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Students' Learning Interest, Academic Achievement and Learning Retention in College Physics as observed from Flipped Classroom Learning Strategy and Traditional Lecture Method

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ABSTRACT

This study examined students' learning interest, academic achievement and learning retention in college physics based on Flipped Classroom Learning Strategy (FCLS) and Traditional Lecture Method (TLM). The study adopted quasi-experimental research design with a study sample of 60 physics students (200L and 300L) drawn using purposive sampling technique from department of physics, Federal College of Education, Abeokuta. The students were assigned as experimental group for PHY 222 and PHY 322 courses and as control group for PHY 223 and PHY 323 courses. The experimental and control groups were taught using FCLS and TLM, respectively. Data were collected through a validated Students' Learning Interest Scale, Flipped Classroom-Physics Achievement Test, Traditional Lecture-Physics Achievement Test, Flipped Classroom-Physics Retention Test and Traditional Lecture-Physics Retention Test with reliability coefficients, r = 0.81, 0.82, 0.79, 0.78, 0.76, respectively, obtained using Cronbach Alpha. Collected data were analyzed using mean, standard deviation and t-test statistics at 0.05 significance level. The result showed that (i) FCLS significantly enhanced students' learning interest and academic achievement in college physics better than the TLM. (ii) FCLS enhanced academic achievement in male physics students better than their female colleagues taught using FCLS, but no significant difference was observed between them, (iii) FCLS positively influence students' learning retention in college physics better than the TLM, but no significant difference was observed between them. We therefore recommend that school authorities should organize training workshops for science lecturers on the use of FCLS for teaching-learning of physics and other sciences.

Keywords: Physics, Flipped Classroom, Learning Interest, Academic Achievement, Learning Retention.

1.0 Introduction

Flipped classroom Learning Strategy (FCLS) is an educational innovative learning model which provides a different teaching-learning process and effectively employs technology. It helps students to effectively participate in the teaching-learning process and to motivate them to study prior to class study time. Flipped classroom Learning Strategy (FCLS) incorporates video lessons, significant interactive activities with lessons which are student-centered, supporting active learning, increasing class study time, providing a richer and more flexible learning environment through technological infrastructure. In FCLS, theoretical knowledge is taught to students by means of videos in out-of-class study time, leaving rooms for academic assessments and other learning activities to be conducted during class study time. With FCLS, students can learn their lessons whenever and wherever they want before coming to school.

In the FCLS, lectures can be replaced by online videos using various screen capture technologies allowing students to use class time for active learning where there is repetition of problem solving, conceptual understanding, and application of what they are learning by practicing with other classmates through group activities and collaboration (Simon, 2013; Cupak & Riabov, 2017). These videos, according to Cupak & Riabov, (2017) and Elazab & Alazab, (2015) contain explanation of concepts, examples and problem walk throughs, while the in-class activities are designed to answer questions or uncover common misconceptions, discuss complex topics, and work with students. Class activities also contain tasks which help students to learn and practice skill sets for mastery of concepts. In this learning environment, students get immediate real-time feedback from other students and faculty during class (Mithun & Evans, 2018). In the FCLS, emphasis is placed on teaching students active learning, their participation and involvement is required to move from lower order thinking skills to the acquisition of higher order thinking skills (Erol, 2020; Zou, 2020), leading to a benefit when they are asked to inquire, search for information, analyze a content and express their point of view (Mohamed & Lamia, 2020), favoring their critical thinking (Al-Samarraiel, Shamsuddin & Alzahrani, 2019), which fosters the development of their learning to learn competence (Cerea, 2019).

According to Mithun & Evans (2018), FCLS enables students receive guidance from instructors as well as fellow students, thus increasing student engagement and facilitates exchange of ideas with fellow students. In summary, FCLS provides opportunity for depth without sacrificing content (Davenport, 2018). FCLS encourages social interaction among students, which is also a useful skill for students' future careers (Elazab & Alazab, 2015)

and also demonstrated higher teacher satisfaction compared to the traditional model (Unal & Unal, 2017). Students often considered it more effective and engaging than the traditional lecture-based approach (Davenport, 2018; Paez, 2017). Thus, FCLS has the capability to supports individual self-paced learning, creates time to fulfil active learning activities, enables students to undertake their responsibilities to learn, could ensures cooperative learning among students. Furthermore, FCLS if properly implemented could offers rich and accessible learning materials that could make learning long-lasting.

