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# Impact of Digital Interaction on Multiple Intelligences

Myle Melody Daniels[1+] and Thelma Palaoag [2]

[1] Ifugao State University, Philippines

[2] University of the Cordilleras, Philippines

**Abstract.** The use of innovative learning materials in digital platform helps enhance learning as studies show that when more senses are involved the higher is the retention rate. With the release of diverse types of digital applications that users interact with, effect on the development of students particularly on their intelligences may differ. This study explores the impact of digital interaction on the multiple intelligences of students as presented by Gardner. Statistical analysis on respondents' multiple intelligence test scores based on Multiple Intelligence Developmental Assessment Scales (MIDAS) and respondents' digital interaction time was performed to determine the level of relationship between the two. Results show that all distinct intelligences has weak direct relationship with digital interaction time. Highest coefficient value is with visual-spatial and naturalistic has the least. Respondents were also categorized according to the type of digital application they mostly interact with. Statistical analysis on each of these categories shows that the coefficient values differ, such that, each of the distinct intelligences have weak direct relationship with social media and computer games interaction time, and a moderate direct relationship with e-learning materials. For VR games, there is a combination of strong, moderate and weak direct relationship among the distinct intelligences. With this, it can be concluded that the type of applications that users interact with is a significant factor in the development of multiple intelligences. A strategic combination of these types of applications is highly recommended to optimize its impact on the development of multiple intelligences.

**Keywords:** multiple intelligence, digital interaction, multiple intelligence developmental assessment scales

## 1. Introduction

The use of electronic devices has become a part of our daily routine. Younger generation are becoming more and more attached to the use of this technology because of its interactive feature that also caters to a versatile medium of learning and social interaction. This is why various materials in digital platform are incorporated into education as a means to engage student interest in learning. In a broader sense, digital refers to the transmission of data in a digital signal, in contrast to analogue. In this study digital interaction simply refers to a person's use of digital devices such as computers and smartphones to access software applications. Aside from an easy-to-use design, digital platform also helps save time and resources. Education whose journey is towards the holistic development of students can benefit from looking into the impact of these digital interaction to the learning process of a student, particularly on their intelligences. Traditionally, linguistic intelligence and logical-mathematical intelligence have been identified and highly valued in education and learning environments [1]. Only until Harvard Professor H. Gardner introduced the theory of multiple intelligences in Frames of Mind [2] shown in Fig. 1. Initially, he presented seven distinct intelligences, namely: interpersonal, intrapersonal, visual-spatial, linguistic, logical-mathematical, bodily-kinesthetic, and musical. Later, Gardner [3] also observed the existence of an eighth intelligence – naturalistic intelligence – that implies the capacity to discern the natural world, by demonstrating expertise in classification of numerous species in the environment. He also considered the possibility of two further types of intelligence, still subject to confirmation – spiritual and existential intelligences. There has been an

[+] Corresponding author.
*E-mail address*: mylemelodydaniels@gmail.com

ongoing relevance of using this theory to meet the varied needs of students in education [4]. Its integration to early childhood curriculum was also found effective as per enhancement of students' strengths [5].

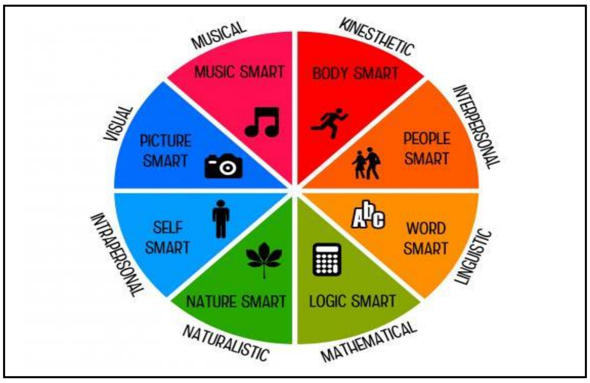


Fig. 1. Multiple intelligences presented by H. Gardner.

