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Effects of Digital Learning Platforms on Academic Achievement of Secondary School Students in Genetics in Ibadan-North LGA, Oyo State

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Abstract

This study investigates the effect of Digital Learning Platforms on senior secondary school students' academic achievement in Genetics hypotheses were formulated and tested at a 0.05 level of significance. A quasi-experimental design was applied. Multi-stage sampling procedure was adopted to purposively select 3 public secondary schools from Ibadan-North LGA. A sample size of 104 participants comprises 50 male students and 54 female students fromSSS II intact classeswere involved in the study. Genetics in Biology Achievement Test (GBAT)(KR-20=0.79) was used as instrument for data collection. Analysis of Covariance (ANCOVA) was used for data analysis.There was a significant main effect of FGWC on senior secondary school students' academic achievement in Genetics $F_{(1,67)}=13.104$, $p<0.05$*].There was a significant main effect of FGWOC on senior secondary school students' academic achievement in Genetics [*$F_{(1,71)}=7.563$, $p<0.05$*]. There was a significant interaction effect of FGWCand FGWOC on senior secondary school students' academic achievement in Genetics [*$F_{(1,67)}=198.71$, $p<0.05$*]. From the results; it is therefore concluded that both the Digital Learning Platforms (Flipped–Google Classroom* with/without collaboration learning approach) are effective to teach

Genetics in Biology. Base on the findings; it is then recommended that Digital Learning Platforms should be considered in teaching and learning process to boost academic achievement in Genetics.

Keywords: Digital Learning Platforms, Genetics, Biology, Academic Achievement.

Introduction

Genetics is the branch of Biology that focuses on the study of genes, heredity, and genetic variation in living organisms. It encompasses a wide range of topics, from the molecular mechanisms of in heritance to the genetic basis of traits and diseases (Teker, Albayrak, Akayli & Urku, 2020). Genes are segments of DNA that contain the instructions for building proteins, which are the building blocks of cells and tissues. Genes determine specific traits, such as eye color, blood type, and susceptibility to diseases. Chromosomes are structures within cells that contain genetic material. In humans, chromosomes are found in the cell nucleus and come in pairs, with one set inherited from each parent. Each chromosome contains many genes. Deoxyribonucleic Acid (DNA) is the molecule that carries genetic information in all living organisms. DNA consists of two long strands twisted into a double helix structure. The sequence of nucleotide bases (adenine, thymine, cytosine, and guanine) along the DNA molecule forms the genetic code (Saher, Naz & Kamal, 2020). Genetic variation refers to the differences in DNA sequences among individuals within a population or species. Genetic variation arises from mutations, genetic recombination, and gene flow, and it is the basis for biodiversity and evolutionary change (Saher, Naz & Kamal, 2020; Webster & Patrick,2023). Mendelian genetics, named after the scientist Gregor Mendel, describes the inheritance of traits according to specific patterns of gene transmission. Mendel's laws of inheritance, including the law of segregation and the law of independent assortment, form the

foundation of classical genetics(Matalova, 2022; Jeffrey,M. C., Robin,L. C., Tawny,A. W. Lexie, Madison,Wilson& Harrison,2022).

Genetic crosses involve breeding experiments in which organisms with known genotypes are crossed to study the inheritance of specific traits. Punnett squares and other genetic tools are used to predict the outcomes of genetic crosses and analyze patterns of inheritance. Genetic disorders are conditions caused by mutations or abnormalities in genes or chromosomes. Examples of genetic disorders include cystic fibrosis, sickle cell anemia, Huntington's disease, and Down syndrome. Genetic engineering is the manipulation of an organism's genetic material using biotechnology techniques. It involves techniques such as gene cloning, recombinant DNA technology, and gene editing (e.g., CRISPR-Cas9) to modify genes for various purposes, such as medical research, agriculture, and biotechnology. Population genetics is the study of genetic variation and evolution within populations. It examines factors such as allele frequencies, genetic drift, gene flow, natural selection, and genetic adaptation to understand how populations change over time. Human genetics focuses on the study of genetic variation and inheritance in humans. It investigates the genetic basis of human traits, diseases, and behaviors, as well as the genetic factors influencing population diversity and ancestry. Genetics plays a crucial role in understanding the mechanisms of inheritance, evolution, and disease, and it has applications in various fields, including medicine, Agriculture, forensic science, and conservation Biology (Teker, Albayrak, Akayli&Urku, 2020; Saher, Naz& Kamal, 2020; Mulvihill & Wayne, 2023).