However, research on flipped classrooms shows that positive outcomes from flipped learning models depend on its design (Kerr, 2015; Liu, Ripley, & Lee, 2016) with its success requiring significant effort and time on the part of the class instructor, faculty or teacher in charge (Elazab & Alazab, 2015). Instructional design plays a very important role in student's experience and performance, thus presently, to design a successful flipped classroom, educators include various factors such as a pre-recorded video lecture with pre-class activity, a follow-up quiz on the pre-class work, an in-class activity, and an in-class group activity (Mithun & Evans, 2018). Studies (Kerr, 2015; Elazab & Alazab, 2015) show that the following factors have significant impact on the success of a flipped classroom model: (1) out-of-class and in-class elements must be carefully integrated for students to understand the model and be motivated to prepare for class; (2) shorter, rather than longer videos; and (3) pre-class activities must be coupled with quizzes or follow-up tasks to assess the student's understanding.

Previous research findings have indicated that FCLS has had a positive impact on students' learning, engagement, performance, and retention (Kerr, 2015; Estes, Ingram, & Liu, 2014; Bachnak & Maldonado, 2014; Liu, 2015; Balaban, Gilleskie, & Tran, 2016). More recently, some experimental studies have found that students under the FCLS gained better learning performance (e.g., Alamri, 2019; Jdaitawi, 2019; Kazanidis, Pellas, Fotaris, & Tsinakos, 2019; Martinez, Diaz, Rodriguez, & Garcia, 2019). Other benefits of FCLS are improving students' engagement (Cronhjort, Filipsson, & Weurlander, 2017), their motivation towards the activities to be performed (Chyr, Shen, Chiang, Lin, & Tsia, 2017), linked to their responsibility, interest and commitment (Bouwmeester, De Kleijn, De Berg, Cate, Rijen, & Westerveld, 2019), regulating their learning pace (Chyr *et al*., 2017; Tse, Choi, & Tang, 2019) and improving the resolution of problems and situations posed during the teaching and learning process (Bognar, Sablić & Škugor, 2019). The FCLS methodology increases student satisfaction (Xiu, Moore, Thompson, & French, 2019), which has also influenced cooperative learning as knowledge enhancement (Chan, 2018), encourages interactions (McLean & Attardi, 2018) and creativity (Huang, 2020). According to Tarik & Servinc (2019), successful implementation of FCLS depends on knowing students' perceived value with regard to in-class and out-of-class study time, their efforts in learning activities, relationships and interactions with their friends and teachers, their acquisitions and feelings stemming from training, involvement and encountered difficulties in these activities.

1.1 Statement of the problem

Low Academic Achievement in science has now become a generational concern and to an extent a choiceless situation among school authorities, parents, guardians and even examination bodies for years now. This is because poor academic achievement can hinder or limit the future success of the students, parents/guardians, and the country's economic and developmental growth as well (Mokuolu & Olowookere, 2022). Several teaching strategies are employed by teachers but still, the problem seems to persist both in secondary schools and tertiary institutions. This therefore necessitates the need for this study.

1.2 Purpose of the study

This study aimed at examining the effect of Flipped classroom Learning Strategy (FCLS) and Traditional Lecture Method (TLM) on students' learning interest, academic achievements and learning retention in college physics.

1.3 Research hypotheses

$H0_1$: There is no significant difference in the learning interest of physics students taught using Flipped Classroom Learning Strategy (FCLS) and those taught using Traditional Lecture Method (TLM).

$H0_2$: There is no significant difference in the academic achievement of physics students taught using Flipped Classroom Learning Strategy (FCLS) and those taught using Traditional Lecture Method (TLM).

$H0_3$: There is no significant difference in the academic achievement of physics students by gender when taught using Flipped Classroom Learning Strategy (FCLS).

$H0_4$: There is no significant difference in the learning retention of physics students taught using Flipped Classroom Learning Strategy (FCLS) and those taught using Traditional Lecture Method (TLM).

