

Effects of Computer-Based Concept Mapping and Flipped Classroom Strategies on Upper Basic Social Studies Students' Performance in Ilorin Metropolis, Nigeria

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ABSTRACT

The decline in students' academic results in Upper Basic Social Studies in Ilorin, Nigeria, remains a concern for educators and policymakers. Data from ten years of BECE results (2015–2024) show consistently low performance, with only an average of 12. 12.25% of candidates achieving Grade A (Excellent). This is largely due to dependence on teacher- centered methods. This study examined how computer- based concept mapping (CBCM) and the flipped classroom (FC) influence students' performance in Ilorin, Kwara State. CBCM uses computer tools to help students visually organize concepts hierarchically, while the flipped classroom shifts direct instruction outside class through recorded videos, leaving class time for active engagement. Four research questions and hypotheses at the 0. 05 significance level guided the study. A quasi- experimental design with a pretest and posttest was used, involving 117 Upper Basic II students from three schools in Ilorin, divided into three groups: CBCM (34 students), FC (31 students), and traditional method control (52 students). Data collection used a validated 30- item Social Studies Performance Test (SSPT), with a reliability coefficient of 0. 0.78. Three instructional packages covering five topics over six weeks were used as treatments. Data analysis included descriptive statistics and ANCOVA with Scheffé post hoc tests, controlling for pretest scores. Results revealed that: (i) CBCM significantly improved performance, $F(1, 83) = 20. 339, p < .05, \eta^2 = .197$, with the CBCM group averaging 67. 26 on the posttest (+ 20. 34. 09 gain) versus 46. 58 in control; (ii) FC also significantly enhanced scores, $F(1, 80) = 47. 303, p < .05, \eta^2 = .372$, with the highest posttest mean of 83. 10 (+ 14. 48. 65 gain); (iii) overall group differences were significant, $F(2, 113) = 30. 366, p < .05, R^2 = .382$, with post hoc comparison showing $FC > CBCM > Control$, all differences significant; (iv) gender did not influence results significantly, $F(2, 110) = 0. 773, p > .05$, indicating both methods benefit males and females equally. The study concludes that CBCM, and especially the flipped classroom, is more effective than traditional methods in improving Social Studies performance, with the flipped classroom being the most effective. It is recommended that teachers adopt both strategies routinely and that professional development programs be expanded to equip teachers with the skills to implement these technology- driven, learner- centered approaches effectively.

Keywords: Computer-Based Concept Mapping; Flipped Classroom; Academic Performance; Social Studies; Upper Basic Education; Gender; Kwara State.

I. INTRODUCTION

Social Studies holds a vital role in basic education by helping learners understand their society, develop social values, think critically about societal issues, and participate responsibly in community and national development. At the Upper Basic level, it equips students with knowledge about social relationships, institutions, civic duties, human behavior, and current societal challenges. Therefore, effective teaching methods should go beyond simple fact transmission and memorization, encouraging students to actively construct, organize, discuss, and apply knowledge (Falade & Adeyemi, 2017). Nonetheless, the success of Social Studies education heavily depends on the instructional strategies teachers use. A major challenge remains shifting from teacher-centered

methods to learner-centered, technology-enhanced approaches in Nigeria's education system (Yusuf, 2023). Evidence shows that traditional teaching methods offer limited chances for active participation, critical thinking, collaboration, and independent learning, which can negatively affect students' understanding and academic performance.

An instructional strategy refers to the systematic approach a teacher uses to organize learning experiences and help students achieve stated instructional objectives. In contemporary classrooms, instructional strategies increasingly emphasize active participation, learner interaction, collaboration, visualization, independent learning, and the meaningful application of knowledge. Ekpoto (2024) emphasized the importance of

effective instructional approaches in promoting students' engagement and learning outcomes, particularly where conventional approaches may not provide sufficient opportunities for active learner involvement. This shift is particularly relevant to Social Studies because the subject deals with interconnected social concepts and issues that learners need to understand in relation to one another and to their everyday experiences. Similarly, **Omojemite (2025)** reported that interactive and student-centred instructional approaches can enhance students' engagement and academic performance by providing learners with greater opportunities to participate actively in the learning process. The reviewed literature therefore suggests the need for instructional approaches that move learners from passive reception of information towards active construction and application of knowledge. In this regard, **Computer-Based Concept Mapping (CBCM)** and the **Flipped Classroom (FC)** are two technology-supported instructional approaches with the potential to transform Social Studies teaching and learning through active participation, conceptual organization, independent learning, and meaningful classroom interaction.

Computer-Based Concept Mapping is an instructional strategy supported by technology, where learners use computer tools to create hierarchical visual representations of Social Studies concepts. These representations include concepts, nodes, lines, and linking phrases, helping students organize information, recognize relationships, integrate new knowledge with what they already know, and visualize complex ideas (Ramatu, 2023). This approach is valuable because it clarifies and deepens the understanding of relationships among concepts. Research reviewed in the thesis shows that computer-based concept mapping can improve how knowledge is organized, promote meaningful learning, and foster interactive educational environments (Ramatu, 2023). Likewise, Chiou et al. (2020) found that multidimensional concept maps can decrease cognitive load and improve learning outcomes by allowing learners to create interconnected networks in their memory. More recent findings from Chen et al. (2024) indicate that students who develop problem-oriented digital concept maps perform better in scientific reasoning, hypothesis formulation, and drawing conclusions compared to those using more static, knowledge-focused maps.

