

The Influence of Digital and Face-To-Face Lessons on Computer Science Students' Academic Achievement in Secondary Schools in Cameroon

Zenabuin, Florence
University of Buea, Cameroon

Professor Rosemary M. Shafack
University of Buea, Cameroon

Professor Fedelis L. Alemnge
University of Buea, Cameroon

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Abstract

This study investigates the effect of blending digital and face to face lessons, on Computer Science students' academic achievement in secondary schools in Cameroon. The study employed a quasi-experimental design involving 100 students from Governemnt Bilingual High School Etoug-egbe and Governemnt High School Bokwango, Buea all in towns in Cameroon divided into two groups: one group of 50 students utilizing digital and face-to-face lessons, and a control group engaging solely traditional face-to-face instruction. The primary objectives included assessing the influence of blending digital lessons and face to face lessons on student's academic achievement. The software used for Data Analysis was SPSS version 27, IBM SPSS Amos version. The data analysis included an ANOVA test revealing a significant difference in academic achievement among the groups, with an F-value of 11.464 and a p-value of less than 0.001. This outcome suggests that the blended approach employed had a pronounced effect on students' achievement, indicating the necessity for diverse instructional strategies to promote engagement and understanding. The findings underscore the effectiveness of blended learning tools, particularly structured digital resources like the digital lessons from the MINESEC distance learning platform <https://distance-learning.minesec.gov.cm>, in enhancing academic outcomes. While students' grades, software and hardware skills gained traction through blending digital and face-to-face lessons, critical thinking development requires further exploration to ensure holistic student growth. This research contributes to the body of knowledge surrounding blended learning practices and offers insights for educators and policymakers aiming to optimize instructional strategies. The implications of this study stress the importance of adopting tailored digital teaching methods to enhance academic achievement in a subject like Computer Science, thereby recommending sustained investment in educational technology and infrastructure to facilitate impactful learning experiences.

Keywords: Digital lessons, Academic achievement.

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1. Introduction

The Ministry of Secondary Education in Cameroon offers a dedicated website that provides digital lessons and resources tailored for secondary education <http://minesec-distancelearning.cm>. This platform features structured

lessons across various subjects, giving students access to curriculum-aligned content. The lessons often include a combination of text, images, and videos, allowing for a comprehensive understanding of the material. Teachers incorporate these lessons into their teaching programmes either by having the students watch particular lessons at home followed by an exploration and discussion of the lesson or by having the students interact with the lessons right there in class while the teacher stops briefly to explain take questions or throw more insight to the content. Students can also navigate the lessons at their own pace, which is particularly beneficial for reviewing complex topics. The website also includes additional resources such as past examination papers and quizzes for self-assessment and an assistant to give responses to students questions in the absence of a teacher. Teachers often follow up on these resources in class discussions, providing feedback based on the content covered on the website. This approach promotes independent learning while ensuring that students remain engaged with the curriculum both in and out of the classroom. -These lessons first started as TV lessons.. These TV lessons were asynchronous and were produced by the Ministry of secondary Education (MINESEC) at the Cameroon Radio Television - Mballa II, and students could watch at specified times. Today, digital lessons were are now produces at the distance learning centre in Yaoundé the capital of Cameroon and uploaded on Youtube and the links sent to the MINESEC website from where students and teachers can either download or watch online.

In essence, computer science in Cameroon secondary schools is still largely taught by face-to-face methods and little or no digital interventions (Ministry of Secondary Education, 2024), thereby exempting secondary school students from gaining the skills that will enable them to engage in Computing Careers in higher education and from meeting up with the current global innovation trends. If this is not ameliorated, students will leave secondary school with epileptic skills unable to make relevant contribution to the technological innovations in their communities and globally. With the advent of the sociopolitical crisis in Cameroon and the Corona Virus pandemic in 2019, teaching and learning became an even more difficult process for most learners. The teaching hours got reduced as ghost towns, lockdowns and quarantine periods were introduced. The Ministry of Secondary Education in Cameroon, in an attempt to solve the problem made requests for distance learning methods to be added to the teaching and learning process in all secondary education institutes in Cameroon (See Appendix 3) In so doing, Cameroon immediately set up an upgraded learning environment which is both face-to-

face and online. Thus, touching directly on the subject of blended learning through digital lessons. Thus necessitating an investigation of how adding digital lessons to the traditional face-to-face learning influences students academic achievement in a subject like computer sciences whose foundations are skills and competency based oriented.

This study therefore aims to answer the question: To what extent does the use of digital and face-to-face lessons influence students' achievement in computer science secondary schools in Cameroon?

The following hypotheses were coined:

H01: The use of digital and face-to-face lessons have no significant influence on students' academic achievement in computer science in secondary schools in Cameroon.

Ha1: The use of digital and face-to-face lessons have a significant influence on students' academic achievement in computer science in secondary schools in Cameroon.

2. Review Of Literature

Digital Lessons

According to Hofmann and Lehmann (2020), a digital lesson is a student resource that uses technology to engage students in learning activities. Digital learning can be any type of learning that uses technology or instructional practices that make effective use of technology. The Ministry of Secondary Education (MINESEC) in Cameroon has embraced digital lessons as a way to enhance educational access and quality, particularly in the context of challenges such as limited resources, geographical barriers, and disruptions like the COVID-19 pandemic. Some key aspects of the MINESEC's distance learning initiatives include enhancing access to quality digital lessons whereby the primary goal is to provide educational opportunities to students in remote or underserved areas, ensuring that all learners can access quality education. Distance learning also aims to maintain educational continuity during disruptions, such as health crises or natural disasters.

Another aspect is that of delivery mode such as online platforms; MINESEC utilizes various online platforms to deliver digital lessons, including the television, youtube and educational websites (Ministry of Secondary Education, 2024). This approach allows for asynchronous and synchronous interaction between teachers and students. In areas with limited internet access, MINESEC has adopted television broadcasts to reach students, providing digital lessons and educational content. The distance learning

programme aligns with the national curriculum, ensuring that students receive the necessary content to meet educational standards. MINESEC provides digital resources, including lesson plans, tutorials, and supplementary materials, to support both teachers and students in the learning process through the various regional delegations of secondary education (Ministry of Secondary Education, 2024).

Another aspect of digital lessons is that of training and support. MINESEC has implemented training programmes for teachers to equip them with the skills needed to effectively deliver online lessons and engage students in a virtual environment, through the various Regional Delegations, seminars, workshops and conferences. Ongoing technical support is provided to both educators and students to address challenges related to technology and online learning. However, one of the significant challenges of using this platform for learning, is the disparity in access to technology and the internet, which can hinder effective participation in distance learning. According to Dreams (2020), another challenge is that keeping students engaged in a remote learning environment can be challenging, necessitating innovative teaching strategies. The integration of distance learning with traditional classroom experiences may become more prevalent, offering a flexible approach to education. MINESEC's distance learning initiatives represent a significant step towards improving educational access and quality in Cameroon. By leveraging technology and innovative teaching methods, the ministry aims to create a more inclusive and resilient education system. As these programmes evolve, addressing challenges such as the digital divide and enhancing engagement will be crucial for their success (Dreams, 2020).