Academic achievement is the successful completion of learning objectives, subject-matter mastery, and the application of abilities and knowledge in educational settings. It includes a variety of academic metrics, such as grades, test results, course completion, and academic achievement across a range of topics or specialisations. Grades are frequently used as measures of academic achievement since they show how well students performed on tests, projects, assignments, and other

evaluations. Grade Point Average (GPA), which is determined by averaging a student's grades over several courses or semesters, is a numerical measure of a student's overall academic performance. Quantitative indicators of students' academic ability in particular courses or areas are provided by test results on standardized assessments, such as standardized achievement tests, state-mandated assessments, and college admission examinations (SAT, ACT). These tests assist in determining how well students have mastered the curriculum's requirements and in comparing their results to those of other countries or regions (Türel & Dokumaci, 2022; Vlădescu, 2023).

Year after year, student performance has been unstable, especially in the field of Biology, in the Secondary School Certificate Examinations (SSCE), which is administered by the West African Examinations Council (WAEC) and the National Examination Council (NECO). Even though Biology is important to people and inventive for a nation's technological growth, the performance of candidates in the subject area is not encouraging as it is not stable and consistent. For instance, In the year 2019,the performance of students in Biology is said to have a raw mean score of 31, and standard deviation of 9.43 which was slightly better than that of WASSCE for School Candidate 2018 with a raw mean score of 31 and standard deviation of 9.00, In 2022, the performance of candidate with a raw mean score of 37 and standard deviation of 9.54 was poorer than that of WASSCE for School candidate in 2021 with a raw mean score of 40 and standard deviation of 10.00 and lastly in the year 2023, it was observed that the performance of candidate with a raw mean score of 31 and standard deviation of 10.91 was worse than that of WASSCE for school candidates in 2022 with a raw mean score of 37 and standard deviation of 9.54. Oyo state got the lowest WAEC results in the Southwest with only 19% passing in 2019. The West Africa Examination Council (WAEC) data that was accessible showed that Biology had the lowest achievement among the science subjects. Students' persistently poor academic achievement in Biology

has been partially attributed to the concept of genetics taught in secondary school (Ibitoye,2021).

Subsequently, The WAEC chief examiner's report on Biology questions in paper 2 indicated that among the Biology questions, genetics questions were unpopular among the candidates and very few candidates attempted them, it was reported that those who attempted them did not respond well to the questions and did poorly (2019-2023) for instance in 2019 examination, the genetics questions required the candidates to identify through the information given the genotype and phenotypic ratio of the offspring, many of them could not identify the parents as Hb which was given as symbol for the genotype of the parents and should have been used for the gametes and the off springs which made them loose marks. It was also observed that candidate failed to put the cross X sign between the parental genotypes; some even failed to cross the gamete appropriately of which all these accounted for huge loses of marks (Adelana,Ayanwale & Sanusi,2024).

In 2021, genetic questions asked was about candidate to briefly explain the process of gene replication in living things, it was observed by the chief examiners report that the question was the least answered among the candidates. Some of them could not explain gene replication in living things. In 2022, the genetic question asked the candidates to give correct punnett squares of dyhybrid cross, write number of offspring that will have required phenotypic characters, it was observed that, many candidate could not give the correct Parental Gamete Horizontal (PGH) and Parental Game Vertical (PGV) thereby getting wrong answers in offspring (F1) in the Punnette square. Also, most candidates wrote 9:3:3:1 or 1:3:3:9 as the number of offspring that will have the required phenotypic characters. Additionally, it was researched at the post-secondary level of education in the fields of science, medicine, and related fields. Even though genetics is a significant topic, reports suggested that science students find the topic challenging and intimidating. They think it's one of the most complicated parts of Biology,

thus they frequently have misconceptions and have trouble understanding its concepts, of which there is a need for teachers to lay more emphasis on the topic Genetics (Adelana, Ayanwale & Sanusi, 2024).

Studies have linked the abstract nature of genetics in Biology to its complexity, which has led to fewer students enrolling in genetics or related disciplines than in other non-STEM (Science, Technology, Engineering and Mathematics) fields. The difficulties in learning genetics are linked to a number of factors, such as its placement late in the Biology curriculum, inadequate or nonexistent science laboratories, non-STEM teachers teaching Biology classes, ineffective teaching methods, and a lack of contemporary instructional technologies specifically designed for teaching genetics. Many teaching techniques, such as the use of metaphorical instruction, logical prose and concept mapping, learning cycles, multimedia genetics self-learning materials, expository techniques, and annotated drawings, have been suggested as solutions to this issue. Additional recommendations include concept mapping and problem-solving techniques, video games, multimedia tools, and design criteria procedures. The potential application of modern technologies, such as digital learning platform, for genetics education has however, received little to no attention (Adelana, Ayanwale & Sanusi, 2024).