2.0 Methodology

2.1 Research design, Population and Sample

This study adopted a quasi-experimental design with control and experimental groups in intact classes with similar academic and social characteristics. The target population for the study includes all physics students from 100L - 300L in the department of physics, School of Secondary Education (Science),

Federal college of Education, Abeokuta, Ogun State, Nigeria. The study sample consists of twenty-seven (27) 200L physics students (also known as 2nd year students) and thirty-three (33) 300L physics students (also known as 3rd year students), making a total of 60 (200L and 300L) physics students drawn using purposive sampling technique from department of physics, Federal College of Education, Abeokuta. The sample students were assigned as experimental group for PHY 222 (Atomic and Quantum Physics I) and PHY 322 (Atomic and Quantum Physics II) courses and as control group for PHY 223 (Basic and Digital Electronics) and PHY 323 (Electromagnetism III) courses.

2.2 Research instrument, Validity and Reliability

The research instruments used for this study are Students' Learning Interest Scale (SLIS), Flipped Classroom-Physics Achievement Test (FC-PAT), Traditional Lecture-Physics Achievement Test (TL-PAT), Flipped Classroom-Physics Retention Test (FC-PRT), Traditional Lecture-Physics Retention Test (TL-PRT). The SLIS is a 15-item questionnaire developed by the researcher to measure the students' learning interest towards the courses taught using FCL and TLM. Responses to the SLIS items were based on 4-point Likert scale of Strongly Agree (SA = 4 points), Agree (A = 3 points), Disagree (D = 2 points) and Strongly Disagree (SD = 1 point). The FC-PAT and TL-PAT are assessment tests developed by the researchers to measure the academic effectiveness of FCL and TLM, respectively. The FC-PAT consists of 50 multiple choice questions selected from PHY 222 (Atomic and Quantum Physics I) and PHY 322 (Atomic and Quantum Physics II) topics. The TL-PAT also consists of 50 multiple choice questions selected from PHY 223 (Basic and Digital Electronics) and PHY 323 (Electromagnetism III) topics. The minimum and maximum scores for FC-PAT and TL-PAT are 1 and 50 marks, respectively. The FC-PRT and TL-PRT are also assessment tests developed by the researchers to measure students' learning retention ability based on FCL and TLM applied on them, respectively. The FC-PRT consists of 40 multiple choice questions selected from PHY 222 and PHY 322 topics (just like the FC-PAT). Similarly, the TL-PRT also consists of 40 multiple choice questions selected from PHY 223 and PHY 323 topics (just like the TL-PAT). In essence, FC-PRT and TL-PRT has similar questions to that of FC-PAT and TL-PAT, respectively but not exactly the same.

The instruments (SLIS, FC-PAT, TL-PAT, FC-PRT, TL-PRT) were validated by expert colleagues in physics, test measurement and evaluation in Federal college of Education, Abeokuta, Ogun State, Nigeria and all necessary corrections were effected on them. The instruments were pilot tested and Cronbach Alpha was used to establish the reliability coefficients (SLIS: r = 0.81, FC-PAT: r = 0.82, TL-PAT: r = 0.79, FC-PRT: r = 0.78, TL-PRT: r = 0.76).

2.3 Study treatment, Data collection and Analysis

The teaching-learning activities were conducted for 1½ months with the experimental group (PHY 222 and PHY 322 courses) taught using the FCLS while the control group (PHY 223 and PHY 323 courses) was taught using the TLM. The SLIS was administered to all study students immediately at the end of teaching-learning activities. Again, the FC-PAT and TL-PAT were administered to the experimental and control groups, respectively, after one week of completion of the teaching-learning activities. Likewise, the FC-PRT and TL-PRT were administered to the experimental and control groups, respectively, after four weeks of completion of the teaching-learning activities. It is worth noting that all instruments (SLIS, FC-PAT, TL-PAT, FC-PRT and TL-PRT) were administered under strict examination conditions so as to avoid cheating and individual responses to the instruments being influenced by others. Collected data were subjected to statistical analyses such as mean, standard deviation and t-test statistics at 0.05 significance level using SPSS software.

3.0 Result and Discussion

3.1 Research hypothesis 1

There is no significant difference in the learning interest of physics students taught using Flipped Classroom Learning Strategy (FCLS) and those taught using Traditional Lecture Method (TLM).