Digital and Face-To-Face Lessons

A closely related study to the influence of digital and face-to-face lessons on students' academic achievement, is the study carried out by Uzorka and Odebiyi (2025) on the Impact of Digital Learning Tools on Student Engagement and academic Achievement in Uganda. Their objective was to find out how digital learning tools influence student engagement and academic achievement in online and offline courses in Ugandan secondary schools. The study employed a descriptive research design to explore the impact of digital learning tools on student engagement and academic achievement in courses. The study involved 52 teachers from 12 schools in Uganda. Data was collected through semi-structured interviews to allow participants to express their insights freely while enabling researchers to explore emerging themes in depth. Participants were

selected based on their experience with online teaching and familiarity with digital learning tools. A purposive sampling technique was employed to select participants who had firsthand experience with digital learning tools in an online teaching. Each interview lasted between 30 to 45 minutes and was recorded with the participants' consent. The interview guide included open-ended questions. The interviews were transcribed verbatim and analysed using thematic analysis. This study found that students who actively engage with digital learning tools tend to perform better academically, a finding consistent with research by Chaudhary et al. (2025), who noted that online tools improve learning outcomes by providing additional practice opportunities and immediate feedback. The unique contribution of this study is that it captures teachers' direct observations of performance improvements in a developing-country context. Unlike studies in highly digitized environments, where digital tools are supplementary, teachers in Uganda found that these tools compensate for traditional instructional gaps such as large class sizes and limited contact hours. The study found that digital tools improved communication between students and lecturers, particularly through discussion forums, instant messaging, and email. These findings align with those of Suen and Hung (Suen & Hung, 2024), who found that asynchronous and synchronous communication tools promote deeper engagement and more frequent student-teacher interaction. A notable contribution of this study is the specific emphasis on how these tools address hierarchical barriers in Uganda, where students traditionally hesitate to approach teachers for clarification. They recommended digital lessons and self-paced learning material to compensate for the gap in traditional face-to-face learning.

Still in response to the influence of digital and face-to-face lessons on students' academic achievement, Selvakumar and Sivakumar (2019) carried out a research in India titled "The Influence of Blended Learning Environment on Academic Achievement of Engineering Students". The main objective of the research was to investigate the influence of Blended Learning Environment on students' academic achievement. The research utilized a quasi-experimental design to investigate the effects of a blended learning environment (BLE) on academic achievement compared to a traditional lecture-based environment (LBE). This design allowed for a direct comparison of student outcomes in two distinct learning settings. A sample size of 200 students was used to ensure sufficient statistical power. This sample represented a diverse demographic, including students from both urban and rural schools enrolled in

computer science courses. The instrument utilized for data collection was an academic achievement test. To analyze the data, t-test was conducted to compare the test mean scores of both groups. For six weeks, the students in the control group were treated with Lecture Based Environment (LBE) where the conventional lecture method of teaching was adopted, while the experimental group was carried out through the Blended Learning Environment (BLE) where both on-line, in this case digital lessons and face-to-face modes are adequately utilized based on the subject matter. Two groups were administered a test before and after the implementation of BLE. Further, the gap closure analysis was used to find out and ensure the effectiveness of the experimental treatment. The findings revealed that there were statistically significant differences between the scores of the two groups. The study recommended that secondary schools should adopt a blended learning approach.

Additionally, incorporating surveys to gauge student engagement and motivation provided a more holistic view of the learning experience. In terms of statistical analysis, Selvakumar and Sivakumar (2019) employed t-tests to compare mean scores between the control and experimental groups, as well as gap closure analysis to evaluate the effectiveness of the blended learning intervention. In this study, similar statistical tools were utilized, such as t-tests or ANOVA for comparing academic achievement scores. Furthermore, regression analysis was employed to explore additional factors influencing academic achievement. Data were analysed using thematic analysis, this was beneficial for interpreting the responses from interviews, enriching. Overall, while both studies share a focus on blended learning, this research adapted its design, sample, instruments, and analysis to reflect the unique educational landscape and challenges faced by secondary school students in computer science in Cameroon. This contextualization enhanced the relevance and applicability of the findings.

The study also revealed that BLE are more conducive to improve academic achievement than LBE (Selvakumar & Sivakumar, 2019). They recommended that the administrators of education should structure the curriculum to include blended learning at all levels of learning. They also recommended that more teachers should be trained to understand and accept all technological skills needed for the successful implementation of blended learning. This study on the influence of blended learning on students' academic achievement in computer science in secondary schools in Cameroon also adopt a quasi-experimental design, and an explanatory sequential design. This would enable a

comprehensive analysis of both quantitative and qualitative data, tailored to the specific educational context of Cameroonian secondary schools.

Another study related to the influence of digital lessons alongside face-to-face instruction on students' academic achievement was carried out by Tabassum et al. (2024) in Pakistan, titled "The Impact of Blended Learning on Student Performance." The objective of the study was to examine the influence of blended learning on students' academic achievement, engagement, and satisfaction. The study adopted a survey-based correlational design, to determine the relationship between blended learning and student performance outcomes. The population consisted of students from diverse academic backgrounds in Pakistan, from which a sample size of 319 students was drawn. Data were collected using a structured questionnaire, which measured constructs such as blended learning usage, academic achievement, satisfaction, and performance. The instrument was validated through a pilot study involving 50 students, and its reliability and validity were established using Cronbach's Alpha, composite reliability, rho A, and Average Variance Extracted (AVE). Data analysis involved both descriptive and inferential statistical methods. Descriptive statistics such as mean, standard deviation, and percentages were used to summarize students' perceptions of blended learning. Inferential statistics included simple linear regression analysis, with beta coefficients, t-values, F-statistics, p-values, and adjusted R² employed to test the study's hypotheses and determine the predictive effect of blended learning on student satisfaction and performance.

The major findings revealed that blended learning had a significant positive effect on students' academic achievement and satisfaction. The findings further showed that blended learning significantly predicted students' satisfaction with learning, explaining a substantial proportion of variance in academic performance. Students reported improved understanding of course content, better access to learning materials, and increased flexibility when digital lessons were combined with face-to-face instruction. Based on these findings, the study recommended that educational institutions adopt and strengthen blended learning programmes to enhance student academic performance. It further recommended that future research should explore the long-term effects of blended learning and identify best practices for its effective implementation.