Digital learning platforms have grown in popularity in the educational sector with a variety of features to improve teaching and learning. An effort to make the process of creating, assigning, and grading assignments easier for educators, Google created a free online tool; a learning management system that offers communication, evaluation, and course administration capabilities for online education. A powerful, secure, and integrated system for creating customised learning environments that is open-source and intended for use by educators, administrators, and students. A virtual learning environment and course administration system are offered by this learning management system. Users can produce, organise, and share academic information using a

social networking site and learning management system. Teachers may develop and share information, manage assignments, and interact with students and parents using this social learning platform; an interactive teaching tool that lets instructors make and present multimedia presentations, tests, surveys, and other interactive exercises; an application for digital portfolios that enables students to produce, distribute, and consider their learning through multi-media uploads. These platforms enable educators and learners in the digital learning environment by providing a variety of features such content development, assignment administration, communication tools, assessment alternatives, and analytics (Lalap, 2021).

Google Applications for Education (GAFE) is an effective cloud computing solution that functions independently of students' time, location, or even device type. It improves education by providing free and simple-to-use learning resources. These programmes have demonstrated their value as a teaching and learning aid that can promote cooperation, evaluate student performance and written work with ease, and give students clear instructions on how to perform at their best. Additionally, by utilising key Google products such as Google Classroom, Google Meet, and Google Forms; students will be able to work together more effectively, become more competent, save money, and have a smaller environmental impact without compromising security or privacy. Educational technology, like Google Apps for Education, can play a significant role in helping to determine the best ways to modify teaching strategies so that students perform better academically. In order to create a successful classroom in the twenty-first century and to prepare students for success in their future occupations, technology in education must be implemented appropriately (Schneider, 2021). In order to educate effectively, a teacher must engage with students in the classroom, model the subject matter, and use all three of these factors. It is well acknowledged that for generations, secondary education in Nigeria has predominantly relied on traditional methods of instruction

that involve face-to-face interactions in a physical classroom. With the emergence of the new coronavirus in 2020, technology-oriented learning has become essential. Teachers must use a digital teaching mode in order to accomplish efficacy in the teaching and learning of science in general and Biology in particular in this digital age (Lalap, 2021).

Flipped Classroom Instruction using Google Classroom (FCIVGC) is one such technique. In 2012, Jonathan and Aaron invented the Flipped Classroom, a Blended Learning Model that uses digital tools to integrate online and in-person instruction. By presenting instruction as audio, video, narrations, text, and graphics, FCIVGC is a multimedia cognitive instructional mode that focuses on the cognitive processes that students used to learn. It considers the students mind as a dual channel, limited capacity, and active processing system. since students study the material at home and practice applying it in class, in order for the learner to actively create meaningful relationships between instructions in both classrooms and online. Teachers can record lectures that focus on certain curriculum subjects to meet learning objectives, which is an added benefit. In addition, it creates an existing library for students to review and complete assignments, and it permits them to pause, rewind, and review. This contrasts with the traditional instructional techniques that only require physical classroom instruction, which results in teaching in a real classroom. The teacher does everything in the classroom, including writing and speaking (Osuafor & Chinasa,2023).

Since secondary education in Nigeria has predominantly relied on traditional methods of instruction that involve face-to-face interactions in a physical classroom and application of digital learning platform received little to no attention to enhance academic achievement of senior secondary school students' academic achievement in genetics education (Mkimbili, 2022; Dominik & Weil, 2023). This study "Effect of Digital Learning Platforms on Senior Secondary School Students' Academic Achievement in Genetics" sought to investigate the students'

persistently poor academic achievement in Biology which has been partially attributed to the concept of genetics taught in secondary school.

Aim and Objectives of the Study

The aim of this study was to investigate effect of digital learning platforms on senior secondary school students' academic achievement in Genetics.

The objectives were to:

i. discover the main effect of Flipped-Google Classroom with collaborative learning approach on senior secondary school students' academic achievement in Genetics.
ii. determine the main effect of Flipped-Google Classroom without collaborative learning approach on senior secondary school students' academic achievement in Genetics.
iii. examine the interaction effect of Flipped-Google Classroom with collaborative learning approach and Flipped Google Classroom without collaborative learning approach on senior secondary school students' academic achievement in Genetics.

