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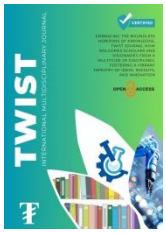

Gender and Learning Styles as Correlates of Grade Six Mathematics Performance in Selected Schools in Buffalo City, South Africa

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Abstract
Mathematics is one of the crucial disciplines that advances science and technology and contributes to any country's economic development. However, students perform poorly in Mathematics classes because of numerous variables. This study examines the connection between two factors, gender and learning preferences, and the mathematical performance of sixth-grade students in Buffalo City. Since this work takes a quantitative approach, the research strategy used is correlational. A stratified sampling technique was used to select 1225 from the population of Grade 6 students in Buffalo City Education District. Descriptive and inferential statistics were used to analyse the data. The findings showed that learning styles have a positive impact on Mathematics performance ($r = 0.999$; $p>0.05$). Nevertheless, these styles affect Mathematics performance in the following order: visual learning style ($\bar{x} = 13.242$, $SD = 5.565$), takes the lead, followed by students with auditory learning style ($\bar{x} = 12.996$, $SD = 3.883$), and Kinaesthetic learning style ($\bar{x} = 11.525$, $SD = 3.800$). There is no significant difference between male and female Grade 6 Mathematics performance in Buffalo city ($t = -.217$, $df = 1218$, $p>0.05$). The study concluded that one of the most fundamental issues to consider in improving Mathematics performance is the understanding of the students' learning styles.

Keywords
gender, learning preferences, sixth-grade mathematics performance

INTRODUCTION

One of the most important disciplines in elementary and secondary education is Mathematics. The recipient's mathematical expertise fosters both social and economic advancement. Our way of life requires planning and computation, which Mathematics teaches us. We must examine the methods used in schools for Mathematics instruction and learning. Several factors influence how well Mathematics is taught and learnt. The peculiarities of the students should be taken into account for the appropriate distribution of Mathematics. Each student is extremely distinctive in their own way (Adu, Pylman & Adu, 2021).

There are differences in the students' assimilation rate, skill types and brain structures: every student uniquely approaches Mathematics. When teaching and learning Mathematics, students' attitudes and behaviours in the classroom are crucial. Various learning styles are displayed by individual students (Adu & Duku, 2022), and every student typically has a unique learning style that shapes their learning process. To find out which learning style will best foster comprehension of the material, a teacher must engage with students. Every educator is motivated to promote desired learning outcomes and meet or surpass the learning objectives. According to Adu and Duku (2022), a student's background, culture, maturity and personal experience are some of the traits that can affect their learning style.

The term "learning styles" describes the many ways that people absorb and process knowledge. Incorporating diverse learning styles into Mathematics helps improve students' comprehension and interaction with a range of scientific ideas. Multiple teaching strategies that accommodate different learning styles have been shown to enhance academic achievement and improve information retention. While auditory students might prefer lectures, podcasts, or audio recordings, visual students might benefit from the use of diagrams, graphs, or animations. Experiments, simulations, and interactive exercises involving movement and hands-on activities may be beneficial for kinaesthetic students. Nevertheless, there are certain difficulties in incorporating different learning styles into Mathematics and science instruction (Albina et al., 2023)

Meeting the various learning needs of students is one of the major issues. Certain students could struggle with studying resources that do not fit their chosen learning style since they have a dominant learning style. The conclusion from a number of existing studies (Harahap et al., 2019; Sahin & Yilmaz, 2020; Adu & Duku, 2021). is that it is critical to comprehend various learning styles in Mathematics and science instruction. For instance, Albina et al. (2023) discovered that by determining students' preferred learning styles, visual, auditory or kinaesthetic, teachers can modify their methods to better suit their needs, enhancing motivation, engagement and learning results. It is fascinating to see how various learning styles affect Mathematics and science education. A study by Kolb et al. (2014) found that students who had an active learning style performed better in Mathematics and science tests and had a more positive attitude towards science courses.