Attempts to measure a person's multiple intelligence is still an area of study which draws different point of view from authors because of its complexity in a sense. Moran and Gardner [6] argue that multiple intelligences can interact through interference, compensation or catalysis. Interference means that weakness in one intelligence area may hinder the actualization of full potential on another intelligence area. In contrast, compensation refers to scenario where strong intelligence areas may support the weaker ones. It is popularly known that some famous contemporary music artists are better at writing music than they are at writing lyrics – and vice versa. The third form of interaction, catalysis, is where one intelligence amplifies the expression of another. In this case, a student may use his bodily-kinesthetic intelligence to play the drumset (bodily-kinesthetic intelligence catalyzes both musical and logical-mathematical intelligences). These different interaction types indicate that multiple intelligences should neither be assessed solely without considering the effect of context in other intelligences. Shearer's [7] review on data from 22 countries shows many different context-specific ways of assessing multiple intelligences with structured interviews or self-report as well as using significant others as informants. His own Multiple Intelligences Developmental Assessment Scales (MIDAS) developed in 1987 to assess the multiple intelligences for adolescents and adults is a self-report questionnaire that produce both a qualitative and quantitative profile that describes the person's strengths and weaknesses in everyday language [8]. This attribute made it more appropriate to be used in this study.

Meanwhile, the endeavor of technology to meet the needs of the society brought about the advent of useful tool in enriching classroom collaboration online. Specialized educational software such as e-learning materials [9], 3D virtual lab [10], virtual environment, and mobile games [11] can supplement teaching aids to cater to different learning styles. In this millennial age, learning style has shifted from traditional to a more student-centered learning which could be achieved with the aid of technology. For instance, game-based learning which is usually in digital platform creates a student-centered learning environment and gives immediate result on student performance [12]. Also, this generation is looking to have a say in what they are learning and how they will learn it [13]. However, while educational games help develop logical-mathematical intelligence [14], it may not provide enough opportunity for other intelligences to be developed. Advances in digital designs may vary the effect on student development especially so that they come in many forms and features that can either be a distraction or a support learning. The impact of digital interaction may be influential on some intelligences but inversely affect the other. This defeats the objective of education for a learner's holistic development. Knowing the intelligences that are highly and least influenced by digital interaction can guide educators in the teaching strategy they can implement in the classroom. This way educators can incorporate supplemental classroom activities that can leverage engagement of all intelligences. Guided by the conceptual framework illustrated in Fig. 2, this study collected a sample population's MIDAS score and digital interaction time as basis for statistical analysis.

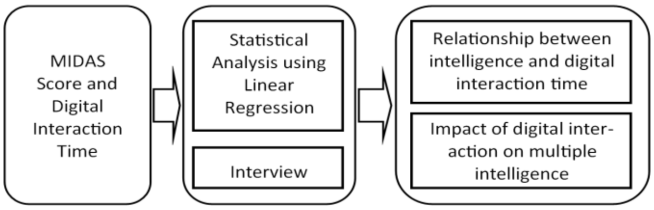


Fig. 2: Conceptual framework of the study.

## 2. Methodology

For a sample population in this study, 180 respondents were randomly selected from students and graduates of Information Technology program in a university. Respondents were selected from users in the same program in order to have a common ground of interest among respondents. Respondents took a multiple intelligence test based on the Multiple Intelligences Developmental Assessment Scales (MIDAS) created by Shearer [8]. The assessment provides a score for each of the eight (8) distinct intelligence identified by Gardner, namely, interpersonal, intrapersonal, visual-spatial, linguistic, logical-mathematical, bodily-kinesthetic, musical, and naturalistic. Later, in a survey form, respondents' daily digital interaction time were collected. These data were statistically analyzed to determine the relationship between MIDAS score and digital interaction time. For further analysis, respondents were categorized according to the type of digital application they interact with and findings show varying results per category. Respondents were also interviewed to gather data about how digital interaction helped improve each of their intelligences.

