Impact of teaching methodologies used in teaching computer science on the performance of senior secondary school students

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Abstract
Computer Science is relatively new in the science courses that are expected of senior secondary students that offer sciences in the West African Examinations Council (WAEC) and the National Examination Council (NECO) in Nigeria. In this report, the outcome of a primary quantitative and qualitative research on the impact of teaching methodologies on the performances of senior secondary school students on Computer Science in WAEC and NECO in selected secondary schools in Abakaliki Metropolis, Ebonyi State was presented. A mixed-method research methodology was adopted for the study. The data collection tools included questionnaire for the quantitative part and semi-structured interview for the qualitative component of the study. The data analysis was done using descriptive statistics for the former and thematic analysis for the latter. The research findings indicated that the teaching methodologies of the secondary school tutors impacted deeply on the performances of students, including motivating the students to continue with Computer Science as their career in the University. The students opined that a teaching methodology that gives room for effective communication between students and their teacher is of much importance to the understanding of computer science. Additionally teachers that use hands-on activities and demonstration of modelling including solving of simultaneous equations using excel packages are amongst the interesting and stimulating things that arouses their curiosity and boost students' performances. The research findings also show that cooperative learning, inquiry-based, explanation-based, demonstration-based, and discussion-based are amongst the teaching methodologies used in the study area. Cooperative learning methodology was adjudged as best from the research findings of this study. Overall findings from both research methodologies indicated that the senior secondary school students had preference for a well equipped information and communication technology (ICT) laboratory for more effective teaching and learning of computer science in secondary schools in the study area.

I.   Introduction
In Nigeria, Senior secondary school students are expected to sit for nine subjects of their choice including English Language and Mathematics irrespective of being a science or an arts inclined candidate (Aitokhuehi, & Ojogho, 2014). Students who hope to further their career in Computer Science typically add Computer Science as one of the subjects that will make up the nine subjects in order to enhance their chances of securing a place in Computer Science course in the University. According to the literature (Indrinal, 2022; Oladejo, Akinola & Nwaboku, 2021), teaching methodologies serves as a fundamental tool in the delivery of knowledge to students at all levels of learning institutions (kindergarten, primary, secondary school, or University). The teaching methodology adopted by the teacher contributes immensely in enhancing the understanding of the subjects by the students. In recent years, research in education has laid more emphasis on the use of teaching methods which can be used to enhance teaching and learning due to the fact that senior secondary school students learn more when the teacher use teaching methods that will enable them to comprehend ICT concepts better, including using the computer to perform simple tasks. It has been observed that the knowledge of computer science is very important to national development especially in this computer age, yet secondary schools students' performance in this subject at secondary level has not been very encouraging.

II.   Literature Review
In Nigeria, teaching computer science subject in the Senior Secondary School level requires effective methods that will actively engage students and facilitate students' interest in computer science, data science, computer engineering, computer and software applications, including in information communication and