The long-standing interest in learning styles in the field of education is reflected in the numerous studies investigating the relationship between learning styles and academic accomplishment (Harahap et al., 2019; Sahin & Yilmaz, 2020). The way Mathematics is taught and learnt will be significantly impacted by an understanding of how different learning styles impact information acquisition and retention in the setting of Mathematics education. An increasing body of research examines how different students perform in Mathematics and science classrooms and how teaching strategies might be adjusted to meet the needs of different students (Stone, 2021; Albina et al., 2023).

Every student has a preferred method for organisation, perception and retention. The students' preferred method of processing, assimilating and repeating knowledge can be characterised as their learning style (Adu & Duku, 2021). Adu and Duku (2021) distinguished three main learning styles: visual, auditory and kinaesthetic, that could influence students' preferences. Visual students use sight to remember and comprehend mathematical concepts; auditory students use hearing and listening to comprehend and retain information; and kinaesthetic students use action rather than sight or hearing. In addition to learning styles, which are one of the primary students' characteristics that might influence mathematical performance, research has shown that gender is another aspect of students that should be taken into account when teaching and studying Mathematics (Doornkamp et al., 2024). The preferred learning styles of males and females differ. According to Adu, Pylman and Adu (2021), females are more adaptable and self-reliant when it comes to their learning preferences than males. In their study, males favoured auditory and kinaesthetic learning styles, whereas females performed well when using visual learning styles. Adom & Adu (2018) reaffirmed that although males chose analytical learning that emphasises abstraction, females favoured divergent learning.

Due to a lack of information and research, the relationship between gender and learning styles may not be well defined. However, aside from Mathematics, learning styles are crucial elements that can improve success in any topic. Learning styles encompass how students feel, act, and process information throughout class activities. Because of their comfort levels, males and females have different learning methods. The students' psychological characteristics are ingrained with the abilities to hear, read, see, and act (Doornkamp et al., 2024).

Depending on their mental state and level of willingness to learn, students can have any of the learning styles. Researchers discovered that, depending on the frequency measured, female students perceive sounds much softer than male students. In other words, females' hearing is four times greater than boys. It has been consistently demonstrated beyond a reasonable doubt that female students have substantially superior hearing compared to male students (Balaresque et al., 2025).

Objective of the Paper

The sole objective of this paper is to examine gender and learning styles as correlates of Grade 6 students' Mathematics performance in Buffalo City, South Africa.

Hypotheses

1. Grade 6 students' learning styles (visual, auditory, and kinaesthetic) have no significant influence on their Mathematics performance.
2. Males and females have no significant difference in Grade 6 students' performance in Mathematics.

KOLB'S EXPERIENTIAL LEARNING THEORY

Kolb's experiential learning theory serves as the theoretical anchor for this paper. Kolb asserts that qualities like self-initiative and self-evaluation are necessary for experiential learning. Experiential learning should follow the wheel of full learning, which includes goal setting, testing, observation, evaluation, and action, to be timely. Students can acquire new abilities in a variety of areas, especially Mathematics, as well as new mindsets and ways of thinking, thanks to this entire process. The four phases of learning identified by Kolb's experiential learning theory are do, observe, think and plan. These phases support students' active engagement in the learning process. (Balaresque et al., 2025; Adu & Duku, 2021). Kolb's Experiential Learning Model (ELM), one of the various learning style models, has been revised to take into account various educational environments and is frequently utilised. Kolb puts forth a fictitious four-phase learning cycle. According to this paradigm, people may exhibit a preference for each stage or may be better able to handle a specific level (Adu & Duku, 2022).