Another strategy considered in this study is the flipped classroom. A flipped classroom reverses the conventional sequence of instruction by moving initial exposure to lesson content outside the classroom through digital resources such as teacher-recorded videos, presentations, or readings.

Classroom time is then used for interaction, discussion, practice, problem-solving, clarification, and application (Li & Xue, 2023). Thus, the flipped classroom does not eliminate face-to-face teaching; it changes how classroom time is used. The approach gives students opportunities to engage with instructional materials independently before class and allows teachers to devote more classroom time to active, collaborative learning. Chi-Pu et al. (2021) emphasized flipped learning's capacity to promote learner autonomy by allowing students to take greater responsibility for their learning and engage with instructional content independently.

The potential of flipped classroom instruction is further supported by recent empirical studies. Agyeman and Aphane (2023) found that flipped classroom instruction improved students' preparation before class, active participation, knowledge acquisition, engagement, classroom discussion, and collaboration. Similarly, Dawal (2023), in a study involving Upper Basic II students, reported that the Flipped Classroom strategy was significantly more effective than Peer-Teaching in stimulating students' interest in Basic Science. More recently, Anjass et al. (2025) found that students exposed to flipped classroom instruction achieved significantly higher academic achievement and motivation than those in the comparison condition, with benefits observed among both male and female students. However, the literature also shows that the success of flipped learning depends on implementation quality. Lo and Hew (2021) identified student disengagement with pre-class activities and increased teacher workload as important implementation challenges. Thus, simply providing students with instructional videos may not automatically improve performance; the videos need to be integrated with purposeful classroom activities that promote active learning.

Academic performance measures how well learners demonstrate achievement of learning outcomes after instruction. In this study, it specifically refers to students' demonstrated learning in Social Studies, assessed through the Social Studies Performance Test. Academic performance is a key indicator of how effective instruction is, as strategies are expected to enhance students' understanding, retention, application, and mastery of subject objectives (Adikwu, 2018). Evidence shows that Upper Basic Social Studies students have consistently faced difficulties in achieving high academic performance. Analyzing records from 2015 to 2024 reveals that while many students pass and earn credits, the percentage reaching the top grades remains low, indicating that many learners meet minimum standards without

demonstrating advanced mastery of Social Studies concepts.

This study includes gender because learners might respond differently to instructional environments due to factors like prior education, participation, motivation, and other characteristics. Nonetheless, gender alone should not be automatically used to predict responses to technology-supported strategies. The evidence from reviewed theses is mixed. Ramatu (2023) found no significant gender difference in performance with computer-based concept mapping, while other research indicates gender-related differences. The thesis also notes that Timothy et al. (2024) observed no significant interaction between peer-tutoring and gender on student performance, implying some learner-centered strategies could be equally effective for both genders. Therefore, exploring how gender interacts with instructional strategies is crucial for understanding if CBCM and flipped classroom methods differ in effectiveness based on gender.

The emphasis on Upper Basic Education is also crucial. It includes the upper basic stage of Nigerian education, typically JSS 1–3. Students at this stage are expected to enhance their knowledge, skills, values, and attitudes across various subjects. Upper Basic II learners are ideal candidates for instructional interventions because they have gained essential foundational knowledge but are not yet under the intense exam pressure seen in Upper Basic III. Implementing innovative teaching strategies at this level can help students better grasp complex Social Studies concepts and engage more actively in learning.

1.0 Statement of the Problem

Despite increasing evidence supporting technology-enhanced and learner-centered teaching methods, a significant empirical gap remains. Prior research has shown the effectiveness of computer-based concept mapping and flipped classrooms, but most studies focus on subjects other than Social Studies or on different educational levels from Upper Basic Education. Additionally, there is limited empirical data comparing the effectiveness of these strategies specifically within Upper Basic Social Studies in Ilorin Metropolis, Nigeria. Literature highlights a lack of focus on computer-based concept mapping in this context and emphasizes the need for evidence relevant to Nigeria. The study also stresses the importance of studying modern instructional techniques within the Nigerian educational setting, rather than assuming findings from other subjects or countries are directly applicable to Social Studies students in Kwara State.

1.1 Objectives of the Study

- i. determine the effect of computer-based concept mapping on the academic performance of Upper Basic Social Studies students in Ilorin South;
- ii. determine the effect of the flipped classroom strategy on the academic performance of Upper Basic Social Studies students in Ilorin West;
- iii. compare the academic performance of students taught using computer-based concept mapping, flipped classroom, and the conventional method; and
- iv. examine the influence of gender on the academic performance of students taught using each instructional strategy.

1.2 Research Questions

- i. What is the effect of computer-based concept mapping on the performance of Upper Basic Social Studies students in Ilorin?
- ii. What is the effect of the flipped classroom strategy on the performance of Upper Basic Social Studies students in Ilorin?
- iii. What are the effects of computer-based concept-mapping, flipped classroom, and conventional strategies on the performance of Upper Basic Social Studies students?
- iv. What is the interactive effect of computer-based concept mapping, flipped classroom, and conventional strategies on the performance of Upper Basic Social Studies students based on gender?

1.3 Research Hypotheses

Ho₁: There is no significant difference in the performance of students taught using computer-based concept mapping and those taught using the conventional method.

Ho₂: There is no significant difference in the performance of students taught using the flipped classroom strategy and those taught using the conventional method.

Ho₃: There is no significant effect of computer-based concept mapping, flipped classroom, and conventional method on the academic performance of Upper Basic Social Studies students in Ilorin.

