

Nigerian Journal of Applied Psychology

Vol. 26 June 2024

UNIVERSITY OF IBADAN LIBRARY

ISSN 0189-5656

Volume 26 June, 2024

Nigerian Journal

of

Applied Psychology

Department of Counselling and Human Development Studies
University of Ibadan

Titles	Authors	Pages
Men Also Cry: Investigating Newspaper Framing Of Domestic Violence Against Men In Nigeria	Olugbenga Elegbe Phd Olubukola Ebum Oyetayo Grace Oluwatofunmi Adeyemo	1
Imperatives Of Students' Soft Skills Acquisition For Improved Academic Achievement Of Economics Students	Akinlosotu Gladys Abimbola Ogundiran Samuel Ogunwale	15
Advocating A Strategic Framework For Ethical And Regulated Use Of Generative Artificial Intelligence In Education And Research In Nigeria	Ojokheta, K.O. Odusanya, Olatunbosun, S. E.	27
Teachers' Perceptions Of Inclusive Education In Nigerian Mainstream Primary Schools: Implications For Educational Psychologists	Olajumoke Omowunmi Olanipekun	42
Teacher's Remuneration And Students Academic Performance In Public Senior Secondary Schools In Lagos State	Olafare Olabisi Boluwaduro Ogundiran Samuel Ogunwale Ukwueze Augustine C.	54
Emotional Intelligence And Locus Of Control As Predictors Of Academic Achievement Among Undergraduates In Nigeria	J.S. Aina	65
Qualitative Analysis of Handedness, Class Participation and Performance in an Online Mathematics Class during Covid-19 Period	Tella, A.	91
Income Inequality and Educational Attainment in Nigeria	Isuku, E.J Nwafor, E.I	104

UNIVERSITY OF IBADAN LIBRARY

Qualitative Analysis of Handedness, Class Participation and Performance in an Online Mathematics Class during Covid-19 Period

Tella, A, PhD.

Department of Science and Technology Education
Faculty of Education
University of Ibadan

Abstract

This study examined a qualitative analysis of handedness, class participation, and performance in an online mathematics class during the Covid-19 period. A qualitative method was adopted using observations and interviews to collect data during three different classes organized via a zoom online platform. Twenty-four students (12 left and 12 right-handers) were purposively and voluntarily selected based on their handedness. Five objectives were developed to guide the study. The results generally revealed no difference in the left-and right-handers' performance in the online mathematics classes. Both the left-and right-handers learn at the same pace, participate in class discussion, and no difference was observed in both the left-and right-handers' overall performance. The study concluded that handedness has no impact on performance in online mathematics and is not a hindrance to learning in an online platform. The study recommends that since technology is having an important impact in streamlining performance in online mathematics class irrespective of handedness; there is a need for investment in online technology infrastructure; and that, social and instructional supports should be provided for all mathematics students in online classes to successfully learn with technology.

Keywords: Class learning, Class participation, Covid-19, Handedness, Mathematics performance and achievement, Online learning

Introduction

The outbreak of Coronavirus otherwise known as Covid-19 towards the end of the year 2019 has resulted in considerable changes in most countries' education particularly teaching and learning and the delivery of instruction. In other words, there is a shift from the regular learning process to electronic learning. Due to the compulsory lockdown and social distancing orchestrated by the outbreak of the pandemic; many educational institutions globally have shifted from face-to-face teaching and learning to an alternative online kind of learning using different electronic platforms. This makes it clear that technological development and the internet have changed the lives of people immensely and have also brought a huge change in various fields of learning (Nadikattu, 2020). During this lockdown, e-learning is a significant tool for effectively continuing the teaching-learning process. Organization for Economic Co-operation and Development, OECD (2020) reported

that the COVID-19 crises have resulted in a dramatic increase in online learning in which most of the training that had started as face-to-face in classroom environments are being pursued online.