Hypotheses

The following null hypotheses were tested at the 0.05 level of significance based on the stated objectives:

$H_0$1: There will be no significant main effect of Flipped-Google Classroom with collaborative learning approach on senior secondary school students' academic achievement in Genetics.

$H_0$2: There will be no significant main effect of Flipped-Google Classroom without collaborative learning approach on senior secondary school students' academic achievement in Genetics.

$H_0$3: There will be no significant interaction effect of Flipped-Google Classroom with collaborative learning approach and Flipped Google Classroom without collaborative learning approach on senior secondary school students' academic achievement in Genetics.

Methodology

The research design was a quasi-experimental design with 3x1 Factorial matrix using pre-test and post-test approach.Multi-stage sampling procedure was adopted to purposively select 3 public secondary schools from Ibadan-North LGA.For Experimental Groups: Anglican Commercial Grammar School, Total Garden (Group A) and Cheshire High School, Alaro Sango (Group B).For Control Group: Methodist Grammar School, Bodija (Group C).The three (3) public senior secondary schools in Ibadan North Local Government Area, Oyo state were selected purposively for this study because most students from the selected schools have access to Smartphone. A sample size of 104 participants comprises 50 male students and 54 female students from SSS II intact classeswere involved in the study. Genetics in Biology Achievement Test (GBAT) was used as instrument with face and content validity for data collection.The instrument's reliability value was determined using Kuder-Richardson (KR-20) with reliability value of 0.79. The fieldworks for the study were carried out within eight (8) weeks. Analysis of Covariance (ANCOVA) was used and tested at 0.05 level of significance for data analysis.

Results and Discussion of Findings

Presentation of Data

Hypotheses

$H_0$1: There will be no significant main effect of Flipped-Google Classroom with Collaborative Learning Approach on Senior Secondary School Students' Academic Achievement in Genetics.

From the Table 1, the F–statistics [$F_{(1, 67)}$] = 13.104 and the probability (significant) value = 0.001. This indicated that the null hypothesis ($H_0$1) that FGWC has no significant main effect on senior secondary school students' academic achievement in Genetics should be rejected. Hence, there was significant difference in mean posttest score of secondary school students [$F_{(1, 67)}$ = 13.104, $p < 0.05$] between Flipped–Google

classroom with collaboration learning approach (FGWC) and the conventional teaching strategy (CONTS), while adjusting for pretest score.

Table 1:Tests of Between–Subject Effects of Flipped-Google Classroom with Collaborative Learning Approach (FGWC) on Senior Secondary School Students' Academic Achievement in Genetics

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	116.225[a]	2	58.113	6.947	0.002	0.172
Intercept	939.950	1	939.950	112.363	0.000	0.626
Pretest	3.292	1	3.292	0.394	0.533	0.006
Strategy	109.616	1	109.616	13.104	0.001	0.164
Error	560.475	67	8.365			
Total	**24119.000**	**70**				
Corrected Total	**676.700**	**69**				

a. R Squared = 0.172 (Adjusted R Squared = 0.147)
Source: Fieldwork, 2024.

$H_0$2: There will be no significant main effect of Flipped-Google Classroom without Collaborative Learning Approach on Senior Secondary School Students' Academic Achievement in Genetics.

From the Table 2, the F–statistics [$F_{(1,71)}$] = 7.563 and the probability (significant) value = 0.008. This indicated that the null hypothesis ($H_0$2) that Flipped–Google classroom without collaboration learning approach (FGWOC) has no significant main effect on senior secondary school students' academic achievement in Genetics should be rejected. Hence,

there was significant difference in mean posttest score of secondary school students [$F_{(1,71)} = 7.563$, $p < 0.05$] between Flipped–Google classroom without collaboration learning approach (FGWOC) and the conventional teaching strategy (CONTS), while adjusting for pretest score.

Table 2: Tests of Between-Subjects Effects of Flipped-Google Classroom without Collaborative Learning Approach on Senior Secondary School Students' Academic Achievement in Genetics

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squard
Corrected Model	68.688[a]	2	34.344	5.046	0.009	0.124
Intercept	667.306	1	667.306	98.040	0.000	0.580
Pretest	9.142	1	9.142	1.343	0.250	0.019
Strategy	51.476	1	51.476	7.563	0.008	0.096
Error	483.258	71	6.806			
Total	**24600.000**	**74**				
Corrected Total	**551.946**	**73**				

a. R Squared = 0.124 (Adjusted R Squared = 0.100)

Source:Fieldwork, 2024

$H_0$3: There will be no significant interaction effect of Flipped-Google Classroom with Collaborative Learning Approach and Flipped Google Classroom without Collaborative Learning Approach on Senior Secondary School Students' Academic Achievement in Genetics.