Ho₄: There is no significant interactive effect of computer-based concept mapping, flipped classroom, conventional method, and gender on the academic performance of Upper Basic Social Studies students in Ilorin.

II. REVIEW OF RELATED LITERATURE

Concept mapping, first developed by Novak and Gowin (1984) as a pedagogical tool grounded in

Ausubel's (1968) theory of meaningful learning, is a graphic organiser that represents knowledge as a hierarchically arranged network of concepts linked by labelled propositions. In its computer-based form, students use digital tools such as CmapTools to construct, revise, share and collaborate on concept maps, with the added advantages of dynamic editability, visual clarity and the ability to embed multimedia resources. Computer-based concept mapping operationalises Ausubel's central claim that learning is most effective when new information is explicitly and consciously connected to relevant existing concepts in the learner's cognitive structure — a process Ausubel termed meaningful assimilation. By requiring students to identify Social Studies concepts, arrange them from general to specific, and draw labelled links expressing the nature of their relationships, concept mapping makes the structure of Social Studies knowledge visible and navigable, facilitating deeper processing, better organisation and improved retention.

Empirically, a recent meta-analysis of 37 concept-mapping studies in STEM education (2004–2023) by Wang et al. (2025) identified a moderate overall effect size of $ES = 0.630$, with the greatest positive impact observed at the secondary education level, providing strong cumulative evidence that concept mapping consistently enhances learners' academic achievement. In Nigerian Social Studies contexts specifically, Haruna, Musa and Alfa (2017) found concept mapping to significantly improve JSS students' achievement and retention in Social Studies in Mubi, Adamawa State. However, contrasting evidence from Ogunji et al. (2017) in Abakaliki, Ebonyi State found no significant effect of concept mapping on Social Studies achievement, underscoring the context-dependence of the strategy's effectiveness and the importance of implementation quality.

The flipped classroom model, popularised by Bergmann and Sams (2012), inverts the traditional instructional sequence by moving direct content instruction outside the classroom — through pre-recorded video lessons, digital reading materials or audio resources and bringing active, application-focused learning activities into the classroom. In a flipped Social Studies classroom, students engage with pre-class instructional materials at home or independently before the lesson, arriving at school with an initial understanding of the topic and ready for in-class collaborative discussion, debate, values clarification, problem-solving and civic application activities under teacher facilitation. This inversion aligns with constructivist learning theory (Piaget, 1954; Vygotsky, 1978), which holds that learners construct deeper and more durable understanding

through active engagement and social interaction with content than through passive reception.

Recent empirical evidence strongly supports the effectiveness of the flipped classroom in improving student performance. Konyeme and Alordiah (2024) found that Nigerian secondary school Biology students in a flipped classroom significantly outperformed those taught conventionally in Delta State. Oduwole, Anaduaka and Orji (2024) reported significantly higher mathematics achievement ($p = .002$) among senior secondary students in FCT Abuja who received flipped classroom instruction. Internationally, Wang, Lu and Yu (2025) confirmed in a four-month quasi-experimental study that flipped classroom produced significantly higher academic performance and motivation than conventional instruction among Chinese college English learners, while Paralikar, Shah, Joshi and Kathrotia (2022) found that flipped classroom students showed significant development in Bloom's higher-order cognitive skills, particularly at the application and analysis levels. Contrasting evidence exists, however: Czarnowske, Heiss, Schmitz and Stammann (2025) found no significant effect of flipped classroom on exam scores or retention in a German university statistics course, suggesting that the strategy's effectiveness is moderated by subject-context, student maturity and quality of pre-class materials.

2.3 Theoretical Framework

This study is anchored on two complementary theoretical frameworks. The first is Ausubel's (1968) Assimilation Theory of Meaningful Learning, which underlies the computer-based concept-mapping strategy. Ausubel posited that learning is most effective when new information is deliberately assimilated into relevant existing cognitive structures, a process facilitated by the use of advance organisers and graphic representations — precisely what concept maps provide. The second framework is Vygotsky's (1978) Sociocultural Theory and constructivist learning principles, which underlie the flipped classroom strategy. Vygotsky's emphasis on active, socially situated knowledge construction and scaffolded learning within the Zone of Proximal Development is operationalised in the flipped classroom's in-class collaborative discussions and teacher-facilitated application activities, while constructivism's insistence on learner agency and meaning-making is reflected in the pre-class independent engagement with content. Together, these frameworks provide a coherent theoretical rationale for expecting both strategies to produce superior learning outcomes compared to the passive, teacher-centred conventional method.

III. METHODOLOGY

3.1 Research Design

This study adopted a quasi-experimental pretest-posttest non-equivalent control group design, using a 3×2 factorial design. The three levels of the strategy factor were: Computer-Based Concept Mapping, Flipped Classroom, and Conventional Method (Control). The two levels of the gender factor were: Female and Male. This design is appropriate because it allows the manipulation of the independent variable, instructional strategy, while using intact classes rather than randomly assigned groups. Pretest scores were used as a covariate in Analysis of Covariance (ANCOVA) to statistically control for pre-existing between-group differences in academic performance.

3.2 Population and Sample

The population comprised all Upper Basic II Social Studies students in public junior secondary schools in Ilorin, Kwara State. Three comparable public junior secondary schools were selected from Ilorin using purposive sampling, based on criteria of school type (public), co-educational status and their comparable BECE performance history. One school was assigned to each instructional condition using intact classes. The resulting sample comprised 117 students: Computer-Based Concept Mapping group ($n = 34$; 21 female, 13 male), Flipped Classroom group ($n = 31$; 16 female, 15 male), and Conventional Method/Control group ($n = 52$; 34 female, 18 male).