The types of online platforms and e-learning applications being adopted range from Google classroom, Microsoft Team, and Zoom. Platforms such as G-Suite and Edu-Page are also being used along with some others. Lecturers and teachers were made to provide study materials in the form of PowerPoint Presentation, PPT, Portable Document Format, PDF, or Word Document, and other forms including audio, videos. In some countries, the ministry of education also organizes radio and television learning in rural communities to facilitate learning. This happens to be the practice in nearly all the countries of the world including Nigeria as coronavirus is a global pandemic. Something that has been bothering the mind of the author of this paper is a long-standing issue of handedness.

Handedness is a demonstration of the functional specialization of the brain, with some skills, like language, occurring primarily in the left hemisphere and others. It is the perception of visual and social-spatial relations, occurring primarily in the right hemisphere. It has to do with human brain function, and consequently, hand preference which is believed to influence the overall cognitive skills (McManus, 2002). Nevertheless, despite the avalanche of studies available on this topic, the pattern and direction of the relationship remain highly contentious and disputable particularly in the subject of mathematics.

According to (Sala et al., 2017), learners' achievement in mathematics is a matter of increased practical relevance that is the quality or state of being closely connected or appropriate. The concept of relevance is studied in many different fields, including cognitive sciences, logic, and library and information science. Mathematics skills are essential or requisite to major in Science, Technology, Engineering, and mathematics (STEM) subjects, and hence, to attain or secure STEM jobs. As pointed out by Halpern et al. (2007), the job market globally demands more graduates in STEM subjects compared to other disciplines including humanities or social sciences and has also become highly competitive. In light of this, the cognitive or biological correlates of mathematical ability have been the object of extensive debates (Lubinski, 2010; Peng et al., 2016). One of these correlates is handedness. The correlation between handedness and mathematical ability still remarkably remains sensitive and debatable. Some researchers argued that left-handers are gifted in mathematics and strong right-handers perform woefully in mathematics activities; some others proposed that mixed handers are the most disadvantaged group (Sala et al., 2017).

Extant literature has revealed the availability of some previous related studies on handedness. For instance, Malkhaz et al. (2020) extended the scientific data regarding the influence of retraining in left-handers and some disabilities attributed to left-handedness. The study participants were required to fill the questionnaire that featured items on the incidence of complaints on weak memory and attention, spatial confusion, bedwetting and stuttering, fears, and depression. The study analyzed responses on the handedness of respondents qualified as left-hander, right-

handers, and retrained left-hander. There was a higher report on spatial left/right confusion, bedwetting, and slowness in writing for left-handers compared to right-handers. Higher fears were reported in retrained left-handers; while no difference exists in the left-handers, retrained left-handers, and right-handers based on the number of reports on stuttering, weak memory, not sustained attention, and depression. The study also examined mental rotation on task performance in another group of left-handed and right-handed respondents. A test on hand performance was used for determining handedness. The study found that left-hander commits more errors in mental rotation task performance compared to right-handers. The study concluded that higher expectancy in slowness in writing, bedwetting, and mental spatial left-right confusion in left-handers compared to right-handers. It was suggested that retraining of the left-hander cause fears, nevertheless, it is not in any way associated with depression, slowness in writing, worsening of memory, attention, and stuttering. Left-handers, retrained left-handers, and right-handers are all expected to exhibit stuttering.

The outburst of COVID-19 which resulted in the application of the e-learning method in the teaching and learning process led Moreno-Guerrero et al (2020) to conduct a study to identify the effectiveness of the e-learning method in the teaching of mathematics with adults who enrolled in high school program compared to the traditional expository method. A quantitative method was adopted using descriptive and correlational designs. The findings demonstrated that the e-learning method positively influenced performance and grades, motivation, mathematical concepts, participation, and autonomy. The study concluded that the e-learning method improves adult students studying mathematics as a subject compared to an expository method. Based on the conclusion, the study recommended the e-learning method for teaching adult mathematics classes.