Doornkamp et al. (2024) acknowledge that across all of these phases, learning is seen as an ongoing, dynamic activity. Concrete experience (CE; experiencing) that encourages experiential learning is one of the four phases of the ELM. Active experimentation (AE; doing) involves active learning through trial and error; abstract conceptualisation

(AC; reasoning) involves conceptual and analytical thinking to achieve understanding; and reflective observation (RO; reflecting) involves carefully considering the task and potential solutions before taking any action (Adu & Duku, 2021). A basic explanation of Kolb's learning theory is necessary to comprehend the significance of learning styles concerning the teaching and learning of Mathematics. Concrete experience (experimenting), active implementation (doing), abstract conceptualisation (thinking), and reflective observation are the fundamental principles that support this philosophy, which focuses primarily on learning. According to Kolb's logic, using tangible teaching resources gives students practical chances to investigate and actively participate in Mathematics education. Students can take charge of their education by experimenting and learning via trial and error when working with tangible objects. (Adu & Duku, 2022). Additionally, as each child learns and processes knowledge differently, educational resources may allow students to learn by doing, which is consistent with Kolb's "active implementation" idea. By providing students with something tangible to see (observe), touch (learn by doing) and consider the relationships between the mathematical problems they have seen and the accuracy of the mathematical solutions offered to these problems (reflective observation), instructional materials stimulate students' abstract thinking and their interests (Adu & Duku, 2021: 415).

LITERATURE REVIEW

The following concepts from the research questions will be reviewed:

Learning Styles and Mathematics Performance

Effective learning and teaching will undoubtedly occur when the student enjoys a suitable learning style and the teacher uses a matching one. However, Adu et al. (2020) assert that it is impossible to overlook the problem of environmental influences affecting teaching and learning styles. Students do engage with their surroundings in different ways. The conduct or character demonstrated by the students is influenced by their environment; for example, the location of the school and the availability of instructional materials might influence the students' preferred learning techniques. The majority of schools in South Africa are located distant from the residences of the students. To relax after a long walk, these students will prefer to listen to the teachers (auditory) and watch what they are demonstrating (visual) (Adu & Duku, 2021). According to Liu, Yue and Liu (2024), students with diverse style preferences would interact with, respond to, and perceive the world in different ways. By influencing learning behaviours, learning styles have an impact on effective teaching and learning. The learning environment can influence the students' chosen learning style and conduct. Learners perceive, interact with, and respond to their surroundings in unique ways.

Teachers must prioritise the traits and personalities that their students exhibit, as well as the differences in their learning styles. These traits and personalities can greatly support the instructor and enhance the significance and interactivity of classroom activities (Adu et al., 2020). In addition, since the needs of the students are different, the knowledge of students' characteristics will assist the teacher in setting up the classroom. When we consider a typical classroom setting, we rarely see all three of these learning modes (visual, auditory and kinaesthetic) used together. While it may appear difficult, it is doable with careful teacher planning and preparation. What students see and hear affects their behaviour. Therefore, the efficiency of learning is determined by what they see and hear. The organisation and usage of instructional materials are critical for effective teaching and learning as well as concept retention (Leontidis, 2024). Sequel to the aforementioned point, Leontidis (2024) believes that students remember 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they hear, see and talk about, and 90% of what they hear, see, talk about and do. The utilisation of instructional materials, according to Adu and Duku (2021; 2022), is what keeps discovered facts securely bonded to the students' memories.

According to Papageorgiou and Callaghan (2018), competitive students in South Africa and elsewhere use learning strategies and an individualistic personal learning plan to accomplish their learning objectives. Competitive students often see all students in the class as working towards the same goal of learning. However, the competitive students want not only to become the first in achieving that goal but also to achieve that goal more outstandingly than their peers (Papageorgiou & Callaghan, 2018). Consequently, competitive students often see academic performance as a system of few winners and many losers. The chief benefit of the competitive learning style is the motivation that stimulates great learning effort (Wu et al., 2024). On the other hand, some educational psychologists have argued that competitive learning may not be desirable because it produces high stress, low self-concept (in the case of failure), cheating and aggression in the classroom (Adu, Pylman & Adu, 2020).