Table 1: t-test results of students' learning interest when exposed to FCLS and TLM

Group	Teaching method	N	MS_{LI}	SD	MSD	df	t_{cal}	t_{crit}	Rmk.
Experimental (PHY 222 + PHY 322)	FCLS	60	4.29	3.91	1.87	118	2.10	1.99	*Sig.
Control (PHY 223 + PHY 323)	TLM	60	2.42	5.67					

MS_{LI} = Mean Score of Students' Learning Interest, MSD = Mean Score Difference, *Sig. = Significant

Table 1 showed the results of students' learning interest when exposed to FCLS and TLM. The table revealed that physics students taught using FCLS had higher learning interest (**MS_{LI}** = 4.29) than those taught using TLM (**MS_{LI}** = 2.42). The t-test analysis conducted also revealed a calculated t-test value (**t_{cal} = 2.10**) that is greater than the t-test critical value (**t_{crit} = 1.99**) at α = 0.05 significant level. With this result, the hypothesis is rejected. This implies that there is a significant difference in the learning interest of physics students taught using FCLS and those taught using TLM.

3.2 Research hypothesis 2

There is no significant difference in the academic achievement of physics students taught using Flipped Classroom Learning Strategy (FCLS) and those taught using Traditional Lecture Method (TLM).

Table 2: t-test results of students' academic achievement when taught using FCLS and TLM

Group	Teaching method	N	MS_{AA}	SD	MSD	df	t_{cal}	t_{crit}	Rmk.
Experimental (PHY 222 + PHY 322)	FCLS	60	41.85	8.36	7.93	118	4.59	1.99	*Sig.
Control (PHY 223 + PHY 323)	TLM	60	33.92	10.47					

MS_{AA} = Mean Score of Academic Achievement, MSD = Mean Score Difference, *Sig. = Significant

Table 2 showed that physics students taught using FCLS had higher academic achievement (**MS_{AA} = 41.85**) than those taught using TLM (**MS_{AA} = 33.92**). The t-test result from the table showed a calculated t-test value (**t_{cal} = 4.59**) that is greater than the t-test critical value (**t_{crit} = 1.99**) at $\alpha = 0.05$ significant level. Thus, the hypothesis is rejected. This implies that there is a significant difference in the academic achievement of physics students taught using FCLS and those taught using TLM.

3.3 Research hypothesis 3

There is no significant difference in the academic achievement of physics students by gender when taught using Flipped Classroom Learning Strategy (FCLS).

Table 3: t-test results of students' academic achievement by gender when taught using FCLS

Group	Gender	N	MS_{AAg}	SD	MSD	df	t_{cal}	t_{crit}	Rmk.
Experimental (FCLS)	Male	32	42.93	8.02	2.16	58	1.00	2.00	*NS
	Female	28	40.77	8.70					

MS_{AAg} = Mean Score of Academic Achievement by gender, MSD = Mean Score Difference, *NS = Not Significant

Table 3 results showed that the male physics students taught using FCLS had higher academic achievement (**MS_{AAg} = 42.93**) than their female colleagues (**MS_{AAg} = 40.77**) taught using the same method with a small mean score difference (**MD = 2.16)**. The t-test analysis conducted based on these results indicated a calculated t-test value (**t_{cal} = 1.00**) which is lesser than the t-test critical value (**t_{crit} = 2.00**) at $\alpha = 0.05$ significant level. Therefore, the hypothesis is accepted. This implies that there is no significant difference in the academic achievement of male and female physics students taught using FCLS.

3.4 Research hypothesis 4

There is no significant difference in the learning retention of physics students taught using Flipped Classroom Learning Strategy (FCLS) and those taught using Traditional Lecture Method (TLM).

Table 4: t-test results of students' learning retention when taught using FCLS and TLM

Group	Teaching method	N	MS_{LR}	SD	MSD	Df	t_{cal}	t_{crit}	Rmk.
Experimental (PHY 222 + PHY 322)	FCLS	60	18.69	9.55	1.05	118	0.63	1.99	*NS
Control (PHY 223 + PHY 323)	TLM	60	17.64	8.81					

MS_{LR} = Mean Score of students' learning retention, MSD = Mean Score Difference, *NS = Not Significant

Table 4 showed the mean scores of physics students' learning retention for those exposed to FCLS and TLM. As indicated by table 3, the physics students taught using FCLS had a slightly higher learning retention (**MS_{LR} = 18.69**) than those taught using TLM (**MS_{LR} = 17.64**) with a mean score difference of 1**.05**. The table further revealed a calculated t-test value (**t_{cal} = 0.63**) that is smaller than the t-test critical value (**t_{crit} = 1.99**) at $\alpha = 0.05$ significant level. With this result, the hypothesis is therefore accepted. This implies that there is no statistically significant difference in the learning retention of physics students taught using FCLS and those taught using TLM, even though those taught using FCLS had higher learning retention score than those taught using the TLM.