The study by Tabassum et al. (2024) employed a purely quantitative approach, whereas the present study adopts a mixed-methods design to capture both quantitative outcomes and qualitative perspectives regarding the impact

of blended learning on students' academic achievement in computer science. Although the study was conducted in Pakistan, a context different from Cameroon, both settings share similar challenges related to digital infrastructure and learning environments. The findings from Tabassum et al. (2024) therefore provides useful empirical support for examining blended learning in the Cameroonian secondary school context. Still in relation to the impact of digital lessons, Venugopal (2024) carried out a study titled "The Impact of Digital Learning Platforms on Student Academic Performance in the Sultanate of Oman" in the Arabian Peninsula in Western Asia. The primary objective of the research was to investigate the impact of digital learning platforms on student engagement and academic performance, as well as to identify the potential benefits and challenges associated with their integration into educational settings. The research utilized a descriptive survey design and employed a mixed-method approach, combining quantitative analysis of student performance data with qualitative insights gathered through surveys and semi-structured interviews with a sample size of 120 students, the study utilized various instruments for data collection. Quantitative data were gathered through metrics such as grades, attendance records, and participation rates, along with surveys. In contrast, qualitative data were collected through semi-structured interviews that allowed participants to share their experiences and opinions regarding the use of digital learning platforms.

The data analysis for the study involved statistical methods, including regression analysis and t-tests for the quantitative data, while thematic analysis was used for the qualitative data to identify recurring patterns and themes. The findings revealed a significant positive correlation between the use of digital learning platforms and student academic performance, indicating that students who actively engaged with digital materials achieved higher grades, increased attendance, and improved participation compared to their peers in traditional classrooms. Additionally, qualitative insights highlighted benefits such as enhanced access to resources, collaboration, and personalized learning experiences. However, the study also identified challenges, including technological barriers, lack of digital literacy, and concerns about data privacy and security. The research underscores the potential of digital learning platforms to positively impact student engagement and academic performance. It recommended that successful integration requires careful consideration of pedagogical strategies, technological infrastructure, and ongoing support for both educators and students. Addressing challenges such as digital inequality and privacy concerns is essential to ensure

equitable access and maximize the benefits of digital learning platforms. Overall, this study contributed valuable insights for educators, policymakers, and stakeholders committed to improving student outcomes.

In another related study is the study conducted by Pate (2019) and titled "Effect of Digital Learning on Academic Achievement of Secondary School Students in India." This research focused on the integration of digital learning in the educational framework of secondary schools and its implications for academic performance among students. The primary objectives of the study were threefold: first, to assess the significant difference in academic achievement between male and female students; second, to explore the role of students' perceptions of digital learning; and third, to investigate the effect of learning motivation on students' outcomes in digital learning environments. These objectives aimed to provide a comprehensive understanding of how digital learning influences academic success and the factors that contribute to this relationship. The research utilized a descriptive survey design, employing a structured questionnaire to gather data from the participants. A total of 102 students were included in the sample, drawn from various government schools. Among these, 53 were female students and 49 were male students, all of whom were studying in grades 8, 9, and 10. This demographic diversity allowed for a more holistic view of the impact of digital learning across genders.

Data collection was facilitated through a comprehensive questionnaire consisting of 45 items organized into multiple scales. These scales included the Teacher-Student Relationship Questionnaire (TSRQ), the Technology-Rich, Outcomes Focused Learning Environment Inventory (TROFLEI), the Test of Science Related Attitudes (TOSRA), the Questionnaire on Teacher Interaction (QTI), and the Students' Questionnaire on Effectiveness of Electronic Classroom (SQEEC). The questionnaire was designed to capture various dimensions of student experience, including demographic information, prior computer skills, support at home, teacher-student relationships, motivation towards learning in a technology-supported classroom, and perception towards digital learning. The responses were collected using a two-point scale (Yes/No) and a five-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." The data were analyzed using the Statistical Package for Social Science (SPSS) version 20, which enabled the researcher to perform various statistical tests to determine the relationships and differences among the variables studied. The findings revealed that there was no significant difference in academic

achievement between male and female students, suggesting that gender does not play a critical role in academic success in the context of digital learning.

However, the study identified several factors that significantly impacted academic achievement. These included prior computer skills and support at home, which were crucial for effective engagement with digital learning tools. Additionally, students' perception towards digital learning, the teacher-student relationship, the hours spent on digital learning, and student motivation towards learning were all found to have a significant effect on academic outcomes. Notably, the research indicated that increasing the time students spent on digital learning activities led to enhanced learning performance, highlighting the effectiveness of digital educational methods. In light of these findings, the author recommended that further research should involve a larger sample size across multiple schools and diverse geographic areas. This approach would yield more reliable and effective results, allowing for a deeper understanding of the dynamics at play in digital learning environments and their impact on student achievement. Overall, the study emphasizes the importance of various factors, including technology access and teacher-student interactions, in shaping students' academic experiences in the digital age.

3. Methodology

The population for the study was made up of computer science students, teachers, and regional pedagogic inspectors of anglophone secondary schools in Cameroon. Cameroon had a total of 148,125 Computer Science student population in the 2024/2025 academic year, 683 Computer Science Teachers and 42 pedagogic inspectors. The students for the quasi-experiment were selected from the four secondary schools in four regions of Cameroon, two from English speaking regions and two from French speaking regions. That is, South West, North West, Littoral and Centre. The computer science teachers were randomly selected from the ten regions of Cameroon. The regional inspectors were selected from all the ten regions of Cameroon.

The accessible population for the study was made up of computer science students, computer science teachers and regional pedagogic Inspectors of computer science in the Centre, Littoral, North West and the South West Regions. The choice of lower sixth was guided by the fact that the students are intentional about taking computer science as a subject and have taken a conscious decision to study the subject. These set of students gave their consent and took

the exercise seriously. Lower sixth students were as follows: students of Government Bilingual High School (GBHS) Etoug Egbe, Yaounde in the Centre Region having 71 students, GBHS Nkongsamba in the Littoral region having 71 students, Government Bilingual High School (GBHS) Down Town, Bamenda was selected in the North West Region having 91 students, Government High School (GHS) Bokwango, Buea was selected in the South West Region having 62 Computer Science. A sample size of 100 students were selected for his study, 50 for the experimental group and 50 for he controls group.