People are not born to share a genetic predisposition in terms of the learning approach; instead, they learn how to conduct learning through a socialisation process that is unique to each culture (Lo & Sasaki, 2024). Certainly, some learning styles can be common to students around the world. For instance, memorisation will dominate students' learning styles if tests primarily require them to replicate knowledge (Adu, Pylman & Adu, 2020). However, other learning styles can be quite culturally distinctive. They stated that every culture has unstated assumptions about people and how they learn, and these assumptions invisibly guide the educational process in that culture (Coma-Roselló et al., 2018; Heyes, 2018).

Learning behaviours are determined by learning styles, and this affects effective teaching and learning. The learning environment has a way of influencing the preference of learning style and behaviour exhibited by the students. Learners have a different way of perceiving, interacting, and responding to this environment (Coma-Roselló et al., 2018; Adu, Pylman & Adu, 2020). Teachers must be familiar with their students' traits and attributes. They must also examine

how their students differ in learning style, as knowing about their preferences can help teachers better understand the differences that students bring to the classroom. (Coma-Roselló et al., 2018; Adu, Pylman & Adu, 2020). Adjustments can then be made to accommodate the students' varied needs.

The cells in the brains of the students generate a varied pattern of perception; according to some studies, the brain's hemispheres have distinct routes for perception (Neuroscience News, 2025). A variety of learning styles exist, including kinaesthetic, visual and auditory. In class, the auditory enjoys sitting near the teachers and listening to their lectures. When being taught, visual students want to see things in real life. Resources such as graphs, charts and images help them learn. Those who learn best by doing are kinaesthetic.

When we think about a typical classroom situation, it is rare to find all three of these approaches (visual, auditory, and kinaesthetic) to learning incorporated into a class. While it may seem impossible to do this, it can be done through the teacher's thoughtful planning and preparation (Adu, Pylman & Adu, 2020).

Teachers can learn which areas they are already proficient in and that require improvement by using the different learning style inventories (Coma-Roselló et al., 2018; Adu, Pylman & Adu, 2020). Numerous studies in the field of learning styles have contributed to some of the biggest advancements in education by acknowledging that students in classrooms have a wide range of distinct learning profiles. Perceptual learning styles, field dependence/independence, analytical/global learning styles, and reflective/impulsive learning styles are a few of the magnitudes that have been studied in the field of learning styles. More interest and motivation in the learning process, increased student responsibility for their learning, and greater classroom community, but little work could be identified on the correlation of learning styles and students' academic achievement, are some advantages of raising students' awareness of their learning styles (Adom & Adu, 2018; Papageorgiou & Callaghan, 2018).

Positive influences found in the literature include the need to identify and respond to students' preferred learning styles if they are to learn, remember complicated material, succeed academically, be motivated to study, and approach learning effectively. This is particularly apparent when students' learning styles and teachers' teaching philosophies diverge (Coma-Roselló et al., 2018; Adu, Pylman & Adu, 2020). Scholars and thinkers also usually concur that students learn differently. To make learning easier and more efficient for students, it is crucial to take into account their unique learning preferences (Lo & Sasaki, 2024; Papageorgiou & Callaghan, 2018).

Gender and Mathematics Performance

When discussing Mathematics education in general, a few distinct elements stand out. These include, among other things, negative socio-social mindsets, family unit assignments at home, a one-sided educational plan based on sexual orientation, inadequate teaching materials, a lack of school offices (quarters), sponsorship, unmotivated and unfit science teachers, a lack of good and financial parental help, a lack of confidence among young women, poor test scores, and and so on (Adu & Duku, 2021).

As indicated by the UNESCO Institute for Statistics report distributed in September 2010, the lowest education rates were seen in sub-Saharan Africa, where the grown-up literacy rate for males is 71.6% and 53.6 % for females, and in Northern Africa, it is separately 76.7% and 58.1 %. It ought to be featured that the greater part of the grown-up populace is as yet ignorant in the ten after nations: Gambia (55 %), Senegal (58 %), Benin (59 %), Sierra Leone (60 %), Guinea (62 %), Ethiopia (64 %), Chad (67 %), Burkina Faso (71 %), Niger (71 %), and Mali (74 %) (UNESCO, 2018; Adu & Duku, 2022). The net enrolment proportion in the young population in sub-Saharan African nations is around 52.3 % young ladies and 60.7 % young men. Dropout among young ladies at the optional school level is expected in some nations due to socio-cultural (early marriage), monetary reasons, institutional boundaries, and lacklustre performance of young ladies (UNESCO, 2018; Adu & Duku, 2021).