From the Table 3, the F–statistics [$F_{(1, 67)}$] = 198.71 and the probability (significant) value = 0.000. This signified that the null hypothesis ($H_0$3) that there would be no significant interaction effect of

FGWC and FGWOC on senior secondary school students' academic achievement in Genetics should be rejected. Therefore, there was significant difference in mean posttest score of senior secondary school students [$F_{(1,67)} = 198.71$, $p < 0.05$] between the interaction of FGWC and FGWOC, and the conventional teaching strategy, while adjusting for pretest score.

Table 3: Tests of Between-Subjects Effects of Flipped-Google Classroom with Collaborative Learning Approach And Flipped Google Classroom without Collaborative Learning Approach on Senior Secondary School Students' Academic Achievement in Genetics

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2220833.603[a]	2	1110416.801	568.266	0.000	0.944
Intercept	346958.057	1	346958.057	177.559	0.000	0.726
Pretest	1998.384	1	1998.384	1.023	0.316	0.015
Strategy	388279.496	1	388279.496	198.706	0.000	0.748
Error	130920.983	67	1954.045			
Total	**4407869.000**	**70**				
Corrected Total	**2351754.586**	**69**				

a. R Squared = 0.944 (Adjusted R Squared = 0.943)

Source: Fieldwork, 2024

Discussion of Findings

There was a significant main effect of Flipped–Google classroom with collaboration learning approach (FGWC) on senior secondary school students' academic achievement in Genetics which is in line with previous study: Students' Academic Performance and their Perception on the use of Google Applications in Social Studies (Lalap, 2021). It was

discovered in the previous study that the use of Google Applications had a "significant effect" on the academic achievement of the chosen Grade 7 students in learning Social Studies, as measured by pre- and post-test results. The claim that using Google Applications has no significant effect on the academic achievement of the chosen seventh-grade students in their social studies classes is not supported which is the same with the current study result but different in subject matter and selected students' level of education. Though, flipped classroom and collaboration learning approach were not performed in the previous study but the previous and current studies used Google Applications.

There was a significant main effect of Flipped–Google classroom without collaboration learning approach (FGWOC) on senior secondary school students' academic achievement in Genetics which is in line with previous study: Effect of Flipped Classroom Instruction via Google Classroom on Secondary School Students' Academic Achievement Chemistry in Onitsha Education Zone (Osuafor & Chinasa,2023). The previous results revealed that there is a statistically significant difference in the academic attitude achievement of students taught chemistry using the FCIVGC method and those taught using the lecture approach, with the FCIVGC group performing significantly better. In spite the fact that both current and previous studies adopted the same teaching strategy with the same results for the same level of students' education, their subject matters were quite different.

There was a significant interaction effect of Flipped-Google Classroom with collaborative learning approach (FGWC) and Flipped Google Classroom without collaborative learning approach (FGWOC) on senior secondary school students' academic achievement in Genetics which is not in line with previous study: The Effect of Google Classroom-Assisted Learning on the Academic Achievement of Students (Sari, Yin & Zakariya, 2024). The ANCOVA test results from previous study indicate no significant difference in post-student accomplishment in Economics from the selected Malaysia Universities based on learning methodologies

[Google Classroom Support with Collaborative Learning Approach (GCDK), Google Classroom Support without Collaborative Learning Approach (GCTK) and Traditional Learning Approach (KPK)]. Although, there exist differences in both studies' geographical scope and level of education; but there also exist similarities in both studies' contextual scope.

Conclusion

From the results, it is therefore concluded that both the digital learning platforms (Flipped–Google Classroom with/without collaboration learning approach) are effective to teach and boost students' academic achievement in Genetics.

Recommendations

From the findings of this study, the following recommendations/ suggestions are made:

i. Flipped–Google Classroom with collaboration learning approach should be considered in usage by Biology teacher to teach Genetics.
ii. Biology students should be encouraged by their teacher to use Flipped–Google classroom without collaboration learning approach in teaching and learning Genetics.
iii. The combination of Flipped-Google Classroom with collaborative learning approach and Flipped Google Classroom without collaborative learning approach is suggested to be practiced in teaching and learning process to enhance students' academic achievement in Genetics.