This study featured a quasi-experiment with three experimental groups that received the intervention, in this case the blended learning approach in teaching computer science comprising of the digital lessons from the MINESEC platform, Zoom platform lessons and lessons on a WhatsApp platform in addition to face-to-face lessons. A comparison group or control was also included that did not receive the intervention, allowing for a more nuanced analysis of the intervention's effects. The pre-test served as a baseline measure of participants' knowledge or skills related to the outcome of interest, in this case academic achievement. Computer Science lessons were taught for 3 weeks in the different experimental groups: Group 1- digital lessons and face-to-face intervention and he Control group : only face-to-face lessons. Following the implementation of the intervention, a post-test was administered to assess any changes in the outcome, which facilitated a comparison with the pre-test results. A research assistant who is experienced computer science teachers was recruited to assist with the teaching of lessons using the MINESEC digital lessons. A WhatsApp group was created where regular feedbacks were given and active follow up of the teaching process was done.

The implementation of a pre-test-post-test quasi-experimental design followed several systematic steps. First, the researcher defined the research question clearly, in this case investigating the influence of blended learning on computer science students' academic achievement in secondary schools in Cameroon. Next, participants were selected through a purposive sampling from four public secondary schools, in four regions of Cameroon, namely South West, North West, Centre and Littoral. The pre-test was then administered to gauge the initial status of participants, followed by the intervention phase, where blended learning was applied. Finally, the post-test was conducted to measure any changes, statistical methods were then employed to analyze the data, allowing the researcher to assess whether significant differences exist between pre-

test and post-test scores.

Quasi-Experimental Results

4. Findings And Discussions

Table 1: Comparing change in score between pre-test and post-test and within group (Control and Digital lessons from MINESEC)

Scales	Stats	Control		MWU	Digital Lessons		MWU
		Pre-test	Post-test		Pre-test	Post-test	
Scenario analysis (on 5)	N	46	46	U=917.500 P=0.247	46	46	U=609.000 P=0.000
	Mean	1.05	1.17		1.30	2.03	
	SEM	0.08	0.09		0.09	0.16	
	Median	1.00	1.50		1.50	2.00	
	Minimum	0.50	0.50		0.50	0.50	
	Maximum	3.00	2.00		2.50	5.00	
	SD	0.55	0.59		0.58	1.07	
Argument evaluation (on 5)	N	46	46	U=437.000 P=0.000	46	46	U=532.000 P=0.000
	Mean	2.57	1.65		1.71	2.41	
	SEM	0.10	0.13		0.12	0.06	
	Median	2.50	1.50		1.75	2.50	
	Minimum	1.50	0.50		0.50	1.50	
	Maximum	4.00	3.50		3.00	4.00	
	SD	0.69	0.91		0.84	0.41	
Reflection (on 5)	N	46	46	U=435.500 P=0.000	46	46	U=422.500 P=0.000
	Mean	2.63	1.90		1.89	2.52	
	SEM	0.10	0.11		0.08	0.06	
	Median	2.50	1.75		1.50	2.50	
	Minimum	1.50	0.50		1.00	1.50	
	Maximum	4.00	4.00		3.00	4.00	
	SD	0.71	0.77		0.57	0.39	
Application (on 5)	N	46	46	U=953.500 P=0.397	46	46	U=54.000 P=0.000
	Mean	1.25	1.30		1.00	2.58	
	SEM	0.12	0.09		0.09	0.10	
	Median	1.25	1.50		0.75	2.50	
	Minimum	0.50	0.50		0.50	2.00	
	Maximum	5.00	2.50		3.00	4.00	
	SD	0.79	0.58		0.59	0.65	
Critical thinking assessment (on 5)	N	46	46	U=652.500 P=0.001	46	46	U=151.000 P=0.000
	Mean	1.89	1.53		1.50	2.40	
	SEM	0.08	0.08		0.06	0.08	
	Median	1.85	1.40		1.45	2.35	
	Minimum	1.00	0.50		0.80	1.40	
	Maximum	3.30	3.00		2.50	3.80	
	SD	0.53	0.55		0.41	0.53	
Hardware skills (on 5)	N	46	46	U=985.000 P=0.554	46	46	U=928.500 P=0.278
	Mean	1.51	1.46		1.48	1.61	
	SEM	0.08	0.08		0.07	0.06	
	Median	1.50	1.50		1.50	1.50	
	Minimum	0.50	0.50		0.50	0.50	
	Maximum	3.00	2.50		2.00	3.00	
	SD	0.57	0.51		0.45	0.43	
Software skills (on 5)	N	46	46	U=898.500 P=0.194	46	46	U=1004.000 P=0.663
	Mean	2.02	1.86		1.99	2.07	
	SEM	0.10	0.08		0.10	0.07	
	Median	2.00	2.00		2.00	2.00	
	Minimum	0.50	1.00		0.50	1.00	

	Maximum	3.00	3.00		3.00	3.50	
	SD	0.67	0.56		0.67	0.50	
Grade (on 5)	N	46	46	U=1031.500 P=0.832	46	46	U=526.500 P=0.000
	Mean	2.14	2.14		1.98	2.57	
	SEM	0.10	0.10		0.09	0.10	
	Median	2.00	2.50		2.00	2.50	
	Minimum	0.50	0.50		0.50	1.00	
	Maximum	3.50	3.50		3.50	3.50	
	SD	0.66	0.70		0.60	0.66	
Overall score on a scale of 20	N	46	46	U=894.500 P=0.201	46	46	U=535.500 P=0.000
	Mean	7.56	6.99		6.95	8.64	
	SEM	0.30	0.30		0.27	0.28	
	Median	7.85	7.20		7.15	8.55	
	Minimum	3.30	2.80		2.80	4.60	
	Maximum	12.10	10.60		11.00	13.80	
	SD	2.01	2.03		1.82	1.89	

The comparative analysis conducted between the control group and the group utilizing digital lessons from the MINESEC website examined changes in pre-test and post-test scores across various assessment scales. For scenario analysis, the control group showed a slight, non-significant improvement from a mean of 1.05 to 1.17 ($p = 0.247$), suggesting that any change might have been due to external factors. In contrast, the experimental group demonstrated a significant improvement from 1.30 to 2.03 ($p = 0.000$), indicating a clear benefit from the MINESEC intervention.

In the area of argument evaluation, the control group experienced a significant drop from 2.57 to 1.65 ($p = 0.000$), which indicated a reversed Hawthorn effect. Conversely, the experimental group showed a significant improvement from 1.71 to 2.41 ($p = 0.000$), reinforcing the positive impact of the intervention. Similarly, reflection scores in the control group declined significantly from 2.63 to 1.90 ($p = 0.000$), while the experimental group improved markedly from 1.89 to 2.52 ($p = 0.000$), further affirming the efficacy of the digital lessons.