## 3. Results and Discussion

First, to determine the intelligence that is highly and least influenced by digital interaction, all respondents' scores for each of the intelligences were plotted against digital interaction time and their individual coefficient values were taken. Summary of coefficient values in all eight intelligences is shown in Fig. 3. With green bar indicating weak relationship and are plotted above 0 coefficient, it shows that all eight intelligences have WEAK DIRECT RELATIONSHIP with digital interaction time. This weak relationship reflect a very minimal impact of digital interaction on multiple intelligences.

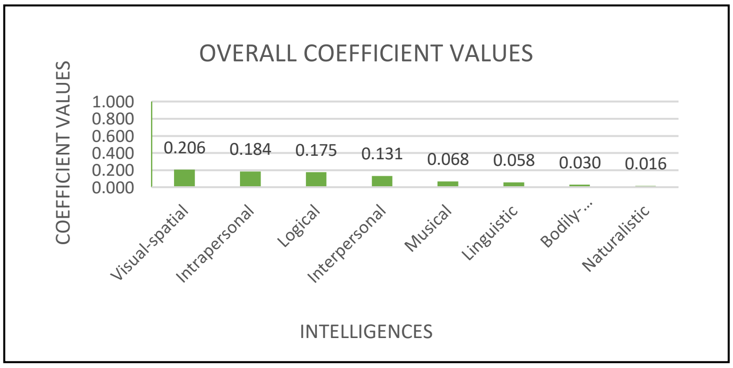


Fig. 3: Coefficient values between digital interaction time and MIDAS score of all respondents.

Because of this result, the researcher took a closer look at the gathered data and discovered four major types of applications that respondents mostly interact with. According to majority of users, these are social media (60%), computer/mobile games (20%), e-learning materials (14%) and virtual reality (VR) games (6%), respectively. Respondents were then categorized according to these types and their digital interaction time is plotted against the MIDAS scores. Coefficient values on these categories yielded a more particular result.

### 3.1. Social Media and Multiple Intelligence

For respondents who interact mostly with social media, their intelligence level on all distinct intelligences has WEAK relationship with their digital interaction time (shown in Fig. 4), such that it is not substantial. Among the intelligences, highest coefficient is with visual-spatial intelligence whereby respondents believe that the realistic images on social media engaged their imagination and also improved their ability to interpret images and art. On the other hand, bodily-kinesthetic intelligence has the lowest positive coefficient value. It shows almost no impact of digital interaction on this intelligence.

Statistical analysis on this category also shows that the only intelligence with INDIRECT relationship is naturalistic intelligence with coefficient value of -0.05 also shown in Fig. 4. However, it is interesting to note that despite this relationship majority of respondents still claim that digital interaction helped improve their environmental awareness increasing their concern for nature because of peer sharing of images and videos about environmental concerns. For this type of VE, it is also worth noting that intrapersonal has higher coefficient than interpersonal. Social media that is generally acknowledged to increase socialization seem to be influencing its users' self-awareness more than social skills. Reading other's experiences on social media is an opportunity of reflections and better self-awareness.

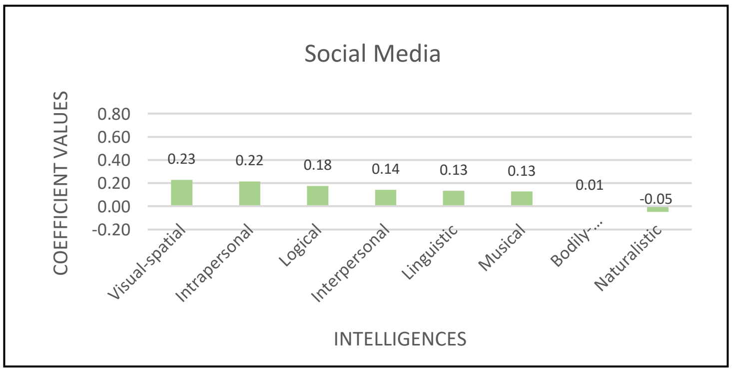


Fig. 4: Coefficient values between Digital interaction time and MIDAS score of respondents under Soacial Media.