As observed by Sala et al. (2017), the relationship between handedness and mathematical ability is largely debatable and contentious. The literature revealed that some researchers claimed left-handers are gifted in mathematics and strong right-handers perform poorly in mathematical tasks while others have proposed that mixed handers are the most deprived/disadvantaged group. Nevertheless, studies in the field differ concerning ages and the gender of the participants, and the type of mathematical ability measured. Sala et al. tried to unravel the disparity and inconsistency by conducting five studies in many Italian schools involving 2,314 students whose ages vary from six to sixteen who were provided mathematical tasks such as arithmetic and reasoning. The findings demonstrate a linear and quadratic function for capturing the association between handedness and mathematical ability; the percentage of variation in mathematics scores explained by handedness was greater in the previous study between 3 and 10% compared to 1%; and the effect of handedness on mathematical ability relied on age, gender, and types of mathematics tasks. As obtained in the previous related studies, handedness represents a relationship of achievement in mathematics, however, the direction of the association is more complex than what has been argued.

As reported in the literature, the results on the link between intelligence and handedness were also mixed. On this note, David and Ranshemaker (2015)

conducted a study in Edinburg, UK to examine the relationship between handedness and intelligence among left and right-handers. The study drew on 210 students who volunteered from various schools. The data for the study was collected using Edinburg Handedness Inventory while Raven's Standard Progressive Matrices was used to assess the level of respondents' intelligence. The findings demonstrated that left-handers are more intelligent than right-handers based on scores and time of completion in the intelligence test. On this note, it was concluded that the asymmetry of left-handed individuals has good retention memory, and coordination to achieve academically.

The effect of using pen-based technology in online mathematics courses to understand instructors' experiences in online mathematics teaching was conducted by Kara et al. (2015). The study featured two instructors who taught mathematics courses in fourteen weeks using the digital pen as pen-based technology. Data for the study was obtained through semi-structured interviews and observation of online mathematics course records. The results revealed that a digital pen is used in the online mathematics course for synchronously displaying problem-solving procedures. Based on the finding, the study concluded that digital pen technology plays a positive role in the enhancement of interaction between the elements of an online learning environment by providing real-time feedback to students and permitting to digitize mathematical concepts. In terms of implication, the findings provided insights into the efficiency of the use of digital pens by an instructor in online mathematics.

The literature revealed that the association between teacher and student handedness is important. On that note, Paris (2011) carried out a study to find out the compatibility between teachers and students. The study postulated that performance and form scores of left-handers that see a right-hander demonstration would be higher than those of right-hander that see a left-handed demonstration. A total of 69 college-aged participants that were equally split in numbers between male and female and left and right-handers were demonstrated a lacrosse shot. An average number in each group saw a left-handed demonstration while the other half saw a right-handed demonstration. Respondents were thereafter assessed based on target accuracy and four components of the shot form. The study used ANOVA to test the hypotheses and the findings revealed that left-handers performed significantly better than right-handers on target accuracy, shot form, and body positioning. Left-handed college students appear to obtain valuable information from an opposite-handed demonstration but the right-handers did not. The study suggested that future research should examine younger children since the study focused on college students with the argument that young children have less experience to adjust.

The reviewed literature has shown that the results on the performance based on handedness are mixed. While some studies reported that left-handers usually perform better compared to right-handers, others reported otherwise. There seems to be limited or no study conducted during the period of lockdown that focused on handedness and mathematics performance in e-learning or online platform. Most of the recent studies on handedness were conducted in the US, UK, and other

developed countries. Conducting a related study in a country of Africa will make data on handedness and performance in online mathematics available from the population of Nigerian students and therefore contributed to knowledge in that area.