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technology. The use different methodologies have been deployed by educators to increase understanding, critical thinking, and practical application of computer science concepts. This literature review examines prominent methodologies (Cooperative learning strategies, inquiry-based learning, Experiential learning, and concept mapping amongst others) used in teaching computer science subjects in Senior Secondary Schools, highlighting their effectiveness and implications for student learning outcomes. According to the literature (Gambari & Yusuf, 2016), cooperative learning methods enhance peer interaction, collaboration, and shared responsibility along the learning process. By the use of group discussions, problem-solving tasks, and collaborative projects, students acquire effective communication skills, effective teamworking, and a sense of team achievement (Gambrari, Yusuf & Thomas 2015). Cooperative learning gives room for student engagement and motivation, thereby yielding to enhanced academic performance in the subjects offered by the students (). There are ample evidences that teaching of science subjects in senior secondary schools by the use of cooperative learning is a successful approach. As evidenced in the literature (Gambari & Yusuf, 2016), engineering the students to reason and think critically, solve problems, and conduct scientific research is one of the major merits of the use of cooperative learning in science classes in senior secondary schools. Also, added with boosting the enthusiasm and engagement of students, cooperative learning exceeds standard lecture-based teaching methodologies (Boleng & Corebima, 2014). The use of cooperative learning methodology, paves way for secondary school students to learn from each another and develop a deeper understanding of science subject related topics through self encouragement, team encouragement, and team collaboration, leading to exchange of ideas and knowledge. In lieu, teaching of computer science is both innovative and inspiring because of the novel nature of the subject. It is in this viewpoint that Sani (2015) argued that while there are always challenges in the area of science at senior secondary schools, educators and researchers are always looking for new and efficient strategies to improve student outcomes and accomplishment through modification of teaching methodologies to a more student-centred approach. Cooperative learning methods generally help to arouse students interest in ways that traditional learning are not always capable of. Through cooperative learning methods, students are given the opportunity to enhance their social skills, critical thinking skills, communication skills, and problem-solving capacities (Olabiyi & Awofala, 2019). In traditional based learning techniques, students have a passive role to play. Inquiry-based learning methods helps students to actively explore computer science concepts using questioning, investigation, and problem-solving methods. However, through engagement in hands-on activities, experiments, and real-world applications, students develops better comprehension of computer science principles through the Cooperative learning methods (Udu, 2018). Conversely, some authors (Brumann, Ohl & Schulz 2022) argue that inquiry based learning instills more curiosity, critical thinking, collaboration, and promotion of a student-centered approach to learning activities.

III.   Research Methodology

Research methodology typically refer to all the strategies that was employed by the researcher in order to address the research question, research topic, or to gain a new knowledge (Lester, 2023). The research methodology that was chosen for a particular study will in turn, determine the type of data collection instruments to be used (LaMarre & Chamberlain, 2022). In primary qualitative or quantitative research, a first-hand information is obtained directly from the original source (the participants) by the researcher. For the qualitative aspect of the research, semi-structured interview was used as data collection instruments. Semi-structured interviews are widely appraised for being flexible (Parker, Scott & Geddes 2019), hence it will be utilised to obtain primary data that will give information on the experiences of the senior secondary students on the impact of teaching methodologies of the computer science tutors on their understanding of the subjects and on their performances in examination. The semi-structured interview was administered online in order to accommodate as many senior secondary school students as possible. Also the use of online mode enabled many senior secondary school students not to feel shy or be afraid to disclose information about how a particular tutor approaches or behaves in the classroom during computer science class. Purposive sampling was used to select the participants. Whether qualitative or quantitative research, purposive sampling is generally utilised to map out and show specific population groups that are identified to the area of interest of the researcher (LaMarre & Chamberlain, 2022). In this research, the sampling method that was used was the criterion and snowball sampling techniques. Criterion sampling are frequently employed to get as many participants that meets the main specifications or requirements of the researcher as possible (Palinkas et al., 2015). In the Criterion sampling, the criteria included: i) male or female senior secondary students in public or private school in Abakaliki Metropolis, (ii) male or female senior secondary students in public or private school in Abakaliki Metropolis whose age was 18 years or above, iii) male or female senior secondary students in public or private school in Abakaliki Metropolis that is a science inclined student, and iv) male or female senior secondary students in public or private school in Abakaliki Metropolis that has been taking part is science inclined and has also been taking part in computer science subject including writing examination on it from senior secondary school 1 (SS1) to senior secondary school 3 (SS3). Snowball sampling in qualitative research helps the research