3.5 Discussion

Results obtained from this study revealed that physics students exposed to Flipped Classroom Learning Strategy (FCLS) exhibited higher learning interest compared to those exposed to the Traditional Lecture Method (TLM). The t-test analysis then showed a significant difference in the learning interest of physics students exposed to FCLS and those exposed TLM. This may be due to the attractive nature of the videos and other interactive sections of the FCLS, leading to direct consequential effect on their academic achievement as revealed in this study. In a similar manner, physics students taught using FCLS performed academically better than their colleagues taught using the TLM, with the t-test analysis indicating a statistically significant difference between them. Gender effect of FCLS in this study also showed that male and female physics students exposed to FCLS exhibited no significant difference in their academic achievement even though the male physics students performed slightly better than their female colleagues. With these results, it therefore safe to say FCLS is not gender biased, with clear capability of improving both male and female cognitive abilities. In all, FCLS has proved to be a better teaching strategy for improving students' academic achievements compared to the TLM. These results agrees with findings of Alamri (2019); Jdaitawi (2019); Kazanidis *et al.,* (2019); Tarik & Sevinc (2019), Shao & Liu (2021), Torres-Martin, Acal, El-Homrani, & Mingorance-Estrada (2022) and Ugwuanyi (2022) who all found FCLS to have a positive effect on academic achievement and thus is effective in enhancing students' academic achievement and in teaching-learning processes. Torres-Martin *et al.,* (2022) in their study results observed that apart from improving academic performance, FCLS also effectively promotes students' interest, their capacity for autonomous learning and personal and cooperative relationships. Ugwuanyi (2022) in a separate study observed that flipped classrooms influence academic performance, and is an effective and active learning technique for learning and student interest, as well as for motivation and engagement, and improvement of critical thinking skills.

Again, physics students exposed to FCLS was observed to have a slightly higher learning retention compared to those exposed to TLM, but t-test analysis indicated no significant difference in learning retention existed between them. This result agrees with the finding of Bouwmeester *et al.,* (2019) who in their study found no significant difference in the retention of knowledge between medical students exposed to FCLS and those exposed to TLM. This finding however contradicts the works of Day (2018); Ahmad, Ehsan, & Ahma (2020); Sirakaya & Ozdemir (2018); and Forster, Maur, Weiser, & Winkel (2022) who all in their studies observed significant difference in retention of knowledge between students exposed to FCLS and those exposed to the conventional method.

4.0 Conclusion

Flipped Classroom Learning Strategy (FCLS) and Traditional Lecture Method (TLM) were compared in this study, in relation to students' learning interest, academic achievements and learning retention in college physics. The study concludes that:

(i) FCLS significantly enhanced students' learning interest and academic achievement in college physics better than the TLM.

(ii) FCLS enhanced academic achievement in male physics students better than the female physics students taught using FCLS, but no significant difference was observed between them.

(iii) FCLS positively influence students' learning retention in college physics better than the TLM, but no significant difference was observed between them.

Recommendations

This study therefore recommends that school authorities and other stakeholders in education should: (i) organize training workshops and seminars for science lecturers on the use of FCLS in teaching-learning of sciences (ii) support lecturers with facilities needed to use FCLS for teaching-learning of physics and other sciences (iii) encourage and ensure science lecturers use FCLS in their teaching-learning activities.

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References

Ahmad Noroozi, Ehsan Rezvani, & Ahma Ameri-Golestan (2020). The effect of flipped classrooms on L2 Learners' development and retention of grammatical knowledge. *Turkish Online Journal of Distance Education*, 21(4), 14-30.

Alamri, M. M. (2019). Students' Academic Achievement Performance and Satisfaction in a Flipped Classroom in Saudi Arabia. *International Journal of Technology Enhanced Learning*, 11, 103-119. https://doi.org/10.1504/IJTEL.2019.096786

Al-Samarraiel, H., Shamsuddin, A., & Alzahrani, A. I. (2019). A flipped classroom model in higher education: A review of the evidence across disciplines. *Educational Technology Research and Development*. https:// doi. org/ 10. 1007/ s11423- 019- 09718-8

Bachnak R. & Maldonado, S. C. (2014). A Flipped Classroom Experience: Approach and Lessons Learned, *proceedings of the 121st ASEE Annual Conference & Exposition*, Indianapolis, IN, June 15-18, 2014.