In Nigeria, classes were organized during the lockdown. Mathematics lessons and instructions were delivered online, the concern of the author is to consider the issue of handedness in terms of how both the left and right-handers are coping in online classes. The author is concerned about the influence of handedness on performance in online classes organized during the lockdown period and to determine the influence of handedness on the pace of learning in online mathematics classes. From the literature, most of the available studies have focused on the influence of handedness in terms of comparing the performance of left and right-handers in mathematics during a normal classroom setting. Most of these studies adopted a quantitative methodology in their conduct. However, this current study differs remarkably in terms of examining the influence of handedness on performance in mathematics in online learning during the lockdown period. Similarly, while previous studies have commonly used a quantitative approach, the current study adopts a qualitative approach. The study is unique in the sense that there seems to be limited or no studies particularly in the Nigerian context than examined during the covid-19 pandemic, the influence of handedness on performance in mathematics through a qualitative method.

Objectives of the study

The main objective of this study was to examine through a qualitative method the influence of handedness on performance in online mathematics classes. The specific objectives of the study were to:

1. Determine the influence of handedness on performance in online mathematics classes during covid-19.
2. Compare the performances of left and right-handers in online mathematics classes during covid-19.
3. Identify the difference in the pace of learning between the left and right-handers in online mathematics classes during covid-19.
4. Investigate the rate of class participation between the left and right-handers in online mathematics classes during covid-19.
5. Identify the challenges encountered by the left and right-handers in online mathematics classes during covid-19.

Methods

This section detailed a discussion on the method adopted to carry out the study. It includes the design, population, and sample, the instrument for data collection, the procedure of administration, data analysis, and presentation of results. The study adopted a purely qualitative method. The qualitative method focused on obtaining data through interviews and observation in a mathematics class offered online

through Zoom. An interview is a qualitative research technique that involves asking open-ended questions to converse with respondents and collect elicited data about an issue. Interviews are usually conducted with a sample from a population and the major feature they demonstrate is the conversational tone. Observation implies the observation and description of respondents' behavior. Observation is a participatory method since the researcher has to immerse in the setting where respondents are while taking notes and or recording. Qualitative methods usually give room for in-depth and additional probing and questioning of respondents based on their responses, where the respondents and or researcher try to understand their motivation and feelings. This study helps in understanding the ways respondents in this study (the undergraduate Mathematics Education students) react, participate, and perform in an online mathematics class organized during the Covid-19 lockdown.

A qualitative method was chosen because it is assumed to help the researcher to describe what he observed about the behavior of the left-handers in an online classroom. Similarly, the design was chosen because the results are usually more descriptive and the researcher can draw inferences from the data obtained from the respondents. Also, the qualitative method is inexpensive especially when it is self-administered. The use of open-ended interview questions in this study enabled the researcher to gather relevant data on handedness, and participation in an online (Zoom) mathematics class. Though many types of qualitative methods are available (Creswell & Poth, 2018), however, asking them open-ended questions and observation was embarked upon because they are considered the most common qualitative research methods; and they are also considered the most practicable method during this pandemic period where social distancing is being observed.

Population and Sample: The population for the study comprised 100 level mathematics education students who participated in online mathematics lessons through Zoom during the lockdown period orchestrated by the coronavirus. The lockdown and coronavirus issue limited the extension of the study to larger classes involving many students. The twenty-four students, 12 right-handers, and 12 left-handers were purposively and randomly selected based on their handedness and test running the online teaching through Zoom as a result of the pandemic. This happened not to be the usual practice before.

Instrument: An interview that featured performed open-ended questions relating to the five objectives of the study was asked from the respondents. This was complemented with observations conducted during the three mathematics classes organized online through zoom. The data obtained from both the interviews and observations were recorded by the researcher and transcribed to enable easy analysis and interpretation—content-wise.

The Procedure of Administration:

STE 153 is a three-unit course whose class was organised three times during the Covid-19 period. The course is titled: Basic mathematics for science and social sciences education students. The course is all about post-secondary school's

enrichment course in fundamental ideas of mathematics course. Content includes Rectangular coordinates and geometry of points and lines. Functions, mapping, and graphs, introductory calculus, the basic concept of differentiation and its applications in solving practical problems and understanding of integration as a reserve of differentiation and its application to practical problems, introductory modern geometry, probability and matrices, and determinants.