scholar to advertise the research by himself/herself, through the participants, or through words of mouth (Parker, Scott & Geddes 2019). In this light, through the Snowball sampling technique, I posted the research title to different social media accounts and also shared the information with other senior secondary students that may fit the criteria. Because snowball sampling equally allows for participants to recommend other potential participants to take part (Parker, Scott & Geddes 2019), the snowball sampling method assisted me to have access to as many potential participants as possible. Using the snowballing sampling technique, I was able to get participants that runs across different age group, which ranges from 18 years to 28 years. Furthermore, the snowballing sampling technique helped me to use word of mouth to attract many participants from diverse age range. Additionally, the intent for purposively employing an online approach of semi-structured interview in the study was to galvanise senior secondary students from: i) different socioeconomic settings (poor, middle-class, rich), ii) senior secondary school student from public or private secondary school within Abakaliki metropolis, iii) senior secondary school student of any status (disability, or no disability), and iv) senior secondary school students from different parenting status (single, divorced, husband and wife, adopted, etc) within Abakaliki metropolis. In this study, the sample size was two hundred and sixty (250) students. One hundred and thirty eight (138) were males whereas one hundred and twelve (112) were females. The population of students that were aged between 18 to 22 years was sixty five (65) percent, those aged between 23 to 25 years were ten (10) percent, and those that were aged between 25 to 28 years were twenty five (25) percent. Furthermore, one hundred and thirty (130) students were from public secondary school while the remaining one hundred and twenty (120) were from private secondary schools. The semi-structured interview was administered online using mobile phone. The semi-structured interview was composed of ten open–ended questions that was developed by me. The semi-structured interview was structured to last for fourty five (45) minutes. Further, the interview data, and the interviewees were all coded in order to ensure confidentiality of the information and that of the participants. In lieu, male secondary students from public secondary school was coded as MS, female secondary school student from public secondary schools as FS, male secondary school students from private secondary school was coded as MPS, and female secondary school student from private secondary schools was coded as FPS. Additionally, names of person used in this study are pseudonyms, in order to maintain the confidentiality and privacy of the teachers in the secondary schools selected for the study. For the qualitative research, data analysis was executed by the use of thematic analysis. In a primary qualitative research, thematic analysis serves as an empirical inductive approach to obtain information-rich data (Castleberry, A., & Nolen, 2018). A theme is an amalgam of coded data that are grouped together because of their relatedness, similarities or patterns. To search for a theme is mostly done in an open-ended manner. According to the literature (Clarke and Braun, 2017), thematic analysis identifies similarities and pattern in a data, and this helps to use the theme to address the research question (Terry et al, 2017). Through the descriptive analysis that was used to analyse the quantitative data, it was easy to identify the teaching methodology that yielded better outcome on the performances of the senior secondary school students in computer science subject.

IV.   Result and Discussion

As the research was conducted using a mixed-method approach, the results will be presented in the qualitative and quantitative forms. In lieu, the qualitative components will be reported through thematic analysis. The major themes that emerged from the study are: i) use of hands-on activities and demonstration of modelling including solving of simultaneous equations using excel packages are amongst the interesting and stimulating things that arouses curiosity and has helped in students' performances, ii) cooperative learning makes the students to enjoy computer science subjects and easily comprehends the teachers' lectures, iii) cooperative learning methods makes the senior secondary school students to develop more interest in learning computer science and to choose computer science as a career in the University, iv) cooperative learning helps to students foster critical thinking skills, develop emotional intelligence, and boost the academic performances of the students in their WAEC and NECO examinations. These themes can be seen clearly from the extracts of the interviewees as given in extracts 1 to 5 that were given as representative of the data.

Extract 1.
''Well, the truth is, I feel very happy anytime I see or remember Mr Tobby. The way he used to demonstrate his lectures made me to develop confidence and begin to use computer more effectively (MS1).

Extract 2.
''It was my friends; Jude, Joan, Chioma, Steve, and Dike who made understand how to use the keyboard more effectively. Our study group made me develop more confidence as I never knew I will do. The use of excel to solve simultaneous equation left serious fear in me the first day. Many thanks the Mrs Vicky and our study team who made move the milestone without pain. (FS1).
Extract 3.