The Trends in Mathematics and Science Study of 2011 announced that somewhere in the range of 68 and 90% of African students in Grade 8 failed to meet the low benchmark in Mathematics (Adu & Duku, 2021). Besides, tragically, no critical advancement was made in TIMSS 2011. It is a pity that Africa is so inadequately represented in such a significant worldwide evaluation of the arithmetic and science information in the sixth grade.

Several studies on Mathematics assessments and sex differences in access to higher education have identified specific sexual orientation disparities at the elementary school and college levels. The largest university in Mexico reported in 2009 that the proportion of female students was higher than that of male students and that females were more likely than males to graduate (56% of female graduates compared to 44% of male graduates). Despite this, women are still significantly underrepresented in science (UNESCO, 2018). Females make up only 38% of students enrolled in science programmes, and 43% of all students who graduate from these programs are female. The gap in gender differences is more noteworthy when considering access to post-graduate training. In 2008, just 30% of students in postgraduate projects were females, even though in programmes identified with Mathematics Education, female students made up 45% (Adu & Duku, 2021).

In an examination including college professors, it was discovered that they considered male students more capable in arithmetic than females. They communicated similar convictions as those found among instructors in primary school about females being effective in mathematics due to their effort and control. Perception of classes recognised a more latent disposition of female students and an inclination of male students to be more participative. Even though outcomes show that, by and large, female students are more perseverant in their studies, it appears that they despise

everything to think about science as a male space, excessively serious for ladies and that educators' convictions will, in general, fortify this perception (Adu & Duku, 2022; Lo & Sasaki, 2024)

METHODOLOGY

Research Approach

This study adopted a quantitative approach. The purpose of using this approach for this study is that it can predict human behaviour or predict likely outcomes (identify relationships among variables). This approach is relevant to this study, which is particularly aimed at exploring gender and learning styles as correlates of Grade 6 Mathematics performance (Adu & Duku, 2021).

Research Design

The researchers used a correlational study design. One kind of non-experimental quantitative design is used in correlational research. Given the high levels of ambiguity and ignorance, the dearth of prior research and literature on the subject, and the fact that this kind of study is typically adaptable and lacks a formal framework, the correlational design was thus the most practical and appropriate research design for this study (Adu, Pylman & Adu, 2020).

Data Analysis

Inferential statistics of Pearson Product-Moment Correlation (PPMC) was employed to test the hypotheses raised in this paper, as it measures relationships between the independent variables (Learning styles and Gender) on the dependent variable (Mathematics performance)

RESEARCH FINDINGS

Hypothesis 1: There is no significant influence of learning styles on Grade 6 students' Mathematics performance.

Table 1 Descriptive Aspect of One-way Analysis of Variance of Gender and Mathematics Performance

	N	Mean	Std. Deviation	Std. Error
Visual_Learning_Style	231	13.2424	4.56572	.30034
Auditory_Learning_Style	836	12.9964	3.88348	.13431
Kinesthetic_Learning_Style	158	11.5253	3.80027	.30233
Total	1225	12.8531	4.04060	.11545

Table 1 shows that Grade 6 students with a visual learning style (= 13.242, SD = 5.565) had the best performance in Mathematics at Buffalo City, followed by students with an auditory learning style (= 12.996, SD = 3.883), and students with a Kinaesthetic learning style (= 11.525, SD =3.800). The above table is expedient. According to Papageorgiou & Callaghan (2018), for any student to be empowered to perform better academically, their preferred learning styles must be considered. Learners' preferred learning styles will improve and enhance their understanding of what is being taught.