The first class focused discussion on rectangular coordinates and geometry of points and lines, functions, mapping, and graphs. The second class focused discussion on introductory calculus, the basic concept of differentiation and its applications in solving practical problems, and understanding of integration as a reserve of differentiation and its application to practical problems while the third class focused discussion on introductory modern geometry, probability, and matrices and determinants. A total of 45minutes was spent in each of the classes being the number of minutes that Zoom could take at a time for free.

The whole essence of it was to confirm whether handedness influences students' performance, rate of response, and class participation in the online mathematics class because students would have to navigate their devices through their hands.

During each of the three classes, the researcher observed the reaction, level of participation, and response rate of the students. At the end of each of the three classes, an interview was conducted. This means the interviews were conducted at three different times. The interviews and observations focus on the influence of handedness, the performance based on handedness- left-and right-handers, the pace of learning, and participation in the three classes. Similarly, an overall assessment was conducted at the end of the three classes to confirm the performances based on handedness in terms of whether one-hander performs better than the other.

Results And Discussion

The results of the data analysis based on the interviews and observations are hereby reported thematically based on the variables and themes in the five objectives of the study.

Influence of Handedness on Performance in an Online Mathematics Class During Covid-19

The various reports on the effect of handedness on academic performance in mathematics were mixed. The researcher based on interview and observation in three different mathematics classes organized online via zoom examine the influence of handedness on both the left and right-handers in three different zoom classes. It was found that both the left and right-handers performed the same way. This finding debunks the fact that either of the handers performs better compared to the other. Concerning the earlier reports and findings (e.g. Nichols et al., 2010; ASSIS et al., 2016; Sala et al., 2017), the results in this study presuppose that

irrespective of the situation normal or abnormal as in the case of a lockdown, handedness does not influence performance in mathematics. This finding may be a result of the fact that students have missed so much during the lockdown and as result want to cover up for what has been missed. This may be the reason why both handers put up good performances without allowing handedness to have any influence on them.

Comparison of Performances of Left and rRght-handers in an Online Mathematics Class During Covid-19

In terms of comparison, the researcher through observations of the respondents in the three online classes found that no difference was observed in the performance during the class lesson and the interview conducted at the end of each class which less focusing on asking questions relating to what was taught in class. Not this alone, the analysis of the average performance of both the left- and right-handers is 50/50 percent. This implies there is no difference in the performance of the left- and right-handers in online mathematics lessons. In comparison with the previous related study, the finding contradicts Malkhaz et al.'s (2020) whose study found that left-hander commits more errors in mental rotation task performance compared to right-handers. This finding also contradicts Sala et al. (2017) who reported the percentage of variation in mathematics scores explained by handedness was greater in the previous study between 3 and 10% compared to 1%; and the effect of handedness on mathematical ability. Similarly, David and Ranshemaker's (2015) finding also runs contrary to the current finding by revealing that left-handers are more intelligent than the right-handers based on scores and time of completion in the intelligence test. On this note, it can be argued that the asymmetry of the left-handed individual has good retention memory, and coordination to achieve academically. The reason for no difference in the performance of both the left-and the right-handers reported in this study may be attributed to the competition in an online classroom where every student wants his or her voice to be heard. Not that alone, the students are remotely located but only meeting with the teacher online for classroom teaching and learning; this removes shyness which usually occurs in a face-to-face classroom.