3.3 Instrumentation

This study used four instruments. The Social Studies Performance Test (SSPT), Computer-Based Concept-Mapping Instructional Package (CBCMIP), Flipped Classroom Video Instructional Package (FCVIP), and Lesson Plan for Conventional Method (LPCM). The researcher used a multiple-choice and structured achievement test drawn from the Upper Basic II Social Studies curriculum for data collection. The SSPT was validated by two experts in Social Studies, two in Educational Technology, and one in Measurement and Evaluation from the University of Ilorin. Reliability was established using the Kuder-Richardson 21 (KR-21) formula on pilot test data, yielding an acceptable reliability coefficient. The SSPT was administered as a pretest before

treatment commencement and as a posttest immediately after the six-week treatment period.

3.4 Treatment Procedure

The treatment lasted six weeks. In the Computer-Based Concept Mapping group, students used Computer system to learn six different topics in Social Studies in the computer laboratory, with concept map and interactive map under teacher guidance, to visualize, established relationship of concepts, and present hierarchical concept maps of Upper Basic II Social Studies topics. Lessons followed a four-step procedure: teacher orientation and demonstration of the tool; guided interactive concept map construction; independent and group map revision with peer feedback; and whole-class map presentation, evaluation, and consolidation against a teacher-prepared master map. In the Flipped Classroom group, students received instructor-prepared pre-class video recording materials covering the week's Social Studies topic, before each class meeting. In-class sessions were devoted entirely to discussion, clarification, group application activities, and values-clarification exercises facilitated by the teacher. The Conventional Method group received the same Social Studies topics through the standard lecture-question-and-answer method, without concept mapping or flipped-classroom package.

3.5 Data Analysis

Descriptive statistics, mean scores, standard deviations, and mean gain scores were computed to answer the four research questions. ANCOVA was employed to test Ho1 (Concept Mapping vs Control), Ho2 (Flipped Classroom vs Control) and Ho3 (three-group comparison) at the 0.05 level of significance, with pretest scores as covariate. The Scheffé post-hoc test was used following the significant overall ANCOVA for Ho3 to identify specific group pairwise differences. A 3×2 factorial ANCOVA (Strategy $\times$ Gender) was used to test Ho4. All analyses were performed using SPSS Statistics, Version 23.

IV. RESULTS

4.1 Research Question One: Effect of Computer-Based Concept Mapping

Table 1 presents the descriptive statistics for the Concept Mapping and Control groups.

Pretest and Posttest Mean Performance Scores of the Concept Mapping and Control Groups

Group	N	Pretest Mean (SD)	Posttest Mean (SD)	Mean Gain	Score Range
Concept Mapping	34	51.18 (21.77)	67.26 (20.34)	+16.09	23–96
Control	52	47.29 (18.49)	46.58 (21.81)	–0.71	13–96

Note. SD = standard deviation.

Table 1 shows that the Concept Mapping group recorded a pretest mean of 51.18 (SD = 21.77) and a posttest mean of 67.26 (SD = 20.34), representing a mean gain of 16.09 score points — the largest absolute mean gain of the three instructional groups. In contrast, the Control group moved from a pretest mean of 47.29 (SD = 18.49) to a posttest mean of 46.58 (SD = 21.81), a marginal mean loss of 0.71 points, indicating that conventional instruction produced virtually no performance improvement over six weeks. The descriptive

evidence suggests a positive effect of computer-based concept mapping on students' Social Studies academic performance, which Ho1 tests for statistical significance.

4.2 Research Question Two: Effect of Flipped Classroom

Table 2 presents the descriptive statistics for the Flipped Classroom and Control groups. Pretest and Posttest Mean Performance Scores of the Flipped Classroom and Control Groups

Group	N	Pretest (SD)	Mean	Posttest (SD)	Mean	Mean Gain	Score Range
Flipped Classroom	31	72.45 (21.38)		83.10 (14.48)		+10.65	46–100
Control	52	47.29 (18.49)		46.58 (21.81)		–0.71	13–96

Note. SD = standard deviation.

Table 2 shows that the Flipped Classroom group recorded a pretest mean of 72.45 (SD = 21.38) and a posttest mean of 83.10 (SD = 14.48), representing a mean gain of 10.65 score points and the highest posttest mean among all three groups. Notably, the Flipped Classroom group entered the study with the highest pretest mean and exited with the highest posttest mean, suggesting the strategy further elevated already high initial performance. The Control group remained essentially unchanged.

Whether the Flipped Classroom's advantage over the Control is statistically significant after controlling for pretest differences is tested in Ho₁.

4.3 Research Question Three: Combined Effects of Both Strategies

Table 3 presents the descriptive statistics for all three groups together. Pretest and Posttest Mean Performance Scores Across All Three Groups

Group	N	Pretest (SD)	Mean	Posttest (SD)	Mean	Mean Gain	Score Range
Concept Mapping	34	51.18 (21.77)		67.26 (20.34)		+16.09	23–96
Flipped Classroom	31	72.45 (21.38)		83.10 (14.48)		+10.65	46–100
Control	52	47.29 (18.49)		46.58 (21.81)		–0.71	13–96

Table 3 shows that both experimental groups recorded positive mean gains over the treatment period: Concept Mapping (+16.09) and Flipped Classroom (+10.65) while the Control group recorded a marginal mean loss (–0.71). The Flipped Classroom group recorded the highest posttest mean (83.10), followed by the Concept Mapping group (67.26) and the Control group

(46.58). The statistical significance of these combined group differences is tested in Ho₃.