References

Adelana, O. P.,Ayanwale, M. A. & Sanusi, I. T. (2024).Exploring Pre-Service Biology Teachers' Intention to Teach Genetics using an AI Intelligent Tutoring - Based System.*Cogent Education,* 11(1), 1 – 25. https://doi.org/10.1080/2331186X.2024.2310976

Dominik, S. & Weil, T. (2023). Chemical Reactions in Living Systems. *Advanced Science,* 11(8), https://doi.org/10.1002/advs.2023 03396.

Ibitoye, T. M. (2021). Project-Based Learning and Self-Regulatory Strategies as Determinants of Secondary School Students' Achievement, Attitude and Practical Skills in Biology Concepts in Ibadan, Nigeria.1 – 196.

Jeffrey, M. C., Robin, L. C., Tawny, A. W., Lexie, H., Madison, L., Wilson, J. & Harrison, D. (2022).Revisiting Mendel: Use of a Behavioral Assay to Examine Inheritance of Traits in Drosophila. *Advances in Biology Laboratory Education,* 42. https://doi.org/10.37590/able. v 42.art56.

Lalap Jr., V. G. (2021). Students' Academic Performance and their Perception on the use of Google Applications in Social Studies. *EPRA International Journal of Research and Development (IJRD),* 6(7), 564 – 571. https://doi.org/10.36713/epra2016

Matalova, E. (2022). Johann Gregor Mendel: Born to Be a Scientist?. *PLOS Biology*, 20(7), e3001703. https://doi.org/10.1371/ journal.pbio. 3001703.

Mkimbili, S. T. (2022). Do Biology Syllabi Provide Opportunities for Secondary School Students to Engage with Critical Thinking Skills?. *Journal of Biological Education,* 58(2), 444–459. https://doi.org/10.1080/00219266.2022.2067582.

Mulvihill, J. J. & Wayne,W. G. (2023).The Gregor Mendel Bicentennial Tribute—Enduring Mementos of the Founder of Genetics. *JAMA,*330(4), 297-298.https://doi.org/10.1001/ jama. 2023.9766.

Osuafor, A. & Chinasa, G. P. (2023). Effect of Flipped Classroom Instruction via Google Classroom on Secondary School Students' Academic Achievement Chemistry in Onitsha Education Zone.*UNIJERPS Unizik Journal of Educational Research and Policy Studies,*15 (3), 86 – 95. http://sjifactor.com/ passport.php?id =21363

Saher, N. U.,Naz, F. & Kamal, M. (2020). Mitochondrial DNA Variation and Population Genetic Structure of Mud Crab, Scylla Serrata from Pakistan/Northern Arabian Sea.*Genetics of Aquatic Organisms,*3(2), 67-77. https://doi.org/10.4194/2459-1831-v3_2_04.

Sari,N. M., Yin, K. Y. & Zakariya, Z. (2024). The Effect of Google Classroom-Assisted Learning on the Academic Achievement of Students.*International Journal of Academic Research in Business and Social Sciences.*14(4), 1 – 16. http://dx.doi.org/10.6007/IJARBSS/v14-i4/21165

Schneider, M. F. (2021). Living Systems Approached from Physical Principles. *Progress in Biophysics and Molecular Biology*. 162, 2–25. https://doi.org/10.1016/j.pbiomolbio.2020.10.001.

Teker, T., Albayrak, G., Akayli, T. & Urku, C., (2020). Screening of Lactococcal Adhesion Genes and Two Pneumococcal Genes as Genetic Determinants of Virulence in Lactococcus Garvieae Strains. *Genetics of Aquatic Organisms,* 4(2), 61–67. https://doi.org/10.4194/2459-1831-v4_2_01.

Türel,Y. K. & Dokumaci, O. (2022).Use of Media and Technology, Academic Procrastination, and Academic Achievement in Adolescence.*Participatory Educational Research,* 9(2), 481–97. https://doi.org/10.17275/per.22.50.9.2.

Vlădescu,C. (2023). The Relationship between Mastery Learning Models and Academic Achievement in Mathematics. *International Electronic Journal of Mathematics Education,* 18(4), em0751. https://doi.org/10.29333/iejme/13705.

Webster, A. K. & Patrick,C. P. (2023).Heritable Epigenetic Variation Facilitates Long-Term Maintenance of Epigenetic and Genetic Variation.*Edited by IKronholm. G3: Genes, Genomes, Genetics*,14(2), 1-15. https://doi.org/10.1093/g3journal/jkad287.