The Pace of Learning Between the Left and Right-handers in Online Mathematics Class During Covid-19

The results of the observations on the pace of learning by both the left-and right-handers in this study reveal that both learn at the same pace. Both respond to questions and issues raised by the teacher. Just as mentioned earlier, competition in online classes is always very high since the students are learning apart from the teacher at the center. Each one wants to impress. Everyone wants their presence to be felt by others. The results of the interview conducted at the end of each of the three meetings provide responses that complement the researcher's observations during the lesson. For instance, a respondent has this to say:

“This is a free atmosphere where there is no distraction. It is only me with my system connected with the platform. This allows me to learn very fast compared to during the time of physical meeting”

Another similar response to the one above from another respondent indicates that:

“I found the class very interesting and this increases my concentration and with that, I can grasp all that the teacher is teaching. How I wish we continue using this platform for all our classes and forget about a physical meeting where colleagues mock you in class when you responded wrongly to questions and issues?”

It should be noted that research has shown that students perform better in online learning compared to face-to-face instruction. However, the lesson will have to be properly planned. Therefore, the result here is not accidental. This is in line with the position of Greenhow (2020) who emphasized that real online learning merges components where students go at their pace and are set up to think deeply and critically about the combined subject matter with the components where students go online at the same time and interact with other students, their teacher as well as the content.

Rate of Class Participation Between the Left and Right-handers in an Online Mathematics Class During Covid-19.

The result of the rate of class participation is parallel. Both the left-and right-hander demonstrate the same level of participation. No one's participation is better than the other. In the interview section, a left-hander respondent mention that:

“I just don't know, I feel like being here almost all the time, I am just excited since there are no distractions, I can follow the teaching and grasp all that is being taught, with that understanding, I can contribute to the class, answer the question, ask questions and contribute to discussions.”

One of the respondents, a right-hander also explained that:

“It is an interesting environment and it is a great experience for me. I feel at home, I feel at ease here, therefore, I want colleagues to know that I am in the room with them because if you don't say anything, colleagues won't know you are at the other end. I just discovered that the more I participate in class, the better understanding of the course I have”.

This result is in agreement with Moreno-Guerrero et al (2020) findings which demonstrated that the e-learning method positively influenced performance and grades, motivation, mathematical concepts, participation, and autonomy. This implies that learning online can erase the difference that was reported in the literature where either of the handers performs better than the other.

Challenges Encountered by the Left and Right-handers in Online Mathematics Class During Covid-19.

The challenges observed by the researcher regarding left and right-handers in online mathematics classes and the results of the interview confirm that both groups of students encounter similar challenges. As observed in the three classes and based on the interviews conducted, the challenges range from insufficient technology, connectivity, slow network, inadequate skills, limited power supply, among others.

A left-handers respondent has this to say:

“As much as I love the online classes, the issue of the limited power supply is a concern to me. Sometimes, as I ready to join the online class, there is a power cut, and the whole essence of the class at that point is defeated” “It is also an ugly experience for me, when I am trying to join the lesson and it takes like 10 minutes before you are true when the class is already 10 minutes old, the network is just too slow and could be bad sometimes”

Another right-hander interviewed also claimed that:

“I enjoyed online mathematics classes it’s my favorite now, thanks to the lockdown that enable us to be exposed to this. However, I have to suffer for some minutes sometimes before getting my fit. The power cut, slow connection, and the technology sometimes make the whole exercise to be grounded”

Generally, both the left-and right-hander indicated they experienced technical difficulties, and lack of motivation. They explained that since it is an online class, individual students are on their own and whatever technical difficulties encounter, such are individually dealtwith since no service assistance is available. Furthermore, since students are learning apart, they have to be their motivators. This finding here relates to Greenhow's (2020) report that the challenges associated with learning online during the pandemic include issues about inadequate access to technology and the social infrastructure needed for online learning.

Conclusion

This study has examined through a qualitative analysis of handedness, class participation, and performance in an online mathematics class during the Covid-19 period. The results generally reveal no difference in the left-and right-hander performance in the online mathematics classes. Both the left-and right-handers learn at the same pace, participate in class discussion, and no difference was observed in the performance of both the left-and right-handers in overall performance. Handedness is not an obstacle or hindrance to learning in an online platform. Finally, handedness is disregarded as a factor responsible for variation in performances in online mathematics class since this study has proved that irrespective of left or right-handedness, the respondents demonstrate similar mathematical ability.