4.4 Research Question Four: Interactive Effect of Strategies and Gender

Table 4 presents posttest descriptive statistics by group and gender. Posttest Mean Performance Scores by Group and Gender

Group	Gender	N	Posttest Mean	SD	Mean Diff. (F – M)
Concept Mapping	Female (1)	21	67.62	20.04	0.93
	Male (2)	13	66.69	21.63	
Flipped Classroom	Female (1)	16	88.50	11.41	11.17
	Male (2)	15	77.33	15.52	
Control	Female (1)	34	49.65	21.63	8.87

Male (2)	18	40.78	21.56
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Table 4 shows that female students outperformed male students in all three groups. The gender gap was smallest in the Concept Mapping group (0.93 points), moderate in the Control group (8.87 points), and widest in the Flipped Classroom group (11.17 points). H_{04} tests whether these observed gender differences within groups, and the pattern across groups, amount to a statistically significant Strategy $\times$ Gender interaction.

4.5 Testing of Hypothesis One (Ho1)

Ho1: There is no significant effect of computer-based concept-mapping strategy on the academic performance of Upper Basic Social Studies students in Kwara State.

ANCOVA Summary for the Effect of Computer-Based Concept Mapping on Academic Performance (Dependent Variable: Posttest Score)

Source	Type III SS	df	Mean Square	F	Sig.
Corrected Model	9,366.648	2	4,683.324	10.409	.000
Intercept	209,454.397	1	209,454.397	465.513	.000
Pretest (Covariate)	568.086	1	568.086	1.263	.264
Group (Strategy)	9,151.303	1	9,151.303	20.339	.000
Error	37,345.224	83	449.942		
Total	345,299.000	86			
Corrected Total	46,711.872	85			

Note. $R^2 = .201$ (Adjusted $R^2 = .181$). Concept Mapping adjusted posttest mean = 67.57; Control adjusted posttest mean = 46.38.

Table 5 shows that, after controlling for pretest scores, group (Concept Mapping vs. Control) had a statistically significant effect on students' posttest performance, $F(1, 83) = 20.339$, $p = .000$ ($p < .05$), partial $\eta^2 = .197$. The Concept Mapping group's adjusted posttest mean (67.57) was significantly higher than the Control group's (46.38)—an adjusted difference of 21.19 score points. The effect size of partial $\eta^2 = .197$ indicates a large practical effect, with the instructional strategy accounting for approximately 19.7% of the variance in posttest performance after controlling for prior academic performance. The pretest covariate was not statistically significant, $F(1, 83)$

$= 1.263$, $p = .264$, confirming that initial ability differences did not significantly confound the results. The Corrected Model was significant, $F(2, 83) = 10.409$, $p = .000$, $R^2 = .201$. Since $p = .000 < .05$, Ho1 is rejected. The computer-based concept-mapping strategy has a statistically significant effect on the academic performance of Upper Basic Social Studies students in Ilorin.

4.6 Testing of Hypothesis Two (Ho2)

Ho2: There is no significant effect of flipped classroom strategy on the academic performance of Upper Basic Social Studies students in Ilorin.

ANCOVA Summary for the Effect of Flipped Classroom Strategy on Academic Performance (Dependent Variable: Posttest Score)

Source	Type III SS	df	Mean Square	F	Sig.
Corrected Model	25,915.276	2	12,957.638	33.940	.000
Intercept	173,278.291	1	173,278.291	453.884	.000
Pretest (Covariate)	12.581	1	12.581	0.033	.856
Group (Strategy)	18,059.727	1	18,059.727	47.303	.000
Error	30,542.821	80	381.785		
Total	338,034.000	83			
Corrected Total	56,458.096	82			

Note. $R^2 = .459$ (Adjusted $R^2 = .446$). Flipped Classroom adjusted posttest mean = 82.78; Control adjusted posttest mean = 46.77.

Table 6 shows that, after controlling for pretest scores, there was a statistically significant effect of group (Flipped Classroom vs. Control) on students' posttest performance, $F(1, 80) = 47.303$, $p = .000$ ($p < .05$), partial $\eta^2 = .372$. The Flipped Classroom group's adjusted posttest mean (82.78) was significantly higher than that of the Control group (46.77), an adjusted difference of 36.01 score points, the largest group difference in the study. The effect size, partial $\eta^2 = .372$, indicates a very large practical effect, with the flipped classroom strategy accounting for approximately 37.2% of the variance in posttest performance after controlling for prior academic performance, notably larger than the effect size obtained for concept mapping (partial $\eta^2 = .197$). The pretest covariate was not statistically significant, $F(1, 80) = 0.033$, $p = .856$, indicating that the pretest did not significantly influence posttest performance within this model.

The Corrected Model explained 45.9% of the variance in posttest scores, $F(2, 80) = 33.940$, $p = .000$, $R^2 = .459$.

Decision: Since $p = .000 < .05$, H_{02} is rejected. There is a statistically significant effect of flipped classroom strategy on the academic performance of Upper Basic Social Studies students in Kwara State, in favour of the flipped classroom group. The flipped classroom produced a substantially larger effect size than concept mapping, confirming its greater instructional effectiveness in the Social Studies context.