In terms of application scores, the control group experienced a slight, non-significant increase, from 1.25 to 1.30 ($p = 0.397$), suggesting a possible positive Hawthorn effect. In contrast, the experimental group experienced a substantial significant improvement from 1.00 to 2.58 ($p = 0.000$). Regarding critical thinking assessments, the scores for the control group declined from 1.89 to 1.53 ($p = 0.001$), echoing a reversed effect, whereas the experimental group improved significantly from 1.50 to 2.40 ($p = 0.000$).

The analysis also covered hardware and software skills, where both groups exhibited minimal changes. The control group's hardware scores ranged from 1.51 to 1.46 ($p =$

0.554), and in terms of software skills, the scores remained relatively stagnant, moving from 2.02 to 1.86 ($p = 0.194$). The experimental group recorded slight, non-significant changes in these areas as well, indicating no clear improvement. In terms of grades, the control group's scores did not change, remaining at 2.14, while the experimental group demonstrated a significant increase from 1.98 to 2.57 ($p = 0.000$). Finally, the overall scores reflected stagnation in the control group, moving from 7.56 to 6.99 ($p = 0.201$), compared to a significant improvement in the experimental group from 6.95 to 8.64 ($p = 0.000$).

The analysis revealed substantial evidence of the effectiveness of the digital lessons provided by the MINESEC website in enhancing various educational outcomes compared to traditional control methods. The experimental group experienced significant improvements in key areas such as scenario analysis, argument evaluation, reflection, application, and critical thinking, indicating the positive impact of integrating digital resources into teaching practices. Conversely, the control group experienced declines and stagnation in multiple assessments, highlighting the limitations of traditional approaches. These results advocated for the continued adoption of digital learning tools in educational settings, particularly in computer science, to foster deeper engagement and improved understanding among students

Similarly, the ANOVA test shows a statistically significant difference in the "Change in Academic Achievement" among the four experimental groups ($F(3, 196) = 11.464, p < .001$). This means that the teaching method used had a significant effect on student academic achievement improvement. The Partial Eta Squared value of .149 indicates that the teaching method accounted for 14.9% of

the variance in performance change. The quasi-experimental design with multiple groups, including a control group and groups utilizing different digital platforms (MINESEC, Zoom, WhatsApp). The primary

inferential statistical method used was Analysis of Variance (ANOVA) to compare the academic performance across these groups.

Table 2: Test of Change in Academic Achievement

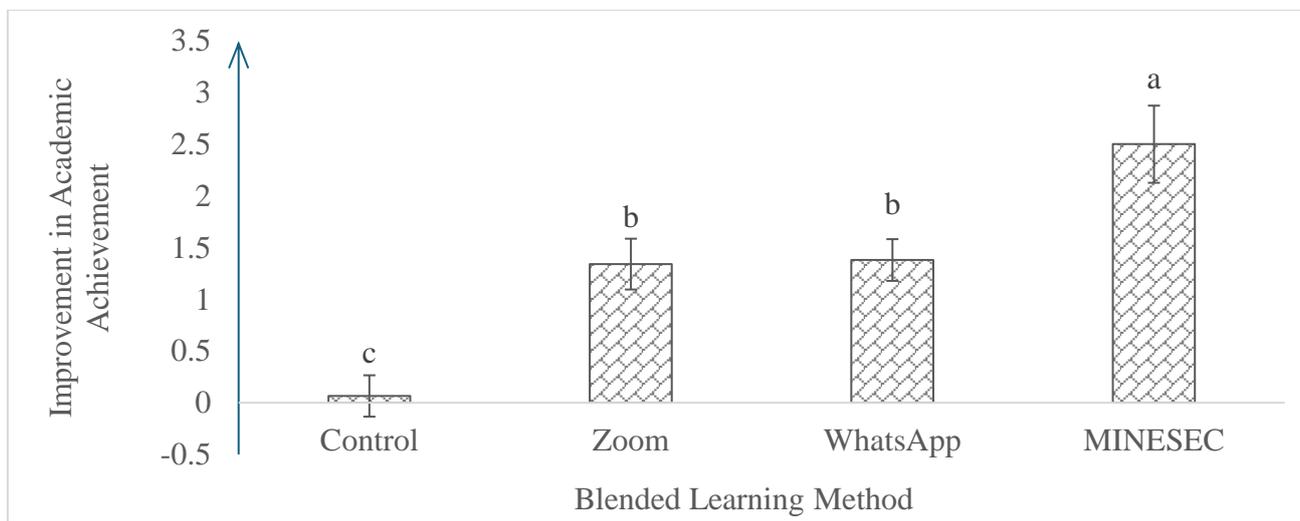
Tests of Between-Subjects Effects						
Dependent Variable: Change in Achievement						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	158.040a	3	52.68	11.464	0.000	0.149
Intercept	233.28	1	233.28	50.765	0.000	0.206
Studentscode	158.04	3	52.68	11.464	0.000	0.149
Error	900.68	196	4.595			
Total	1292	200				
Corrected Total	1058.72	199				
R Squared = .149 (Adjusted R Squared = .136)						

The ANOVA test was conducted to determine whether there were statistically significant differences in the mean academic achievement among the groups. The results yielded the values $F(3, 196) = 11.464, p < .001$.

The Waller-Duncan test was used to compare the improvement in performance change across the specific

groups. The results show that all three digital intervention groups performed significantly better than the Control group. This indicates that while all three tools were effective, the structured digital lessons from the MINESEC website led to the greatest improvement in student performance in the experimental setting.

Figure 1: Improvement Academic Achievement vs Blended Learning Method



The quasi-experiment revealed significant improvements in academic achievement among students using MINESEC digital lessons. The ANOVA results indicated that the digital lessons from the MINESEC group demonstrated the highest improvement in academic performance, with a Mean change of 2.5 compared to the Control group's 0.0652, Zoom's 1.3404, and WhatsApp's 1.38 ($F(3, 196) = 11.464,$

$p < .001$). This finding aligns with existing literature that emphasizes the effectiveness of digital content in enhancing student engagement and learning outcomes (Uzorka & Odebiyi 2025). Digital lessons often provide interactive components that can cater to diverse learning styles, which can lead to improved retention and understanding.

Verification of Hypothesis

H01: The use of digital lessons from the MINESEC website in addition to face-to-face method has no significant influence on students' academic achievement in computer science in secondary schools in Cameroon.

Ha1: The use of digital lessons from the MINESEC website in addition to face-to-face method has a significant influence on students' academic achievement in computer science in secondary schools in Cameroon.

From the quasi-experimental results, the null hypothesis is rejected and the alternative affirmed, and we conclude that the use of digital lessons in addition to face-to-face lessons has a significant influence on students' academic achievement in computer science in secondary schools in Cameroon.