Balaban, R. A., Gilleskie, D. B. & Tran, U. (2016). A quantitative evaluation of the flipped classroom in a large lecture principles of economics course. *The Journal of Economic Education*, 47 (4), pp. 269–287.

Bognar, B., Sablić, M., & Škugor, A. (2019). Flipped learning and online discussion in higher education teaching. In C. Reidsema, L. Kavanagh, R. Hadgraft, & N. Smith (Eds.), *The flipped classroom: Practice and practices in higher education* (1st ed., pp. 371–392). Springer.

Bouwmeester R. A. M., De Kleijn R. A. M., De Berg Ing ET Van, Cate Olle Th J Ten, Rijen Harold V. M. & Westerveld Hendrika E. (2019). Flipping the Medical Classroom: Effect on workload, interactivity, motivation and retention of knowledge. *Computers & Education*, 139, 118-128.

Cerea, N. (2019). The flipped classroom in university learning environments: Case study of the course journalism and social media. In *Learning, innovation and cooperation as drivers of methodological change, proceedings of the V international congress on learning, innovation and cooperation. CINAIC*. https:// doi. org/ 10. 26754/ CINAIC.

Chan, C. C. (2018). The relationship among social support, career self-efficacy, career exploration, an career choices of Taiwanese college athletes. *Journal of Hospitality, Leisure, Sports and Tourism Education, 22*, 105–109. https:// doi. org/ 10. 1016/j. jhlste. 2017. 09. 004

Chyr, W. L., Shen, P. D., Chiang, Y. C., Lin, J. B., & Tsia, C. W. (2017). Exploring the effects of online academic help-seeking and flipped learning on improving students' learning. *Journal of Educational Technology & Society, 20*, 11–23.

Cronhjort, M., Filipsson, L., & Weurlander, M. (2017). Improved engagement and learning in flippedclassroom calculus. *Teaching Mathematics and Its Applications: An International Journal of the IMA, 37*(3), 113–121. https:// doi. org/ 10. 1093/ teamat/ hrx007

Cupak, J. J. & Riabov, V. V. (2017). Applying "flipped classroom" methodology in computer science courses. *Rivier Academic Journal*, 13(2), 1-6.

Davenport, C. E. (2018). Evolution in Student Perceptions of a Flipped Classroom in a Computer Programming Course. *Journal of College Science Teaching*.

Day, Leslie J. (2018). A gross anatomy flipped classroom effects performance, retention and higher-level thinking in lower performing students. *Anatomical Sciences Education*, 11(6), 565-574.

Elazab, S. & Alazab, M. (2015). The Effectiveness of the Flipped Classroom in Higher Education, *2015 Fifth International Conference on e-Learning*, Manama, Bahrain, 18-20 October..

Erol, A. N. (2020). Using the flipped classroom model in the history course: A learning experience. *International Journal of Educational Methodology, 6*(1), 113-121.

Estes, M., Ingram, R. & Liu, J. C. (2014). A review of flipped classroom research, practice, and technologies. *International Higher Education Teaching & Learning Review*.

Forster Manuel, Maur Andreas, Weiser Constantin & Winkel Kirsten (2022). Pre-class video watching fosters achievement and knowledge in a flipped classroom. *Computers & Education*, 179, 104399.

Huang, C. E. (2020). Discovering the creative processes of students: Multi-way interactions among knowledge acquisition, sharing and learning environment. *Journal of Hospitality, Leisure, Sport & Tourism Education, 26*, 1–14. https:// doi. org/ 10. 1016/j. jhlste. 2019. 100237.

Jdaitawi, M. (2019). The Effect of Flipped Classroom Strategy on Students Learning Outcomes. *International Journal of Instruction*, 12, 665-680. https://doi.org/10.29333/iji.2019.12340a

Kazanidis, I., Pellas, N., Fotaris, P., & Tsinakos, A. (2019). Can the Flipped Classroom Model Improve Students' Academic Performance and Training Satisfaction in Higher Education Instructional Media Design Courses. *British Journal of Educational Technology*, 50, 2014-2027.

Kerr, B. (2015). The flipped classroom in Engineering Education: A survey of the research, *2015 International Conference on Interactive Collaborative Learning (ICL)*, Florence, Italy.