### 3.2. Computer/Mobile Games and Multiple Intelligence

For respondents who play computer and mobile games, coefficient values between their digital interaction time and MIDAS scores are also considerably WEAK (Fig. 5). Among the distinct intelligences, logical-mathematical and visual-spatial intelligence have the same coefficient value of 0.10, highest among others. Despite this weak relationship, respondents assert that their digital interaction helped enhance their analytical skills and engaged their pictorial imagination and expression. Fig. 5 also shows that under this category, linguistic and musical intelligences have coefficient values -0.17 and -0.03, respectively, both indicating an INDIRECT relationship with digital interaction time.

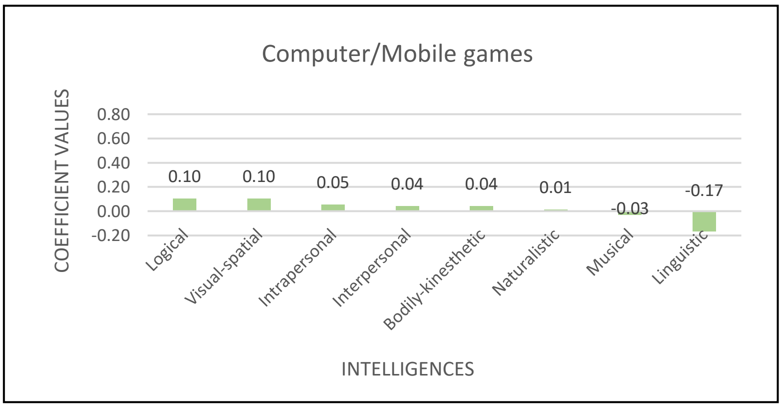


Fig. 5: Coefficient values between Digital interaction time and MIDAS score of Respondents under Computer Games.

Nevertheless, majority of respondents believe that playing computer games helped improve their reading comprehension skills because of the need to read instructions in a fast paced scenario. As for musical intelligence, however, respondents habitually play on silent mode to save battery and avoid distractive noise. This is one reason why they think digital interaction has not helped improve their skills in musical notes.

### 3.3. E-learning and Multiple Intelligence

Unlike coefficient values of the two previous categories, respondents who mostly interact with e-learning materials have MODERATE DIRECT RELATIONSHIP between all their distinct intelligences and their digital interaction time, as shown in Fig. 6. This reflects that the higher the digital interaction time, the higher their MIDAS scores.

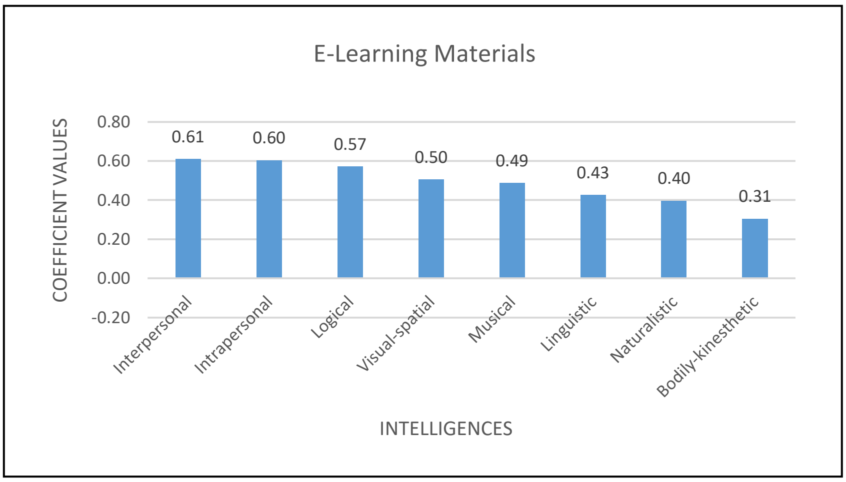


Fig. 6: Coefficient values between digital interaction time and MIDAS score of respondents under E-learning materials.

