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Correlation of Learners' Brain Dominance and Mathematics Performance: An Investigation in Educational Setting

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ABSTRACT: While a lot of studies in the past proved the relation of personality type to brain dominance, studies now tend to disprove the association of such variables. With this trend in research, the researcher was challenged to conduct an investigation in educational setting, taking into consideration the correlation of learners' brain dominance and mathematics performance.The brain dominance characterized by Left Right Brain Dominance Test and grades in Algebra and Trigonometry were elicited from the sample student-respondents. The coefficient of variations and coefficient of correlations were computed to scientifically examine the extent of correlation of the chosen variables. Findings disclosed that there were a smaller number of left-brain dominant learners with a smaller variation in the mathematics performance. Moreover, there were no significant correlations found between the learners' brain dominance and their performance in mathematics. The non-significance in correlation may be explained by the insights yielded from previous researches that (1) learners do have different personalities and have unique strengths and weaknesses in how they process information; and (2) personalities and abilities of learners are not determined by favoring one hemisphere over the other, but both hemispheres are used by learners in thinking processes. The opposing opinions revealed by several researchers can be taken positively as a challenge in the educational environment, specifically for learners and teachers.

KEYWORDS: brain dominance, left-brain learner, right-brain learner, mathematics performance.

1 BACKGROUND

In 1981, a psycho biologist, Roger Sperry who won the Nobel Prize in Physiology or Medicine, discovered that the human brain is actually made up of two parts. He found out that both the left and right parts of the human brain have specialized functions and that the two sides can operate independently. The left hemisphere, according to Sperry, is dominant over analytical and verbal tasks, while the right hemisphere handles spatial, visual, and emotional tasks [1].

In 2013, it was reported that neuroscientists lead by Jeff Anderson of the University of Utah conducted a research and asserted that there is no evidence within brain imaging that indicates some people are right-brained or left-brained. These neuroscientists concluded that people do not tend to have a stronger left-sided or right-sided brain network, connections went across the hemispheres, according to them, with no one side dominant in an individual [2].

While a lot of studies in the past proved the relation of personality type to brain dominance, studies now tend to disprove the association of such variables. With this trend in research, the researcher was challenged to conduct an investigation in educational setting, taking into consideration the correlation of learners' brain dominance and mathematics performance

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2 MATERIAL AND METHODS

The researcher conducted her study during the second semester of the academic year 2014-2015. Seventy (70) freshmen engineering students of the Pamantasan ng Lungsod ng Maynila (University of the City of Manila) majoring in the fields of civil engineering and mechanical engineering were chosen as sample. PLM is a chartered university created by the Congress of the Philippines in 1965, now with twelve (12) colleges, two (2) professional schools, and seven (7) graduate schools.

The brain dominance of sample students were characterized using the Left Right Brain Dominance Test created by EduNova: Innovations from Leading Education Experts. People behind this expressed that most individuals have distinct preference for either the left or the right brain thinking and that ideally, they said, individuals should use both sides of their brain to unlock their true potential. These experts explained that in order to become whole brained, an individual needs to first know his preference. Taking the said test, according to them, one may be able to find out if he is inherently right brain or left brain dominant [3].

The students' grades in Algebra and Trigonometry were also elicited from the student-respondents. Algebra and Trigonometry are the mathematical foundation subjects of the first year engineering students prior to their advancement to calculus subjects. The coefficient of variations and coefficient of correlations were computed to scientifically examine the extent of correlation of the chosen variables.

3 RESULTS AND DISCUSSION

3.1 THE LEARNERS' BRAIN DOMINANCE

Table 1 shows the frequency distribution of the left-brain dominant (LBD) and right-brain dominant (RBD) learners out of the seventy sample student-respondents.

Table 1. Frequency Distribution of Left-Brain Dominant and Right-Brain Dominant Learners

Learner Type	Number	Percent
LBD Learner	32	46 %
RBD Learner	38	54 %
All Learners	70	100 %

3.1.1 THE LEFT-BRAIN LEARNERS

Thirty-two out of seventy learners (46 percent) are left-brain dominant (Table 1). Herrmann explained that the two left side structures of the brain: left cerebral hemisphere (analytical) and left limbic system (sequential) were combined to represent the so called left brain thinking, characterized by logical, analytical, sequential and rational thinking [4]. Sperry, Hubel and Wiesel classified the LBD learners as having left hemisphere dominant in all activities involving language, arithmetic, and analysis [5].

Left-brain learners as Enomoto characterized are those that best absorb material by listening to lectures in which the material is logical and with a set of defining rules. Enomoto further described LBD learners as those that take neat notes; keep a well-organized binder; consider timed tests not overly challenging; read directions carefully and thoroughly; follow sequential reasoning; and seek definitive final answers and closure [6].