These findings underline the considerable influence of learning styles on students' success in Mathematics (Mangwende, 2024), and they also support the argument of Heyes (2018), which categorises visual students as sensing students. 'Sensing' students are concrete and methodical; they are good at memorising facts and doing hands-on work, and are more comfortable with following rules and standard procedures, hence, they perform better than the other categories. However, it contradicts Adu and Duku (2022), who say students retain 30% of what they see and 50% of what they see and hear, while 90% of what they say as they do something, since visual students learn visually using charts, graphs, and pictures.

This result is in line with earlier research by Tahir et al. (2019), which showed that a visual learning style was linked to higher rates of subpar academic performance and lower rates of academic achievement. This trend is also seen in other subjects, where students who identified as visual performed statistically worse than their friends who did not. Students with auditory and kinaesthetic learning styles, on the other hand, did better (Oliveira et al., 2023; Nurcahya et al., 2025). Evidence from recent studies suggests that the idea of learning styles may not even be true.

According to Stone (2021), participants who were categorised as visual or auditory students did not perform better when the instructional materials matched their putative learning styles. In a similar Albina et al. (2023) contended that the idea of learning styles should be dispelled as a fiction.

Table 2 Output of ANOVA: the combination of the three types of learning styles understudy

	Sum of Square	Df	Mean	F	Sig.	Remark
Between Groups	330.739	2	165.369			
Within Groups	19652.812	1222	16.082	10.283	.000	Sig.
Total	19983.551	1224				

Table 2 shows the combination of the three learning styles that influenced students' Mathematics performance. It revealed that there is a significant influence of learning style (visual, auditory, and kinaesthetic) on Grade 6 students' Mathematics performance ($F(2,1222) = 10.283$, $p<0.05$). Therefore, hypothesis one is rejected.

The above findings are supported by Lo and Sasaki (2024). who are of the view that learning styles make an impact on the students' overall achievement, and students in their study possessed multiple learning styles or a combination of different learning styles, thus, they can learn effectively.

Hypothesis 2: There is no significant difference between male and female Grade Six students' performance in Mathematics

Table 3 Output of the T-test on differences between Male and Female performance in Grade 6 mathematical concepts

	Gender	N	Mean	Std. Deviation	T	Df	Sig(P)	Remark
Maths Performance	Male	455	12.8198	3.96883	-.217	128	.061	Not Sig
	Female	765	12. 8719	4.09818				

Table 3 shows that there is no significant difference between male and female Grade 6 Mathematics performance in Buffalo city ($t = -.217$, $df = 1218$, $p>0.05$). The mean difference between male students (=12.820, SD = 3.969) and female students (=12.872, SD=4.098) was negligible. Therefore, hypothesis two is not rejected.

The finding of this study agrees with the findings of Adu and Duku (2021), who revealed an insignificant effect of gender on Mathematics performance. It is, however in contrast with the findings of Adu, Pylman, and Adu (2021) and Adom and Adu (2018) that, found that they considered male students more proficient in Mathematics than females Overall, it is hoped that if both genders are given proper orientation, opportunities and training gender will no longer be an issue in Mathematics achievement in general.

CONCLUSION

The study investigated the relationship between learning styles, gender, and Grade 6 Mathematics performance. There are different types of students, such as auditory, visual, and kinaesthetic. The auditory appreciates listening to the teachers and sits close to them in class. Visual students like to see things physically during teaching. They learn from materials like charts, graphs, and pictures. Kinaesthetic students learn by doing. Students can prefer one, two, or three learning styles. The findings of the study revealed that all three major types of learning styles have a positive effect on students' academic performance in Mathematics. Nevertheless, the visual learning styles proved to be the best; this shows that students need to see things before they can understand them better. This is in line with Chinese philosophers who say, "what I see, I remember and what I hear, I forget. Teachers need to play a significant role in making sure that students are shown what is relevant and what can enhance their performance. The findings also revealed that gender has no significant effect on the performance of students in Mathematics.