Recommendations

Based on the findings and conclusion in this study, the following are hereby recommended:

Since the findings demonstrate that both the left-and right-handers put up the same performance in an online mathematics class' it implies technology is having an important impact in streamlining the performance irrespective of handedness. In light of this, there is a need for a similar investment in online technology infrastructure. Moreover, social and instructional supports should be provided for all students in online classes for them to successfully learn with technology.

One of the obstacles identified as a hindrance or challenge encounter while learning mathematics online is a slow internet connection. Therefore, it is recommended that students without reliable fast internet, suitable devices for mathematics classes should be helped to overcome these challenges. Furthermore, alternative power generation should be provided to facilitate and enhance online teaching during a critical period such as the lockdown.

Limitations of the Studies

There are some noticeable limitations in this study. Firstly, the study only uses observations, interviews, and overall assessment of the performance of respondents to arrive at the conclusions. In light of this, future research should consider replicating the study using a questionnaire to gather data using the same online platform to teach the course on mathematics. This will enable confirmation of whether handedness has an impact on learning mathematics online through technology or physical instructional delivery in a face-to-face lesson. Secondly, the sample size was limited. This sample may not be fully representative of the entire population of mathematics students at the universities in Nigeria.

From the literature, it is observed that gender seems to significantly affect the relationship between handedness and mathematics problem-solving. In light of this, future research should consider gender when examining the relationship between handedness and performance in online mathematics classes. Also from the literature, it seems that the type of task is another variable or factor that can bring about variation in performance in online mathematics class. Therefore, future research should test performance in online mathematics classes to evaluate the role played by the variable on the relationship between handedness and mathematics achievement.

Trying to and endeavoring to use the measures of hand skills such as square checking tasks using questionnaires to assess hand preference would help confirm whether the relationship between handedness and mathematics abilities varies based on the assessment of handedness.

References

- Ahn, J.Y.; Edwin, A. (2018). An e-learning model for teaching Mathematics on an open-source learning platform. *International Review of Resources Open Distributive Learning*, 19(5), 255–267.
- Albano, G.; Dello, U. (2019). GeoGebra in e-learning environments: A possible integration in mathematics and beyond. *Journal of Ambient Intelligence and Humanization Computer*, 10(11), 4331–4343.
- Annett, M. (1985). *Left, right, hand, and the brain: The right shift theory*. London: Erlbaum.
- Annett, M. (2002). *Handedness and brain asymmetry: The right shift theory*. Hove: Psychology Press.
- Annett, M., & Manning, M. (1989). The disadvantage of dextrality for intelligence. *British Journal of Psychology*, 80(2), 213–226. DOI: 10.1111/j.2044-8295.1989.tb02315.x
- Assis, A., Abreu, N., Prinz, M.C.C, Argolio, N., & Miranda, T. (2016). Performance comparison between right-handers and left-handers in a Brazilian sample of the Developmental Neuropsychological Assessment. *Estudos de Psicologia (Campinas)*, 33(2), 283–291. <https://doi.org/10.1590/1982-02752016000200010>
- Benbow, C. P. (1986). Physiological correlates of extreme intellectual precocity. *Neuropsychologia*, 24 (5), 719–725. DOI: 10.1016/0028-3932(86)90011-4
- Casey, M. B. (1995). Empirical support for Annett's conception of the heterozygotic advantage. *Cahiers Psychological Cognition*, 14 (5), 520–528.
- Casey, M. B. (1996a). A reply to Halpern's commentary: theory-driven methods for classifying groups can reveal individual differences in spatial abilities within females. *Development Review*, 16(3), 271–283. DOI: 10.1006/drev.1996.0011
- Cerone, L. J., & McKeever, W. J. (1999). Failure to support the right-shift theory's hypothesis of a 'heterozygote advantage' for cognitive abilities. *British Journal of Psychol.* 90 (1), 109–123. DOI: 10.1348/000712699161305
- Corballis, M. C. (1997). The genetics and evolution of handedness. *Psychological Review*, 10(4), 714–727. DOI: 10.1037/0033-295X.104.4.714
- Corballis, M., Hattie, J., and Fletcher, R. (2008). Handedness and intellectual achievement: an even-handed look. *Neuropsychologia* 46 (1), 374–378. DOI: 10.1016/j.neuropsychologia.2007.09.009
- Creswell, J.W. & Poth, C.N. (2018). *Qualitative inquiry and research design: choosing among five approaches*. Thousand Oaks. Sage.
- Deary, I. J., Strand, S., Smith, P., & Fernandes, C. (2007). Intelligence and educational achievement. *Intelligence*, 35(1), 13–21. DOI: 10.1016/j.intell.2006.02.001
- Dong Y, Mo X, Hu Y, et al. (2020). Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. *Pediatrics*, DOI: 10.1542/peds.2020-0702
- Felix, A. (2020). Awareness of students towards e-learning in education. *Purakala with ISSN 0971-2143 is a UGC CARE Journal*, 31(15), 620-626.
- Greenhow, C. (2020). Ask the expert: Online learning vs. classroom learning. A Michigan State University (MSU) Today Presentation. Retrieved from