These learners' left hemispheres according to Allon are better at recognizing sequences of words and letters; control the logic, reasoning, and analytical thought processes; can focus on details; but with difficulty comprehending the whole picture [7]. Moreover, Scull described that their left hemispheres focus attention, isolate, fix, and make explicit certain features, giving learners the power to learn and to make things [8]. Melina characterized such left hemispheres of LBD learners as in charge of carrying out logic and exact mathematical computations [9].

3.1.2 THE RIGHT-BRAIN LEARNERS

Thirty-eight out of seventy learners (54 percent) are right-brain dominant (Table 1). Herrmann explained that the two right side structures of the brain: right limbic system (interpersonal) and right cerebral hemisphere (imaginative) were combined to represent the so called right brain thinking, characterized by global perception, intuition, synthesis and emotional expression [4]. Allon classified the RBD learners as those whose right hemispheres are more specialized for the

analysis of space and geometrical shapes and forms. Allon further illustrated their right hemisphere as creative half that can see the whole out of parts, thus allowing the learners, as he said, to connect puzzle parts together [7].

The RBD thinkers according to Enomoto are persons that scan directions, rather than listen to or thoroughly read directions; visualize a picture to help them remember facts; tend to be day dreamers who lose track of time; thrive on hands-on learning; but struggles on sitting, listening and taking notes [6]. The right hemisphere of these learners, according to Scull, grasp things as whole; exhibit a broad perspective; capable of taking the perspective of the other; and allow empathy and social side of human beings to flourish [8].

Sperry, Hubel and Wiesel disclosed in their study that the right hemisphere was nonverbal, nonmathematical and nonsequential in nature; largely spatial and imagistic [5]. Melina said that the right hemisphere of RBD learners performs some mathematics, but only for rough estimations and comparisons [9].

3.2 The Coefficient of Variation of the Left-Brain Dominant and Right-Brain Dominant Learners in Algebra and Trigonometry

To assess the relative variability of the learners' performance in mathematics, the coefficient of variation was computed. The coefficient of variation of RBD learners in Algebra (0.1951) and Trigonometry (0.1712) are observed to be consistently higher than the LBD learners (0.1691 and 0.1615, respectively). This indicates that the mathematics performance of the RBD learners are more likely to be varied compared to the LBD learners (Table 2).

Table 2. Coefficient of Variation of the LBD and RBD Learners in Algebra and Trigonometry

Learner Type	Algebra	Trigonometry
LBD Learner	0.1691	0.1615
RBD Learner	0.1951	0.1712
All Learners	0.1824	0.1657

It may be recalled from the earlier discussions that LBD learners are generally characterized by being logical, analytical, sequential and rational. Considering that the sample students in this study are engineering students, there may be reasons to expect a larger number of LBD learners and a smaller variation in the performance of such group in mathematics.

However, Tables 1 and 2 disclose that there were a smaller number of LBD learners and, as expected, there was a smaller variation in the performance of this group in mathematics. There are several possible reasons why a smaller number of LBD learners turned out after taking the Left Right Brain Dominance Test. Reasons are supported by the research findings in science that people are not exclusively right-brain thinkers or left-brain thinkers. It may also be recalled as mentioned earlier that EduNova even expressed that ideally everyone should use both sides of their brain to unlock their true potential.

There was a claim on a social network metaphor as revealed by Molfese and Segalowitz that the brain is a unified and differentiated community of neuronal subprocessors where tasks compete for functional brain space and the asymmetrically activated hemispheres share their resources. The capacity limits, according to them, are not acknowledged and interference between tasks occurs both within and between hemispheres when tasks encroach on the same conceptual space [10]. Hampson defined the hemispheric specialization as one side of the brain more adept than the other and does not necessarily mean that the other side cannot perform a function at all or is not routinely involved in a particular activity [11].

Chiron and other members of the research team described that the brain functions localized initially on the right, but later on the left hemisphere (i.e. visuospatial and later language abilities) [12]. Enomoto disclosed that people are not exclusively right-brain thinkers or left-brain thinkers. Even if learners are left-brain dominant, they should not be excluded from right-brain presentations, Enomoto said, as a visual context can be helpful to everyone [6].

Boehm said that personalities and abilities are not determined by favoring one hemisphere over the other and many other functions are lateralized in the brain [13]. In normal daily functioning, as Ergo and Sheedy observed, the cognitive abilities of the left and right brain are coordinated quite seamlessly. Each half of the brain, as they said, has distinct abilities and strengths that may be uniquely used for particular mental activities [14].

Nielsen and other members of the research team concluded that the lateralization of brain connections appears to be a local rather than global property of brain networks, and data are not consistent with a whole-brain phenotype of greater left-

brained or greater right-brained network strength across individuals [15]. It was reported by Whiteman that that it is absolutely true according to Anderson that some brain functions occur in one or the other side of the brain and people do not tend to have a stronger left-sided or right-sided brain network [16].