Similarly, by establishing a robust association between learning styles and mathematical achievement, this study provided a significant contribution, highlighting the need to identify and cater to each student's individual learning preferences. It also emphasised how gender has no impact on a child's mathematical achievement. The results indicated that while students with an auditory and kinaesthetic learning style would have had little difficulty in their mathematical development, those with a visual learning style were more likely to succeed.

This study implies that educators should concentrate on the subject matter of the lessons rather than the presumptive learning preferences of the students. Furthermore, several studies in the literature support the idea that there might not be conclusive evidence that teaching in accordance with study patterns is more effective than teaching using other approaches. Teachers must intentionally incorporate a wide range of instructional strategies to accommodate unique learning processes. For example, students may be given unique learning patterns through peer conversations, interactive exercises, and visible aids.

RECOMMENDATIONS

It is recommended that teachers should be trained to know the different types of learning styles exhibited by their students to use them to impact knowledge and disseminate information to them, since learning style could be described as a set of factors, behaviours, and attitudes that facilitate learning for an individual in a given situation. These styles influence how students learn, how teachers teach, and how the two interact during classroom activities. More research is needed to create a more distinct link between learning styles and academic success. One of the many teaching strategies that go beyond learning style preferences that educators may find useful is the incorporation of cognitive and metacognitive techniques that can improve academic achievement regardless of learning style. With a better understanding of the many factors influencing academic achievement, teachers may develop more effective teaching strategies to support students' learning and performance.

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DECLARATION OF CONFLICTS

The author reiterated that there is no personal relationship or financial interest that influenced the findings and the outcome of this research work.