4.7 Testing of Hypothesis Three (Ho3)

H_{03} : There is no significant combined effect of computer-based concept-mapping and flipped classroom strategies on the academic performance of Upper Basic Social Studies students.

One-Way ANCOVA Summary for the Combined Effects of Concept Mapping, Flipped Classroom and Conventional Method on Academic Performance (Dependent Variable: Posttest Score)

Source	Type III SS	df	Mean Square	F	Sig.
Corrected Model	27,221.986	3	9,073.995	23.259	.000
Intercept	244,048.091	1	244,048.091	625.519	.000
Pretest (Covariate)	121.219	1	121.219	0.311	.578
Group (Strategy)	23,693.100	2	11,846.550	30.366	.000
Error	44,084.800	113	390.131		
Total	683,333.000	117			
Corrected Total	71,306.786	116			

Note. $R^2 = .382$ (Adjusted $R^2 = .365$). Adjusted posttest means: Flipped Classroom = 83.98; Concept Mapping = 67.07; Control = 46.18.

Table 7 shows that, after controlling for pretest scores, the overall one-way ANCOVA revealed a statistically significant combined group effect, $F(2, 113) = 30.366$, $p = .000$ ($p < .05$), partial $\eta^2 = .350$, $R^2 = .382$. This indicates that the instructional strategy received significantly determined students' posttest Social Studies performance, with the three strategies collectively accounting for approximately 35.0% of the variance in posttest

scores after controlling for prior academic performance. The pretest covariate was not statistically significant, $F(1, 113) = 0.311$, $p = .578$, confirming that the groups were comparable at entry and that posttest differences can be attributed to the differential effects of the instructional strategies. Since the overall ANCOVA was statistically significant, a Scheffé post-hoc test was conducted to identify specific group pairwise differences. The results are presented in Table 8.

Scheffé Post-Hoc Test — Pairwise Comparisons of Adjusted Group Posttest Means

Group (I)	Group (J)	Adj. Mean Diff. (I–J)	F	Sig.
Control	Concept Mapping	–20.89	11.493	.000
Control	Flipped Classroom	–37.80	35.567	.000
Concept Mapping	Flipped Classroom	–16.91	5.946	.004

Note. Adjusted means: Flipped Classroom = 83.98; Concept Mapping = 67.07; Control = 46.18. All comparisons significant at $\alpha = .05$.

Table 8 shows that all three pairwise comparisons were statistically significant. The Control group's adjusted mean (46.18) was significantly lower than both the Concept Mapping group (67.07), $F = 11.493$, $p = .000$, and the Flipped Classroom group (83.98), $F = 35.567$, $p = .000$. Critically, the Concept Mapping and Flipped Classroom groups also differed significantly from each other, $F = 5.946$, $p = .004$, with the Flipped Classroom group scoring significantly higher. This establishes a clear and statistically confirmed three-tier performance hierarchy: Flipped Classroom (adj. M = 83.98) > Concept Mapping (adj. M = 67.07) > Conventional Method (adj. M = 46.18), with all pairwise differences significant at the .05 level.

Decision: Since $p = .000 < .05$ for the combined group effect, and the Scheffé post-hoc test

confirmed significant pairwise differences among all three groups, Ho3 is rejected. Computer-based concept mapping and flipped classroom strategies have a significant combined effect on the academic performance of Upper Basic Social Studies students. Both strategies significantly outperformed the conventional method, and the flipped classroom significantly outperformed concept mapping.

4.9 Testing of Hypothesis Four (Ho4)

Ho4: There is no significant interactive effect of computer-based concept-mapping and flipped classroom strategies and gender on the academic performance of Upper Basic Social Studies students.

3 × 2 Factorial ANCOVA Summary for the Interactive Effect of Strategy and Gender on Academic Performance (Dependent Variable: Posttest Score)

Source	Type III SS	df	Mean Square	F	Sig.	Partial η^2
Corrected Model	29,212.708	6	4,868.785	12.723	.000	.410
Intercept	235,878.419	1	235,878.419	616.342	.000	
Pretest (Covariate)	213.852	1	213.852	0.559	.456	.005
Group (Strategy)	24,480.588	2	12,240.294	31.986	.000	.368
Gender	1,398.956	1	1,398.956	3.657	.058	.032
Group × Gender	591.765	2	295.883	0.773	.464	.014
Error	42,094.079	110	382.673			
Total	683,333.000	117				
Corrected Total	71,306.786	116				

Note. $R^2 = .410$ (Adjusted $R^2 = .378$). Adjusted cell means — Concept Mapping: Female = 66.97, Male = 67.03; Flipped Classroom: Female = 90.01, Male = 78.21; Control: Female = 49.11, Male = 40.23.

Table 9 shows that the Strategy × Gender interaction effect was not statistically significant, $F(2, 110) = 0.773$, $p = .464$ ($p > .05$), partial $\eta^2 = .014$. This indicates that the performance advantage of the two innovative strategies over the conventional method was consistent across both male and female students — neither concept mapping nor the flipped classroom differentially benefited students of one gender over the other. Both male and female students benefited similarly from whichever instructional strategy they received, confirming that both strategies are gender-equitable instructional approaches.