''Yes, Yes, Yes, Cooperative learning is just very encouraging and helpful. If it were to be Mr Johnson style of constant questioning and long discussion and long notes taking on computer, I'm not sure, I would have performed very well in my WAEC and NECO. I wouldn't have even chosen it as my career in the university. Cooperative learning methodology from Mr Chris really helped our study team. I'm really proud of him. (MPS1).
Extract 4.
''I'm already opening trying to open a computer shop where I will sell the knowledge I already gained from Miss Tessy. The way she cooperates with us in her teaching not only includes understanding the subject but being able to repair a computer. Yes, I have learnt how to repair computer, do analysis, modelling, and many more. I can say it is only by cooperative learning. (FPS1).
Extract 5.
'' When Uncle Joe (the nickname we gave to our computer science teacher) was saying to us, through cooperative learning teaching methodology, you will all teach me and I will teach you all. I didn't appreciate the statement the first day but as time went on, I became a teacher of computer science to others. We enjoy his class more than the other story/discussion telling or questioning approach methods of other teachers. (FPS2).

As indicated earlier, the results of the quantitative components of the research will be presented in Tables 1 to 2.

Table 1. Preferences of students based on teaching methodologies of their teachers

S/No	Teaching methodology of the teachers	Number of senior secondary school students	Percentages
1	Cooperative learning	150	60
2	Discussion method	10	4
3	Explanation method	10	4
4	Demonstration-based	70	28
5	Inquiry-based	10	4

Table 2. Students' feelings on computer science subjects

S/No	Students' feelings	Number of senior secondary school students	Percentages
1	Very interesting and worthy of making a career	210	84
2	Not interesting and not worthy of making a career in	30	12
3	No comment	10	4

Figure 1 also presented the data given in Table 1 in a pie chart for quicker and clearer demonstration of the findings.
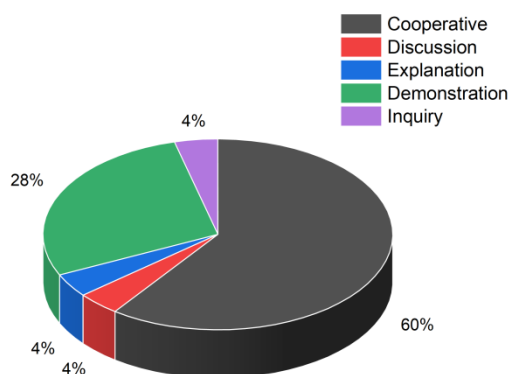
As shown on Table 1 and in Figure 1, sixty percent of the participants had preference for cooperative learning methodology. Cooperative learning is a teaching methodology which aims to organize classroom activities into academic and social learning experiences. The findings of this study is in line with that of Gambari and Yusuf (2014) which noted that teachers should be encouraged to use computer-supported cooperative strategies in the classroom for teaching physics concepts in secondary schools in the study area.

Cooperative learning methodology is widely shown to be best in teaching science subject in secondary school as evidenced in the literature (Aitokhuehi & Ojogho, 2014). The research findings obtained in this study is also in agreement with that of Udu (2018) which opined that cooperative learning significantly enhanced students' achievement in Organic Chemistry more than the Lecture method approach. Furthermore students were more motivated to pursue computer science as a career as indicated in Table 2. A very high percentage of eighty four as shown in Table 2, clearly indicates that good teaching methodology can lead to student motivation in that subject. This is because of the impact of the cooperative teaching methodology on those students. The findings from the quantitative component is in agreement with the qualitative aspect of this research work, and in line with the findings from the literature (Sani, 2015; Udu, 2018).

V. Conclusion

The study investigated the impact of teaching methodology on the performance of senior secondary school on computer science subjects in selected public and private secondary schools in Abakaliki metropolis in Ebonyi State. The findings showed that cooperative learning methodology was not only preferred by the students, but it also led to their being motivated to go into the study of computer science as a career in the university.

Acknowledgements

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