Highest coefficient value is with interpersonal intelligence with coefficient 0.61 followed by intrapersonal of 0.60 coefficient, while the least is with bodily-kinesthetic of coefficient value 0.31. Respondents claim that with the help of virtual learning materials their interpersonal intelligence is improved because they can relate with other people much better and they have a wider perspective on situations involving other people. Additionally, studying in a virtual environment gives users the opportunity to analyse and internalize their lessons thereby engaging logical sense with self-realization and reflection. For bodily-kinesthetic, although the least, it still has a moderate direct relationship with digital interaction time. Being able to visualize the application of strategies and concepts helped improve respondents' agility in applying it with proper body coordination.

### 3.4. VR Games and Multiple Intelligence

Finally, for the fourth category, respondents' digital interaction time have DIRECT RELATIONSHIP with all distinct intelligences as shown in Fig. 7. Visual-spatial and logical intelligences have STRONG direct relationship with digital interaction time, respectively; intrapersonal, bodily-kinesthetic, interpersonal, musical and naturalistic intelligences have MODERATE direct relationship; while linguistic has a WEAK direct relationship. Majority of respondents under this category believes that VR games made an impact on their distinct intelligences because of its realistic experience and interactive environment. Visual vigilance is required to overcome obstacles in the games along with analytical ability which is probably why visual-spatial and logical both have strong relationship with digital interaction time. As for intrapersonal intelligence, respondents affirm that playing in such an environment helps them realize their own weakness and learn from their own mistakes. Virtual games that has motions sensors required bodily movements that is accurate for the success of the game. Multi-player VR games caters to a friendly environment where all players are physically present and need to interact with each other during the game. In this type of games, music is essential because in most games, it is the players guide with respect to timing. Sensors detect player's movement which is the basis for game score. Respondents did not find any relevant VR feature that influenced this naturalistic intelligence. Contrary to expectation, naturalistic intelligence under this category has moderate relationship to digital interaction time. Linguistic skills were enhanced through the need to communicate verbally with each player during the games.

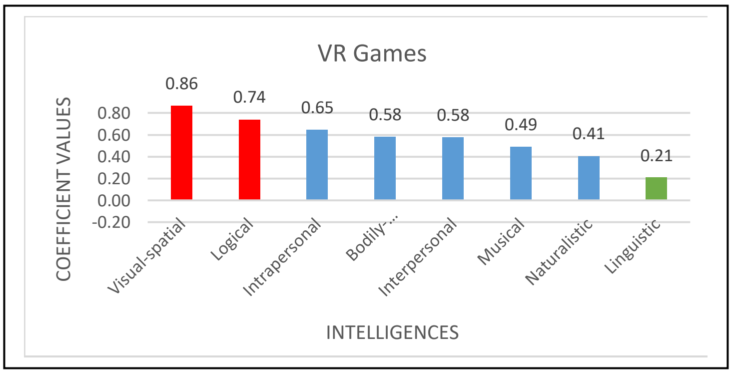


Fig. 7: Coefficient values between digital interaction time and MIDAS score of respondents under VR Games.

## 4. Conclusion and Recommendation

Statistical analysis between all respondents' MIDAS scores and digital interaction time reveals a weak direct relationship. This means that there is a very minimal impact of digital interaction to each of the distinct intelligences. However, a comparison of statistical results among the four types of digital applications shows that VR games has the highest correlation coefficient with digital interaction time, followed by e-learning, social media, then computer games, respectively. With this, it can be concluded that the type of applications that users interact with is a significant factor in the development of multiple intelligences. From the statistical analysis on the existing data of respondents, VR games has the highest association with intelligence level. It is therefore recommended that the design of virtual games be integrated into e-learning materials to improve its impact on multiple intelligence development. Social media is also a suitable avenue for e-learning materials since it has the most number of users in agreement to Faizi et al. [15] who recommended online tools in distant, blended, or face-to-face language learning settings. Moreover, adding educational games to virtual e-learning materials will also add to its impact on learning. Still, it should be designed in such a way that linguistic, bodily-kinesthetic, musical and naturalistic intelligences will be addressed since they have the least coefficient values among the rest. Finally, since the number of respondents taken from each category was only based on existing respondent's digital preference, a further study is recommended to collect data from equal number of users for each category for a more vivid comparison.

## 4. Acknowledgements

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