Liu, S. (2015). Teaching Engineering Computation Using a Flipped Classroom Model, *Proceedings of the 2015 ASEE North Central Section Conference*.

Liu, L., Ripley, D. & Lee, A. A. (2016). Flipped Learning and Influential Factors: Case Analysis. *Journal of Educational Technology Development and Exchange (JETDE):* 9(2), Article 5.

Martinez, T. S., Diaz, I. A., Rodriguez, J. M. R., & Garcia, A. M. R. (2019). Eficacia del Metodo Flipped Classroom en la Universidad: *Meta-Analisis de la Produccion Cientifica de Impacto. REICE. Revista Iberoamericana sobre Calidad, Eficacia y Cambio en Educacion*, 17, 25-38.

McLean, S., & Attardi, S. M. (2018). Sage or guide? Student perceptions of the role of the instructor in a flipped classroom. *Active Learning in Higher Education, 4*, 1–2.

Mithun Shamima & Evans Nancy. (2018). "Impact of the Flipped Classroom on Students' Learning and Retention in Teaching Programming". 2018 American Society for Engineering Education, (ASEE) Annual Conference & Exposition, June 24-27, Salt Palace Convention Center, Salt Lake City, UT, U.S.A.

Mohamed, H., & Lamia, M. (2020). Efficacy of the flipped classroom to teach the digital storytelling process. In F. Soares, A. P. Lopes, K. Brown, & A. Uukkivi (Eds.), *Developing technology meditation in learning evironments* (pp. 57–77). IGI Global.

Mokuolu, A. O. & Olowookere, I. O. (2022). Analysis of Locus of Control by Gender, Study Level and Academic Achievement among Physics Students in F.C.E, Abeokuta, Ogun State, Nigeria. *Journal of Science Education*, 16(1), 282-291. ISSN: 1118-1364. Published by School of Secondary Education (Science), Federal College of Education, Abeokuta, Ogun State, Nigeria.

Paez, N. M. (2017). "A Flipped Classroom Experience Teaching Software Engineering", *2017 IEEE/ACM 1st International Workshop on Software Engineering Curricula for Millennials (SECM)*, Buenos Aires, Argentina, pp. 16-20, May 20 - 28.

Shao, M. M., & Liu, X. H. (2021). Impact of the Flipped Classroom on Students' Learning Performance via Meta-Analysis. *Open Journal of Social Sciences*, 9, 82-109.

Simon, B. "Why the flip should I flip my classroom: Results on the use of peer instruction in computing courses," *Journal of Computing Sciences in Colleges*, 28(4), 92, 2013.

Sirakaya Alsancak Didem & Ozdemir Selcuk (2018). The Effect of a Flipped Classroom Model on Academic Achievement, Self-Directed Learning Readiness, Motivation and Retention. *Malaysian Online Journal of Educational Technology*, 6(1), 76-91.

Tarik Talan & Sevinc Gulsecen (2019). The effect of a flipped classroom on students' achievements, academic engagement and satisfaction levels. *Turkish Online Journal of Distance Education-TOJDE*, 20(4), 31-60.

Torres-Martin César, Acal Christian, El-Homrani Mohammed & Mingorance-Estrada Ángel C. (2022). Implementation of the flipped classroom and its longitudinal impact on improving academic performance. *Education Tech Research Dev*., 70, 909–929.

Tse, W. S., Choi, L. Y., & Tang, W. S. (2019). Effects of video-based flipped class instruction on subject reading motivation. *British Journal of Educational Technology, 50*, 385-398.

Ugwuanyi, C. S. (2022). Developing sound knowledge of basic science concepts in children using flipped classroom: A case of simple repeated measures. *Education and Information Technologies*.

Unal, Z. and Unal, A. (2017). "Comparison of Student Performance, Student Perception, and Teacher Satisfaction with Traditional versus Flipped Classroom Models", *International Journal of Instruction*, 10(4), 145-164.

Xiu, Y., Moore, M. E., Thompson, P., & French, D. P. (2019). Student perceptions of lecture-capture video to facilitate learning in a flipped classroom. *TechTrends, 63*(4), 369–375.

Zou, D. (2020). Gamified flipped EFL classroom for primary education: Student and teacher perceptions. *Journal of Computers in Education, 7*, 213-228. https:// doi. org/ 10. 1007/ s40692-