AUTHORS' CONTRIBUTION

Sole authorship. 100% contribution of the author

REFERENCES

1. Albina R. Shaidullina, Natalia A. Orekhovskaya, Evgeny G. Panov, Marina N. Svintsova, Oksana N. Petyukova, Nataliya S. Zhuykova, & Elena V. Grigoryeva (2023). Learning styles in science education at university level: A systematic review. EURASIA Journal of Mathematics, Science and Technology Education, 2023, 19(7), 1-10.
2. Adom, G., & Adu, E., O. (2018). Motivation and attitude of grade nine students towards Mathematics in King Williams Town Education District. Ghana Journal of Development Studies. (GJDS), 15(1), 133-148.
3. Adu, K.O. & Duku, N. (2022). Instructional Materials, Gender, and Learning Styles as Correlates of Grade 6 Mathematics Performance in Selected Schools in South Africa. In E.O. Adu & M. Fabunmi (Eds), Proceedings of the 11th Multidisciplinary International Conference. Being a Publication of the Global Education Network. Pp 231-244
4. Adu, K.O. & Duku, N. (2021). Gender and instructional materials as a correlate of Grade 6 students' Mathematics performance in Buffalo City, South Africa. Universal Journal of Educational Research. 9(3), 413-422
5. Adu, K.O., Pylman, J. & Adu, E.O. (2021). Learning styles as correlates of Grade 6 students' performance in Mathematics in Buffalo City Municipality, South Africa. Journal of Social Sciences and Humanities-E-Bangi. 17(5), 119-131
6. Balaresque, P., King, T., et al. (2025). Sex differences in cochlear sensitivity: An international study of 450 individuals across 13 populations. Scientific Reports. Advance online publication.
7. Coma-Roselló, T., Aguelo-Arguis, A., Álvarez, P., Sanz, C., & Baldassarri, S. (2018). Analysis of innovative approaches in the class using conceptual maps and considering the learning styles of students. IEEE Revista Iberoamericana de Tecnologías del Aprendizaje [IEEE Ibero-American Journal of Learning Technologies], 13(4), 120-129. https://doi.org/10. 1109/RITA.2018.2879388
8. Doornkamp, L., Doornkamp, F., Van der Pol, L. D., Groeneveld, S., Mesman, J., & Groeneveld, M. G. (2024). Student–teacher gender congruence and student performance: The role of context. Social Psychology of Education, 27(6), 3299–3328.
9. Harahap, F., Nasution, N. E. A., & Manurung, B. (2019). The effect of blended learning on students' learning achievement and science process skills in plant tissue culture course. International Journal of Instruction, 12(1), 521-538. https://doi.org/10. 29333/iji.2019.12134a
10. Heyes, C. (2018). Cognitive gadgets: The cultural evolution of thinking. Harvard University Press..
11. Kolb, D. A. & Kolb, A. (2005). Experiential learning: Experience as the source of learning and development (Vol. 1). Englewood Cliffs, NJ: Prentice-Hall.
12. Kolb, D. A., Boyatzis, R. E., & Mainemelis, C. (2014). Experiential learning theory: Previous research and new directions. In Perspectives on thinking, learning, and cognitive styles (pp. 227-248). Routledge. https://doi.org/10.4324/9781410605986-9
13. Leontidis, G. (2024). Improving the efficiency of multimedia learning and the quality of experience by reducing cognitive load. Applied Sciences, 15(3), 1054
14. Liu, Y., Yue, K., & Liu, Y. (2024). Behavioural analysis in immersive learning environments: A systematic literature review and research agenda. arXiv preprint
15. Lo, R. F., & Sasaki, J. Y. (2024). Lay misperceptions of culture as "biological" and suggestions for reducing them. Perspectives on Psychological Science, 19(2), 365–380.
16. Mangwende, E. (2024). Learning Styles and Academic Achievement of Distance e-Learning University Mathematics Students: A Case of a University in Zimbabwe. European Journal of Education and Pedagogy, 5(1), 61–65. https://doi.org/10.24018/ejedu.2024.5.1.324
17. Neuroscience News. (2025, May 12). How your brain splits space to double its perception power. Neuroscience News
18. Nurcahya Binti Abdul Rashida, Siti Rahayu Binti Mohd Hashima, B., & Mohd Khairuddin (2025). Multiple Linear Modelling in Revealing the Relationship between Learning Styles and Mathematics Performance. International Journal of Academic Research in Progressive Education and Development. 14(01), 68-81.
19. Oliveira, A., Spinola, V., Garrido, D., Teixeira, M. M., Salles, C., & Haddad, A. E. (2023b). Influence of learning styles on student performance in self-instructional courses. PLoS ONE, 18(7), e0289036. https://doi.org/10.1371/journal.pone.0289036
20. Papageorgiou, E., & Callaghan, C. W. (2018). Personality and adjustment in South African higher education accounting studies. South African Journal of Accounting Research, 32(2–3), 189–204.
21. Russell, L. V. (2011). Educational multimedia of "tomorrow": High intellectual and creative educational multimedia technology. London: Macmillan.

22. Sahin, D., & Yilmaz, R. M. (2020). The effect of augmented reality technology on middle school students' achievements and attitudes towards science education. Computers & Education, 144, 103710. https://doi.org/10.1016/j.compedu.2019. 103710
23. Stone, D. C. (2021). Student success and the high school university transition: 100 years of chemistry education research. Chemistry Education Research and Practice, 22(3), 579-601. https://doi.org/10. 1039/D1RP00085C
24. Tahir, W. M. M. W., Hussin, A. H., & Jabar, J. A. (2019). Students' learning styles and their academic performance in Accounting Course / Wan Mardyatul Miza Wan Tahir. . . [et al.]. https://ir.uitm.edu.my/id/eprint/31182/
25. UNESCO Institute for Statistics (2018). Adult and youth literacy: global trends in gender parity. UIS Fact Sheet. (September 2010, No. 3).
26. Wu, S., Cao, Y., Cui, J., Li, R., Qian, H., Jiang, B., & Zhang, W. (2024). A comprehensive exploration of personalised learning in smart education: From student modelling to personalised recommendations. arXiv preprint, Jan 15, 2024