The main effect of gender on posttest performance was not statistically significant at the .05 level, $F(1, 110) = 3.657$, $p = .058$, partial $\eta^2 = .032$, though the marginal p-value (.058) suggests a borderline trend

towards female students outperforming male students overall. The main effect of the instructional strategy (Group) remained highly significant after accounting for gender, $F(2, 110) = 31.986$, $p = .000$, partial $\eta^2 = .368$, consistent with the Ho3 result. The pretest covariate was not significant, $F(1, 110) = 0.559$, $p = .456$. The overall model explained 41.0% of the variance in posttest scores, $F(6, 110) = 12.723$, $p = .000$, $R^2 = .410$. Since $p = .464 > .05$ for the Group × Gender interaction, Ho4 is not rejected. Computer-based concept-mapping and flipped classroom strategies did not interact with gender to affect the academic performance of Upper Basic Social Studies students. Both strategies produced comparable benefits for male and female students.

V. DISCUSSION OF FINDINGS

The study established that computer-based concept mapping significantly improved Upper Basic Social Studies students' academic performance

relative to the conventional method, $F(1, 83) = 20.339$, $p = .000$, partial $\eta^2 = .197$, with the concept-mapping group recording the largest absolute mean gain of 16.09 score points across the study. Several factors account for this positive effect. The process of constructing concept maps required students to deliberately identify, arrange and connect Social Studies concepts, operationalizing Ausubel's (1968) meaningful assimilation process and compelling deeper cognitive engagement with the content than the passive reception characteristic of conventional instruction allows. The computer-based format further enhanced this engagement by making maps dynamic, colourful and easily revisable, sustaining students' interest across the six-week treatment. The large effect size (partial $\eta^2 = .197$) indicates a practically meaningful impact on Social Studies learning outcomes.

The finding implies that Social Studies teachers should incorporate computer-based concept mapping into their instructional practice, and that schools must provide the requisite ICT infrastructure to support its implementation. This result is consistent with Haruna, Musa and Alfa (2017), who found concept mapping to significantly improve JSS Social Studies achievement and retention in Adamawa State, and with Wang et al.'s (2025) meta-analysis confirming a moderate-to-large positive effect of concept mapping at the secondary level ($ES = 0.630$). It contrasts, however, with Ogunji et al. (2017), who found no significant effect of concept mapping on Social Studies achievement in Ebonyi State — a result that may reflect differences in implementation fidelity, intervention duration and ICT availability, and which underscores the context-dependence of the strategy's effectiveness. The flipped classroom strategy produced the most substantial positive effect on students' Social Studies academic performance in this study, with the Flipped Classroom group recording the highest posttest mean of 83.10 and the largest adjusted group difference of 36.01 points over the Control group, confirmed by a very large effect size of partial $\eta^2 = .372$, $F(1, 80) = 47.303$, $p = .000$. The superior effectiveness of the flipped classroom over both concept mapping (partial $\eta^2 = .197$) and conventional instruction can be attributed to the unique features of the model. Pre-class exposure to Social Studies content allowed students to arrive at in-class sessions with initial familiarity with the material, enabling all of in-class time to be devoted to higher-order Social Studies activities — discussion, values clarification, collaborative application and civic problem-solving — rather than first-time content delivery. This inversion directly reflects constructivist learning principles,

maximising students' active knowledge construction time and fostering the self-directed learning habits that are directly aligned with Social Studies' civic competency objectives.

The finding implies that the flipped classroom should be the primary recommended learner-centred strategy for Social Studies instruction at the upper basic level where ICT resources are available, given its substantial and statistically confirmed superiority. This finding aligns with Konyeme and Alordiah (2024) in Nigerian secondary Biology, Oduwale, Anaduaka and Orji (2024) in secondary Mathematics in Abuja, and Wang, Lu and Yu (2025) internationally, all of whom reported significant advantages of flipped classroom over conventional instruction. It contrasts, however, with Czarnowske et al. (2025), who found no significant effect in a German university statistics course, reinforcing that the flipped classroom's effectiveness is mediated by subject matter, student maturity and the quality of pre-class instructional materials.

The three-group one-way ANCOVA confirmed that both computer-based concept mapping and the flipped classroom significantly outperformed the conventional method, $F(2, 113) = 30.366$, $p = .000$, $R^2 = .382$, with the Scheffé post-hoc test establishing a statistically significant three-tier performance hierarchy: Flipped Classroom (adj. $M = 83.98$) > Concept Mapping (adj. $M = 67.07$) > Conventional Method (adj. $M = 46.18$). Critically, the Scheffé test also confirmed that the Flipped Classroom and Concept Mapping groups differed significantly from each other ($F = 5.946$, $p = .004$), with the Flipped Classroom producing significantly higher performance — a finding that carries important implications for instructional decision-making. While both strategies are significantly more effective than conventional instruction, they are not equally effective, and teachers should prioritize the flipped classroom over concept mapping where resources allow, and adopt concept mapping as the preferred alternative where consistent ICT access is unavailable.

The finding that instructional strategy alone accounted for 35.0% of the variance in posttest performance (partial $\eta^2 = .350$) reflects the powerful role that the quality and nature of instruction plays in determining Social Studies achievement. This result corroborates evidence from the broader Nigerian literature showing that learner-centred strategies collectively produce superior Social Studies outcomes over conventional instruction, and is consistent with the meta-analytic evidence of Wang et al. (2025) and the single-study evidence of Haruna et al. (2017) for concept mapping and Konyeme and Alordiah (2024) for flipped classroom. The contrasting evidence from

Ogunji et al. (2017) and Czarnowske et al. (2025), which found no significant effects in their respective contexts, further underscores that the superior effectiveness of innovative strategies over conventional instruction is real but context-dependent, and is contingent on implementation quality, duration and resource availability.

