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A Comparative Study of Students Performance in Object Oriented Programming (OOP) Using Java Before and During COVID-19 (A Case of Kapasa Makasa Campus)

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To cite this article:
Kashale Chimanga, Nimrod Siluyele, Shumba Langton, Edward Nkonde. A Comparative Study of Students Performance in Object Oriented Programming (OOP) Using Java Before and During COVID-19 (A Case of Kapasa Makasa Campus). *American Journal of Networks and Communications*. Vol. 10, No. 1, 2021, pp. 1-5. doi: 10.11648/j.ajnc.20211001.11

Abstract: The purpose of this study was to compare the performance of students in Object Oriented Programming using Java before and during COVID-19 pandemic, to this effect a total of 66 students were selected to take part in the study and their results compared. The results revealed that the performance of students in OOP Java before COVID-19 pandemic outbreak were better than during the pandemic. The reasons for this was that, before the outbreak, the students were taught in physical class and were able to use the university facilities such as Internet and Computer laboratory for their practice. On the other hand, during the COVID-19 pandemic, students were subjected to virtual learning which proved to be a challenge to most of them, especially those in rural areas with no access to the Internet and electricity but affordability of the data bundles too. The study also established that gender had no effect on students' performance in OOP in Java regardless of the mode conclusion provided; the study recommended that deliberate measures should be put in place to encourage online learning in order to motivate learners in embracing technology in learning, more especially during this second wave of the COVID-19 pandemic. This will ensure continuity in learning without any major changes to the learning ability. In addition, more strategic interventions and pedagogies to teach practical courses such as programming online should be derived and used for teaching and learning so that students take advantage of both modes of studies (online and face to face).

Keywords: E-learning, Academic Performance, OOP, Java, Academic, COVID-19, Gender

1. Introduction

Zambia's education sector, just like that of other countries of the world had not been spared by the devastating effects of COVID-19 pandemic. According to [1], beginning in March 2020, when the country recorded the first case of COVID-19, education for more than 4.4 million children and adolescents got disrupted. The rapid increase in the cases of COVID-19 forced the government to enforce lockdown measures, which saw most institutions closed or operate virtually using e-learning. It involved utilization of electronic technologies to access educational curriculum outside of a traditional classroom. For Kapasa Makasa University Campus, various online learning platforms such as Moodle, Google Classroom, YouTube and Whatsapp were the major platforms utilized to support continuity of learning for students.

While it was much easier for some students to adapt to this change, it was not the case with the majority of the learners particularly those from rural areas with no access to electricity and Internet. Other researchers [3] also were also highlighted these challenges when they established that in remote and rural areas e-learning measures were far from ideal as learners without access to internet services and electronic devices could not actively participate in the online classes and this move had an adverse effect on their overall performance.

In some areas that are connected to the national grid, prolonged hours of load shedding affected the student's participation in e-learning and thereby affecting their participation in virtual learning. In addition, the lack of

electricity to power electronic gadgets in certain parts of the country further reduced access to e-learning platforms available for students and thereby affecting their overall performance. It is against this background that the current study was conducted to compare students 'performance in ICT, with the focus on Object Oriented Java programming before and during COVID-19 at Kapasa Makasa University Campus.

1.1. Statement of the Problem

The problem of the study is that, since the closure of schools due to the rapid spread of COVID-19pandemic, Kapasa Makasa University Campus continued to record poor performance of students in various courses and more especially in practical courses such as Object Oriented Programming (OOP Java). According to Coleman, G., O'Connor, R.: programming requires total commitment as it involves preparing the instructions of a computer program, running those instructions on the computer, testing the program to see if it is working properly and making corrections to that program whenever possible, [14],. It is based on this background that the study was conducted to compare the performance of students in Object Oriented Programming Java (OOP Java) before and during COVID-19pandemic.

1.2. Purpose of the Study

The purpose of this study was to compare the performance of students before and during COVID-19pandemic in order to determine whether or not there was variance in student performance during the two periods.

1.3. Objectives of the Study

i. To determine whether there is a statistically significant difference in academic performance of students before and during COVID-19pandemic in Object Oriented Programming (Java).
ii. To determine whether or not the performance of students in Java Programming during COVID-19 varied with respect to gender.

1.4. Research Questions

i. Is there a statistically significant difference in academic performance of students before and during COVID-19 pandemic in Object Oriented Programming (Java)?
ii. Does the performance of students in Java Programming during COVID-19 varied with respect to gender?

