gauge the extent to which the participants in this study were representative of the target population of gamers. This population was used due to financial constraints. As the population of gamers who participated are not even close to the millions who are gamers worldwide, thus the sample size was insufficient to give a true representation. Table 2 represents how often each respondent played each game genre. Also, in table two the one genre that outperformed all the others was the Action/Adventure genre. Due to the expected counts being so far different from the actual population in the study the Fisher's Exact Test had to run on each genre.

Out of all the video game genres only two of them showed a kind of correlation. The two genres that showed a correlation are Life Simulators and Survival Games. Both genres may have a statistically significant correlation but there is a problem with these correlations. Only 7 people were with VARK type 2 styles and only 6 people with VARK type 1 styles in the current study. The statistically significant relationships between these two VARK types and Life Simulator, and Survival games may not replicate in a larger study where the law of large numbers can deliver more reliable results (Moore, Notz & Fligner, 2018). To maximize participation, demographic information was not collected. As a result, confidentiality of participants was safeguarded but consideration of external validity was sacrificed.

Therefore, with no correlation coming from the other game genres and the only two correlations having no external validity then, this study fails to reject the null hypothesis. The null hypothesis states, "There is no relationship between a person's preference of video game genre and that of an individual's preferred

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learning style preference." What was found for most of the video game genres was that there is no statistical relationship between a video game genre and learning style preference.

Based on this information one cannot say that the video game genres are completely independent because two genres did correlate with two learning style preferences. The problem with this lies with the fact that the population that make up the correlation is between six or seven individuals. Six or seven individuals do not represent the population of this study thus two conclusions are made. One stated before, preferred genre is independent from preferred cognitive learning style, and second that this correlation needs to be farther investigated. The fact that Life Simulators and Survival Games correlate with VARK Type I and II despite no external validity, another study is warranted.

The two correlations have implications for differentiation the lessons need to touch all the primary learning style preferences. Since life simulators have everything to do with real life then the lessons need to have real world examples and situations incorporated into the lesson plan. The most important thing that an educator could do is create a workshop on how to use real life situations in a type of role-playing where students need to solve real life situations using what they have learned. An example of this is having the class act out a situation given to them on being the governing group of a town and a bill needing to be passes. How to solve the issue, how to deal with the population of the town and other issues that may pop up. Another example of this could be using an engineering situation for understanding how to use the math they learn in school in real life. The only exception to this would be the lessons using an abundance of visual aids to support the lesson. By having the students use real life role-playing situations the teacher can utilize all the learning style preferences, depending on the part the student fills, to differentiate for the entire class and individualization. In the city of Syracuse, New York there is a local TV station where on the third floor there is a small-scale city where they have students from all grades come to learn to run it (Mulder, J., 2019). Elect a mayor, run shops, run a factory, become consumers, and more, over all they have to complete a main objective given to them (Mulder, J., 2019). This is an example of real-life simulation at work.

The current research is the first contribution to the literature that attempted to find meaningful relationships between learning style preferences and game genres. Although the lack of meaningful evidence was disappointing, however future studies may benefit from the limitations in this study. For instance, perhaps asking about the frequency of gaming beyond 4 hours a week was not a reliable tool. Although more burdensome for study participants, future studies should work on several questions to determine game genre preferences in addition to frequency of play. Although previous researchers were pessimistic about such an attempt (Vargas-Iglesias, 2020) perhaps some creative brainstorming with several researchers in this field would produce a questionnaire that would meet the research standards for reliability and validity. Such a questionnaire would produce composite scores that could be used to categorize game genre preferences. Similarly, the composite scores that the VARK website uses to categorize the learning style preferences.

VII. Conclusion

As indicated in this research, there is a statistically significant correlation between two video game genres and two learning style preferences. While this correlation is very important the number involved cannot show an accurate representation of the population. While a future study is recommended, changes are needed to not only the study format but the survey itself to gain a better understanding of preferred video game genre. Further recommended studies are needed to find how these correlations truly represent the target population and to see if there are possibly more correlations ore to strengthen the correlations already found.

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