5. Recommendations

The results show that the independent variables have a significant effect on each other as seen on the covariance table. To the computer science student in Cameroon, it is therefore recommended that the three be used along with each other for maximum benefit in academic achievement as the circumstance permits. However, based on the findings and discussions regarding the influence of blended learning on the academic achievement of Computer Science students in secondary schools in Cameroon, the following recommendations are made for various stakeholders:

Educators and School Administrators

This study recommends that schools should adopt and implement blended learning strategies that effectively combine face-to-face instruction with online learning. Professional development programmes should be provided to equip teachers with the necessary skills to design and facilitate blended learning environments.

Promote collaborative learning activities that leverage online platforms to enhance student engagement and peer interaction. This can include group projects, coding challenges, and online discussions.

Government and Educational Authorities

The government of Cameroon should increase investment in technology infrastructure, including internet access and digital resources, to ensure all students can participate in blended learning. This includes supporting schools in rural and crisis areas. Establish clear policies and guidelines for the integration of blended learning in the curriculum, ensuring that educational standards are met while promoting

innovation in teaching practices.

Curriculum Developers

Curriculum developers should create curricula that are adaptable to blended learning environments, integrating online resources and interactive content that cater to diverse learning styles and paces. Curriculum developers should incorporate digital literacy training into the Computer Science curriculum to prepare students for the demands of a technology-driven world.

Parents and Community Members

Encourage parents to engage with their children's learning by providing a conducive environment for study and facilitating access to technology. Community workshops can help parents understand the importance of blended learning.

Community stakeholders should work together to raise awareness about the benefits of blended learning and the resources available to support students.

Researchers and Educational Institutions

Continued research into the effectiveness of blended learning in various contexts is essential. Studies should focus on long-term impacts, specific digital tools, and the experiences of diverse student populations.

Encourage collaboration among educational institutions to share best practices and successful models of blended learning implementation.

By taking these recommendations into account, stakeholders can enhance the effectiveness of blended learning in the teaching and learning of Computer Science in the secondary education in Cameroon, ultimately leading to improved academic achievement and better preparation for students in a rapidly evolving technological ecosystem. Collaboration among educators, government, parents, and the community is key to creating a supportive and effective learning environment for all students.

References

1. Adeyi, M., Ayanjoke, M., Benard, A., Olalere, F., & Olayiwola, K. (2022). Effects Of Zoom Application and Google Hangouts on Achievement and Retention of Mathematics Students in Private Schools, in Minna Nigeria. 2(2).
2. Alemnge, F. L. (2018). Distance Learning Models and Their Effectiveness in Cameroon Higher Education. Creative Education.

- <https://doi.org/10.4236/ce.2018.95059>
3. Al-Harbi, A. S. (2015). The impact of WhatsApp use on academic achievement among Saudi secondary school students in computer science. *Journal of Educational Technology Systems*, 44(1), 73–88.
 4. Anderson, T. (2009). Distance education— Implications of online and Blended learning for the conceptual Development and Practice of Distance education. *International Journal of E-Learning and Distance Education*, 111–116. <http://www.editlib.org/p/105545/>
 5. Atem, R. (2019). Teaching methods in secondary schools in Cameroon: A comparative analysis. *Journal of Education and Pedagogy*, 15(2), 78–95.
 6. Bates, T., & Bozkurt, A. (2025). A Critical Scholarly Conversation with Tony Bates: Insights on the Future of Online and Distance Education. *Open Praxis*, 17, 632–637. <https://doi.org/10.55982/openpraxis.17.3.968>
 7. Béché, E. (2020). Cameroonian responses to COVID-19 in the education sector: Exposing an inadequate education system. *International Review of Education*, 66(5–6), 755–775. <https://doi.org/10.1007/s11159-020-09870-x>
 8. Beck, C. T., & Polit, D. F. (2017). *Nursing research: Generating and assessing evidence for nursing practice*. Wolters Kluwer.
 9. Bidder, C., Mogindol, S., Saibin, T., Andrew, S., & Naharu, N. (2016). Students' Perceptions of Blended Learning and Achievement (pp. 213–225). https://doi.org/10.1007/978-981-10-0954-9_19
 10. Bongwong Bruno & Diangha Brenda Lawyer. (2020). THE EFFECT OF WHATSAPP USE ON STUDENTS' SOCIO-EMOTIONAL DEVELOPMENT AND ACADEMIC ACHIEVEMENT. <https://doi.org/10.5281/ZENODO.3710738>
 11. Britannica. (2025). Computer science | Definition, Types, & Facts | Britannica. <https://www.britannica.com/science/computer-science>
 12. Bua, A., Cabeje, G., Sabardan, G., Sarmiento, J., Saro, J., & Garcia, S. (2022). Blended Learning Education: The Effectiveness of New Ways of Teaching and Learning in Enhancing Students' Academic Achievement. Volume 5, 348–355. <https://doi.org/10.5281/zenodo.7273062>
 13. Carmi, G. (2024a). E-Learning using zoom: A study of students' attitude and learning effectiveness in higher education. *Heliyon*, 10(11), e30229. <https://doi.org/10.1016/j.heliyon.2024.e30229>
 14. Carmi, G. (2024b). E-Learning using zoom: A study of students' attitude and learning effectiveness in higher education. *Heliyon*, 10(11), e30229. <https://doi.org/10.1016/j.heliyon.2024.e30229>
 15. Ceruzzi, P. E. (2023). A History of Modern Computing. <https://quod.lib.umich.edu/j/jahc/3310410.0002.218/--paul-e-ceruzzis-a-history-of-modern-computing?rgn=main;view=fulltext>
 16. Chaudhary, A., Arif, S., Calimlim, R., Khan, S., & Sadia, A. (2025). The Impact of Ai-Powered Educational Tools on Student Engagement and Learning Outcomes at Higher Education Level. https://www.researchgate.net/publication/382559080_The_Impact_Of_Ai-Powered_Educational_Tools_On_Student_Engagement_And_Learning_Outcomes_At_Higher_Education_Level
 17. Chika, A. J. (2024). Reforms And Innovation In Secondary Education Through Community Participation.
 18. Clough, M. (2007). Learning and teaching in the school science laboratory: An analysis of research, theory and practice (pp. 393–441).
 19. Djam'an, N., Asdar, N., Djadir, & Fauzan. (2021). The Effect of Online Learning Using Zoom on Students' Learning Outcomes.
 20. Dreams, O. (2020, May 3). E-learning in Cameroon: How Effective? Open-Dreams-. <https://www.open-dreams.org/post/e-learning-in-cameroon-how-effective>
 21. Egara, F. O., & Mosimege, M. (2024). Effect of blended learning approach on secondary school learners' mathematics achievement and retention. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-024-12651-w>
 22. Engwari, M. C., & Marcelle, M. K. (2021). Hybrid Education, Pedagogical Continuity and Instructional Efficiency amid the COVID-19 Pandemic in Cameroon Universities. *International Journal of Research and Innovation in Social Science*, 05(06), 559–564. <https://doi.org/10.47772/IJRIS.2021.5632>
 23. Fallwickl, E., Lead, C. A. T., WES, McNally, R., Manager, K., WES, Mackie, C., Editor, & WENR. (2021). Education in Cameroon. WENR. <https://wenr.wes.org/2021/04/education-in-cameroon>
 24. Farone, A. (2020, August 4). The history of coding and software engineering. Hack Reactor. <https://www.hackreactor.com/resources/the-history-of-coding-and-software-engineering/>