Ideally, Eden said, both brains work together in people with optimum mental ability. This coordinating ability, as he revealed, may be the key to superior intellectual abilities [17]. Iaccino explained that the functional asymmetries reported for each of the hemispheres suggest that the cortical differences are mainly ones of the relative (rather than absolute) specializations: namely, the left hemisphere is more language oriented than the right, whereas the right is more visuospatial oriented than the left. Although relatively specialized for a particular input, he added, that each hemisphere still requires the other to complement its overall functioning [18].

3.3 The Coefficient of Correlation of Learners' Brain Dominance and Performance in Algebra and Trigonometry

The coefficient of correlation was computed using the Pearson product moment of correlation to determine the relationship of the learners' performance in mathematics and the percent dominance of being left-brained or right-brained. Table 3 reveals that the relationship of the LBD learners' performance in Algebra (0.0168) and Trigonometry (0.0788) were observed to be higher compared to the RBD learners (-0.1347 and 0.0253, respectively).

Table 3. Coefficient of Correlation of Learners' Brain Dominance and Performance in Algebra and Trigonometry

Learner Type	Algebra		Trigonometry	
	r-value	p-value	r-value	p-value
LBD Learner	0.0168	0.9273 ^{ns}	0.0788	0.6681 ^{ns}
RBD Learner	-0.1347	0.4225 ^{ns}	0.0253	0.8802 ^{ns}
All Learners	0.0516	0.6714 ^{ns}	0.0306	0.8015 ^{ns}

ns means p-value not significant at $p < 0.05$.

However, upon testing the significance of those relationships, their corresponding p-values disclosed that the performance in Algebra and Trigonometry of the LBD (p-values of 0.9273 and 0.6681, respectively) and RBD (p-values of 0.4225 and 0.8802, respectively) learners are all found not significant.

Such relationships observed may be related to a series of studies conducted by several researchers who found no consistent relation of the students' brain dominance and their performance in mathematics.

Kitchens together with other members of the research team found out in their study that LBD learners tend to be generally successful in algebra, while right brain students tend to succeed in classes involving trigonometry, conics, vectors, and complex numbers [19]. In a study of brain hemisphere dominance and vocational preference, Szirony, Pearson, Burgin, Murray and Elrod disclosed that no correlation was observed between mathematical concept and left brain alone [20]. When the measure of hemispheric laterality was compared to mathematical ability by Szirony, Burgin and Pearson, they revealed that the relationship between mathematics and left-brain hemisphere preference was considered to be marginal [21].

O'Boyle concluded that the mathematically gifted students showed no hemispheric differences. Those who were precocious in mathematics, according to him, were equally good at processing global and local elements with either hemisphere, suggesting more interactive, cooperative left and right brains [22]. Mitchel reported that mathematically gifted students showed a faster and more accurate ability to exchange information between hemispheres than those of average mathematical ability. She said that researchers described this as enhanced interhemispheric interaction and collaboration and a highly integrated form of bilateralism [23].

Hsu described that the best mathematics students do not even seem to settle for being left brain people. He explained further that while the typical person might lean more heavily on one hemisphere or the other to do mental tasks necessary for mathematics calculation, the brightest among individuals can more fully integrate both hemispheres of the brain [24].

4 CONCLUSION AND RECOMMENDATION

This study disclosed that there were no significant correlations between the learners' brain dominance and their performance in mathematics. The non-significance in correlation may be explained by the insights yielded from previous researches that (1) learners do have different personalities and have unique strengths and weaknesses in how they process information; and (2) personalities and abilities of learners are not determined by favoring one hemisphere over the other, but both hemispheres are used by learners in thinking processes. The opposing opinions revealed by several researchers can be taken positively as a challenge in the educational environment, specifically for learners and teachers.

Learners may use as guide the results of various studies pertaining to brain dominance. They should be aware of their own neurological strengths and weaknesses and should help themselves strengthen the weaker parts of their brain. Learners should understand how their brain processes information to help themselves learn fast and efficiently. They should consider that no matter which hemispheric dominance they have, they need to learn to adapt to varied learning strategies that will lead them to academic success.

Teachers may facilitate the learning of the LBD and RBD learners by promoting complementary hemispheric interaction. They should understand the processes at work in the learners' brain to help their learners explore their individual preferences. Teachers should consider teaching strategies of more balanced approach that will equally address the needs of their LBD and RBD learners. They must recognize the right-brain and left-brain characteristics in their learners for them to plan instructional classroom activities that will stimulate the use of learners' both hemispheres to attain the expected learning outcomes.

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