<https://msutoday.msu.edu/news/2020/ask-the-expert-online-learning-vs-classroom-learning/>

- Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbacher, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science Public Interest*, 8, (1), 1–51. DOI: 10.1111/j.1529-1006.2007.00032.x
- Lubinski, D. (2010). Spatial ability and STEM: a sleeping giant for talent identification and development. *Personality and Individual Differences*, 49(4), 344–351. DOI: 10.1016/j.paid.2010.03.022
- Malkhaz, M., Elene, K., Tamar, K., Guram, E., & Nikoloz, A. (2020). Left-handers retrained left-handers and right-handers: A comparative study. *World Journal of Advanced Research and Reviews*, 7(1), 41-47.
- McManus, I. C. (2002). *Right hand, left hand*. London: Orion Books Ltd
- Moreno-Guerrero, A.J., Aznar-Díaz, I., Cáceres-Reche, P. & Alonso-García, S. (2020). E-learning in the teaching of mathematics: An educational experience in adult high school. *Mathematics*, 8 (5), 840, doi: 10.3390/math8050840
- Nadikattu, R.R. (2020). Information Technologies: Rebooting the World Activities during COVID-19 (June 9, 2020). Retrieved from SSRN: <https://ssrn.com/abstract=3622733> or <http://dx.doi.org/10.2139/ssrn.3622733>.
- Ozyurt, O.; Ozyurt, H.; Baki, A.; Guven, B. (2013). Integration into mathematics classrooms of an adaptive and intelligent individualized e-learning environment: Implementation and evaluation of UZWEBMAT. *Computers in Human Behaviour*, 29(3), 726–738.
- Peng, P., Namkung, J., Barnes, M., and Sun, C. Y. (2016). A meta-analysis of mathematics and working memory: moderating effects of working memory domain, type of mathematics skill, and sample characteristics. *Journal of Educational Psychology*, 108 (4), 455–473. DOI: 10.1037/edu0000079
- Public Health Seattle and King County (2020). Novel Coronavirus. Retrieved from: www.kingcounty.gov/covid
- Sala G, Signorelli M, Barsuola G, Bolognese M, & Gobet F (2017). The relationship between handedness and mathematics is non-linear and is moderated by gender, age, and type of task. *Frontier in Psychology*, 8; 948. DOI: 10.3389/fpsyg.2017.00948. <https://pubmed.ncbi.nlm.nih.gov/28649210/>

Income Inequality and Educational Attainment in Nigeria

<https://departmentofchdsui.net.ng/archive/>