25. FATIN, F. (2018). Is hypothesis needed for a mixed method research? University of Malaysia, Sarawak. https://www.researchgate.net/post/Is_hypothesis_needed_for_a_mixed_method_research
26. Forbes. (2024). What Is WhatsApp? – Guide To The International Messaging App. <https://www.forbes.com/sites/technology/article/what-is-whatsapp/>
27. Friere, P. (2012). Key Pedagogic Thinkers: Paulo Friere—Journal of Pedagogic Development | University of Bedfordshire. <https://www.beds.ac.uk/jpd/journal-of-pedagogic-development-volume-2-issue-3/key-pedagogic-thinkers-paulo-friere/>
28. Garrison, D. R. (2011). E-learning in the 21st century: A framework for research and practice.
29. Garrison, D. R., & Vaughan, N. (2008). Blended Learning in Higher Education Framework, Principles, and Guidelines. San Francisco, CA Jossey-Bass. - References—Scientific Research Publishing. <https://www.scirp.org/reference/referencespapers?referenceid=1424115>
30. GCE Board, C. (2015, June). GCE Examinations Regulations and Syllabuses. Cameroon GCE Board.
31. Glen, S. (2023). Sample Size in Statistics (How to Find it): Excel, Cochran's Formula, General Tips. Statistics How To. <https://www.statisticshowto.com/probability-and-statistics/find-sample-size/>
32. Godfrey, M., & German, D. (2008). The Past, Present, and Future of Software Evolution. In Proceedings of the 2008 Frontiers of Software Maintenance, FoSM 2008 (p. 138). <https://doi.org/10.1109/FOSM.2008.4659256>
33. Graham, C. R. (2022). Blended learning systems: Definition, current Trends and Future Directions. San Francisco, Pfeiffer publishers.
34. Guskey, T. R. (2003). Grading and Reporting Student Learning.
35. Hamzah, M. I., Zhaffar, N. M., & Razak, K. A. (2018). Barriers in Teaching Critical Thinking in Islamic Education. *Creative Education*, 09(14), 2350–2356. <https://doi.org/10.4236/ce.2018.914175>
36. Hanna, E. P. (2013). A Cognitive Emotional Methodology for Critical Thinking. *Advances in Applied Sociology*, 03(01), 20–25. <https://doi.org/10.4236/aasoci.2013.31003>
37. Hew, K. F., & Cheung, W. S. (2014). Using Blended Learning: Evidence-Based Practices. London, Springer Publ., 123.
38. IEEE, X. (1990). IEEE Standard Glossary of Software Engineering Terminology. IEEE Std 610.12-1990, 1–84. IEEE Std 610.12-1990. <https://doi.org/10.1109/IEEESTD.1990.101064>
39. Kara, M. (2020). Distance education: A systems view of online learning: by Michael G. Moore and Greg Kearsley, Belmont, CA, Wadsworth Cengage Learning, 2012, 361 pp., £92.99 (paperback), ISBN: 978-1-111-52099-1. *Educational Review*, 72(6), 800–800. <https://doi.org/10.1080/00131911.2020.1766204>
40. Karugu, A., Kamere, I., & Mugo, P. (2001). The Education System of Cameroon. <https://ir-library.ku.ac.ke/bitstream/handle/123456789>
41. Leblanc, R., Sabel, A., Hilburn, T., & McGettrick, A. (2003). IEEE-CS/ACM computing curricula—Software engineering volume (p. S3C_27). <https://doi.org/10.1109/FIE.2003.1265988>
42. Lillian, W. N., Mutsotso, S. N., & Wasike, D. W. (2023). Teachers' Perceptions of Blended Learning and the Acquisition of Language Skills in National and Extra-County Schools in Western Region, Kenya. *International Journal of Research and Scientific Innovation*, X(IX), 314–322. <https://doi.org/10.51244/IJRSI.2023.10929>
43. Lleshaj, L., & Çika, N. (2024). Software Skills and Their Impact on Enhancing Job Performance: A Perspective from Finance and Accounting Postgraduate Students. *Review of Economics and Finance*, 21, 2485–2493. <https://doi.org/10.55365/1923.x2023.21.264>
44. Mason, J. (2021). Learning about noticing, by, and through, noticing. *ZDM*, 53, 231–243. <https://oro.open.ac.uk/73220/>
45. Mbakwa, P. N. (2020). The State and Challenges of Technology Enhanced Learning in Cameroon's English Subsystem of Education: Case Study of Colleges. <https://doi.org/10.2991/assehr.k.200521.026>
46. Michael, & Reeves, T. C. (2006). Michael Graham Moore: A Significant Contributor to the Field of Educational Technology.
47. Milner, M. (2023). Can Students Learn from Lecture Demonstrations? ResearchGate. https://www.researchgate.net/publication/238711199_Can_Students_Learn_from_Lecture_Demonstrations
48. Ministry of Secondary Education, C. (2024). MINESEC Statistical Yearbook. MINESEC Cameroon.
49. Moore, M., & Keegan, D. (1993). Theoretical principles of distance education. Paris, France: OECD Publishing. <http://www.worldcat.org/title/givings->