The 3×2 factorial ANCOVA found no significant gender interaction effect, $F(2, 110) = 0.773$, $p = .464$, partial $\eta^2 = .014$, confirming that both concept mapping and the flipped classroom were equally effective for male and female students. This equity-affirming finding indicates that neither strategy differentially advantages or disadvantages students on the basis of gender — both are inclusive instructional approaches suitable for mixed-gender Upper Basic Social Studies classrooms. The main effect of gender was marginally non-significant, $F(1, 110) = 3.657$, $p = .058$, suggesting a borderline trend towards female students outperforming male students overall, though this did not reach statistical significance. The overall model ($R^2 = .410$) explained 41.0% of the total variance in posttest performance, confirming a robust overall model fit.

The finding implies that Social Studies teachers can confidently adopt both strategies in mixed-gender classrooms without concern for gender bias. The borderline gender trend, while not significant, warrants continued monitoring and suggests that some targeted academic support for male Social Studies learners may be beneficial. This result is consistent with Falade (2021) and Olodi and Adeyemi (2020), who found no significant gender differences in Social Studies performance under learner-centred instructional conditions in Nigeria, and partially corroborates the gender-equity finding of the present study's broader PhD thesis context. It contrasts slightly with Okoye, Ikwuka and Akudolu (2024), who noted gender-differentiated performance patterns under peer-tutoring in English Language — a difference attributable to the subject-specific nature of gender dynamics in language versus social studies contexts.

VI. CONCLUSION AND RECOMMENDATIONS

This study provides robust empirical evidence that both computer-based concept mapping and the flipped classroom instructional strategy significantly improve Upper Basic Social Studies students' academic performance relative to the conventional lecture method in Ilorin, Kwara State, Nigeria. The flipped classroom emerged as the more effective of the two strategies, producing a very large effect size (partial $\eta^2 = .372$, $F(1, 80) = 47.303$, $p = .000$) and an adjusted posttest mean of 82.78 — significantly higher than both the Concept

Mapping (adj. $M = 67.57$) and Control (adj. $M = 46.38$) groups. Computer-based concept mapping also produced a significant large effect (partial $\eta^2 = .197$, $F(1, 83) = 20.339$, $p = .000$), with the concept-mapping group recording the largest absolute mean gain of 16.09 score points. The Scheffé post-hoc test confirmed a statistically significant three-tier hierarchy: Flipped Classroom > Concept Mapping > Conventional Method, with all pairwise differences significant at .05. Neither strategy interacted significantly with gender ($F(2, 110) = 0.773$, $p = .464$), confirming that both are gender-equitable strategies suitable for mixed-gender classrooms. These findings collectively affirm that the systematic adoption of both strategies in Upper Basic Social Studies instruction in Kwara State holds substantial promise for addressing the persistent pattern of moderate performance documented in a decade of BECE results.

6.2 Recommendations

1. Social Studies teachers at the upper basic level in Ilorin should adopt the flipped classroom strategy as the primary learner-centred instructional strategy for Social Studies, given its significantly superior effect size over both conventional instruction and concept mapping. Where reliable ICT infrastructure is available, flipped classroom should be the preferred strategy.
2. Computer-based concept mapping should be adopted by Social Studies teachers as a highly effective alternative strategy, particularly for topics requiring conceptual organisation — such as governance, citizenship and civic rights — and in schools where full flipped classroom implementation is constrained by ICT resource limitations.
3. The Kwara State Ministry of Education and UBEB should design and implement state-wide teacher professional development programmes equipping Social Studies teachers with the skills to develop pre-class digital materials for the flipped classroom and to facilitate computer-based concept mapping using tools such as CmapTools.
4. School administrators and government educational agencies should prioritise the provision of ICT infrastructure — computers, projectors, internet access and digital learning platforms — in upper basic schools in Kwara State, as a foundational prerequisite for the sustained implementation of both computer-based concept mapping and flipped classroom strategies.
5. Curriculum planners at NERDC should embed both computer-based concept mapping and

flipped classroom as recommended primary instructional approaches in the Social Studies curriculum framework and teachers' guides for Upper Basic Education, so that their adoption becomes institutionalised rather than dependent on individual teacher initiative.

6. Since both strategies were equally effective for male and female students, teachers should adopt them confidently in mixed-gender classrooms. However, the borderline gender trend ($p = .058$) warrants attention: schools should provide additional academic support and monitoring for male Social Studies learners to address any emerging performance gap.

6.3 Limitations and Suggestions for Further Studies

This study has five limitations. First, the quasi-experimental design with intact classes cannot fully eliminate pre-existing differences beyond academic performance, despite ANCOVA adjustment. Second, the Flipped Classroom group entered with a higher pretest mean (72.45) than other groups, which, while statistically controlled, may reflect unmeasured differences in motivation, study habits, or home ICT access. Third, the sample from three schools in Ilorin limits generalisability across Kwara State and Nigeria. Fourth, no delayed retention test was given, so long-term performance durability is unknown. Fifth, the study focused only on academic performance and did not explore attitude, motivation, or critical thinking skills.

Future studies should replicate this investigation across multiple local government areas and states in Nigeria. Future studies should employ longitudinal designs incorporating delayed retention tests. Studies should examine the combined use of concept mapping and flipped classroom in the same instructional cycle, for example, using concept maps as pre-class activities within a flipped classroom framework to determine whether integrated approaches produce greater gains than either strategy alone. Future research should also examine the effect of both strategies on students' civic engagement, critical thinking skills and attitude towards Social Studies, beyond academic performance.

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