- knowledge-forfree-the-emergence-of-open-educational-resources/
50. Muhammad, D., & Umar, A. (2016). Effectiveness of Demonstration and Lecture Methods in Learning Concept in Economics among Secondary School Students in Borno State, Nigeria. *Journal of Education and Practice*.
 51. Musawi, Al., & Porcaro, D. (2011). Lessons Learned from Adopting Computer-Supported Collaborative Learning in Oman | EDUCAUSE Review. <https://er.educause.edu/articles/2011/12/lessons-learned-from-adopting-computersupported-collaborative-learning-in-oman>
 52. Nasution, M. K. M., Hidayat, R., & Syah, R. (2022). *Computer Science*. <https://doi.org/10.48550/ARXIV.2207.07901>
 53. Nganji, J., Kwemain, R., & Taku, C. (2010). Closing the digital gap in Cameroonian secondary schools through the CIAC project.
 54. Niaz, M. (2003). Constructivist theory of learning in science and in science education: A philosophical critique. *Science & Education*, 12(6), 535–550.
 55. Njideka, O. (2024). The Effect of Blended Learning on Students' Academic Achievement and Interest in Mathematics in Secondary Schools in Southeast, Nigeria. <http://www.ijrpr.com/>
 56. Njike, C., Ngwane, F., & Njike, F. (2019). Challenges and prospects of computer science education in secondary schools in Cameroon. *Journal of Information Technology Education: Research*, 18, 235–252.
 57. Nkwenti, M. (2016). Baseline Study on the Current State of Open and Distance Learning in Cameroon.
 58. Ogbudu, L., Stephen Bepeh, U., Okpe, O., & Atsu Liwhu, A. (2023). Perceived Influence of Whatsapp Usage on Students' Academic Achievement in the University of Cross River State. *International Journal Of Multidisciplinary Research And Analysis*, 06. <https://doi.org/10.47191/ijmra/v6-i9-23>
 59. Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd edn). Sage Publications.
 60. Paul, R., & Elder, L. (2007a). *Critical Thinking: Strategies for Improving Student Learning, Part II*.
 61. Paul, R., & Elder, L. (2007b). The nature of critical and creative thought. *Journal of Developmental Education*, 31(2), 34–35.
 62. Peterson, D. S. (2008). A meta-analytic study of adult self-directed learning and online nursing education: A review of research from 1995 to 2007. *Cite Journal*. <http://search.proquest.com.proxy.lib.sfu.ca/docview/194001867?accountid=13800>
 63. Praxent. (2020, January 2). *Innovation Over Time: A History of Software Development*. Praxent. <https://praxent.com/blog/history-of-software-development-innovation>
 64. Roberts, R. M. (2011). Best instructional practices for distance education: A meta-analysis. <http://search.proquest.com.proxy.lib.sfu.ca/docview/900728274?accountid=13800>
 65. Selvakumar, S., & Sivakumar, P. (2019). The Impact of Blended Learning Environment on Academic Achievement of Engineering Students. https://www.researchgate.net/publication/336891858_The_Impact_of_Blended_Learning_Environment_on_Academic_Achievement_of_Engineering_Students
 66. Shamboul, H. A. E. (2022). The Importance of Critical Thinking on Teaching Learning Process. *Open Journal of Social Sciences*, 10(01), 29–35. <https://doi.org/10.4236/jss.2022.101003>
 67. Shameel, M. (2024). *Top Technology Trends 2024: Hardware & Embedded Electronics*. <https://www.actalentservices.com/en-in/insights/articles/top-technology-trends-for-2024>
 68. Siemens, G. (2004). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance*, 2(1), 3–10.
 69. Siemens, G. (2005). Connectivism: A learning theory for the digital age. Retrieved from <http://www.elearnspace.org/Articles/connectivism.htm>
 70. SODEI. (2021, November 26). *Digital Education in Cameroon: An Analysis into Available Tools and Perceptions Regarding Benefits, Barriers, and Access to e-Learning Tools in Southwest Cameroon, November 2021 - Cameroon | ReliefWeb*. <https://reliefweb.int/report/cameroon/digital-education-cameroon-analysis-available-tools-and-perceptions-regarding>
 71. Staker, H., & Horn, M. B. (2013). *Classifying K-12 Blended Learning*. <http://www.christenseninstitute.org/wp-content/uploads/2013/04/Classifying-K-12-blended-learning.pdf>
 72. Steinmayr, R., Meißner, A., Weidinger, A., & Wirthwein, L. (2014). *Academic Achievement*. <https://doi.org/10.1093/obo/9780199756810-0108>
 73. Suen, H.-Y., & Hung, K.-E. (2024). Revealing the influence of AI and its interfaces on job candidates' honest and deceptive impression management in asynchronous video interviews. *Technological*

- Forecasting and Social Change, 198, 123011.
<https://doi.org/10.1016/j.techfore.2023.123011>
74. Suhaimi, M. A., & Baharom, F. (2017). The impact of WhatsApp on students' achievement in computer science in secondary schools. *International Journal of Interactive Mobile Technologies*, 11(2), 45–56.
75. Tambo, L. (2003). *Principles and Methods of Teaching Application in Cameroon Schools*. University of Buea ANUCAM Publisher, Limbe. - References—Scientific Research Publishing.
<https://www.scirp.org/reference/referencespapers?referenceid=2954901>
76. TeachThought. (2024). *The Pedagogy Of John Dewey: A Summary* | TeachThought.
<https://www.teachthought.com/learning-posts/pedagogy-john-dewey-summary/>
77. Tentama, F., & Abdillah, M. H. (2019). Student employability examined from academic achievement and self-concept. *International Journal of Evaluation and Research in Education (IJERE)*, 8(2), 243.
<https://doi.org/10.11591/ijere.v8i2.18128>
78. Thomas. (2013). Exploring the use of asynchronous online discussion in health care education: A literature review. *Jornal of Computers and Education*.
doi:<http://dx.doi.org/10.1016/j.compedu.2013.07.005>
79. Trochim, W. M., & Donnelly, J. P. (2008). *The Research Methods Knowledge Base*. Atomic Dog Publishing.
80. Ugboja, A., Omachonu, C., & Gowon. (2023). Blended Learning Approach and Students' Academic Achievement in Essay Writing in Senior Secondary Schools in Anyigba, Kogi State. 1, 11–21.
81. UN Sustainable Development Group. (2020). *United Nations COVID-19 Socio Economic Response for Cameroon*. <https://unsdg.un.org/resources/united-nations-covid-19-socio-economic-response-plan-cameroon>
82. University of Louisville. (2024). *Paul-Elder Critical Thinking Framework*.
<https://louisville.edu/ideastoaction/about/criticalthinking/framework>
83. Venugopal, A. (2024). *Impact of Digital Learning Platforms on Student Academic Performance. Medicon Engineering Themes*.
<https://doi.org/10.55162/MCET.06.208>
84. Watson, J., & Murin, A. (2014). *A History of K-12 Online and Blended Instruction in the United States. Handbook of Research on K-12 Online and Blended Learning*. N.P., ETC Press Publ.
85. Willinsky, J., Jonas, R., Shafack, R., & Wirsiy, K. C. (2005). Access to Research in Cameroonian Universities. *The Electronic Journal Of Information Systems In Developing Countries*, 21(1), 1–15.
<https://doi.org/10.1002/j.1681-4835.2005.tb00134.x>
86. Zarei, N., & Jailani, M. A. (2018). Students' perceptions towards blended learning approach. *Asian Journal of Social Science Research*, 1(1).
<https://ajssr.unitar.my/doc/vol1i1/2111.pdf>