2. Review of Literature

The current pandemic caused by the worldwide spread of COVID-19 is being described as a global crisis without precedence. The imperative for education to respond to the "warnings of impending pandemics" had been noted – though only in one study we are aware of, [2].

According to Atchley, et al, [7] a situation was considered in which young men in Sweden have differing number of days to prepare for important tests. These differences are conditionally random allowing the authors to estimate a causal effect of schooling on skills. The authors show that even just ten days of extra schooling significantly raises scores on tests of the use of knowledge ('crystallized intelligence') by 1% of a standard deviation. As an extremely rough measure of the impact of the current school closures, if we were to simply extrapolate those numbers, twelve weeks less schooling (i.e. 60 school days) implies a loss of 6% of a standard deviation, which is non-trivial. They do not find a significant impact on problem-solving skills (an example of 'fluid intelligence'.

Other studies suggests that the improved outcomes among students who are home-schooled could be due to flexible instruction (without age-tracking), small "class sizes," and dedicated parent-teachers who should make home schooling more effective than other forms of education, [6]. He also notes that "educational outcomes may be skewed toward those on which the family has competence, and educational progress may be slow if there is no formative assessment or peer-pressure to learn (although home-school parents may exert more pressure or have higher expectations as a result of their supervision)." More recent studies suggest that parameters such as structured or unstructured instruction may also be important drivers of the results, [4].

Other studies have focused on the education-in-emergencies research that underscores that "contingency plans" are critical to dealing with emergency and post-emergency situations, [5]. Specifically during crises arising from war, conflicts, natural disasters, and pandemics, children are displaced often as homes, neighborhoods, and schools are destroyed and this may threaten survival or inflict some level of trauma upon school going children. A certain level of preparedness is critical in order to provide an effective response at the onset of a crisis, and to "prepare, cope, and recover", [13].

In Zambia, most learners were only able to study through online learning platforms. However, in remote and rural areas, including among migrant children, such distance learning measures were far from ideal as learners without Television sets, radios and internet services could not access such lessons. This was compounded by lack of affordability of data bundles to use in e-learning by most rural learners.

In some areas, the lack of electricity to power electronic gadgets further reduces access to distance learning platforms currently made available, [8]. The risk of gaps widened in learning was higher among children from families that can afford and those that could not afford to access facilities that enable remote learning modalities thereby affecting their performance.

Colleges and universities are now touting the efficiencies of Web-based education and are rapidly implementing online classes to meet student needs worldwide. One study reported "increases in the number of online courses given by universities have been quite dramatic over the last couple of years". Think tanks are also disseminating statistics on Web-

based instruction. "In 2010, the Sloan Consortium found a 17% increase in online students from the years before, beating the 12% increase from the previous year", [15].

Based on the above literature, it can be deduced that there is little or just limited studies conducted to compare the performance of students in Object Oriented programming before and during the COVID-19 pandemic. Therefore, this research was aimed at filling this knowledge gap.

3. Research Methodology

This section explains the research design used in the study, the population and sample, data collection, treatment of the experiment and statistical analysis techniques applied in the study.

3.1. Research Design

For the purpose of this study, a causal-comparative research design was used to determine whether or not there is a statistically significant difference in students' performance in Java programming before and during COVID-19. According to Parker White et al, [3], a causal-comparative research design is a research design that seeks to find relationships between independent and dependent variables after an action or event has already occurred. The students' performance in Java was the dependent variable in the study and the independent variable was the mode of learning (face to face before COVID-19 or virtual learning during COVID-19).

3.2. Method of Data Collection

For the purpose of this study, the researchers used both primary and secondary data. Secondary data gathered from different published reports by government sources, and other countries that have managed to successfully do some similar studies in attempting to compare the performance of students in different courses.

3.3. Population and Sample Size

The population for this study comprised 79 students (45 Male and 21 Female) drawn from two third year undergraduate classes for the Bachelor of Science in ICT with Education. The first class had a total of 36 students which was taught normally before the outbreak of COVID-19pandemic and the second class consisted of 43 students who were taught virtually during the pandemic outbreak. Out of the 79 participants, 13 students declined to participate in the study leaving only 66 participants. Therefore, the members from the two classes consisted the sample size for this study which came to 66

3.4. Sampling Design

Sampling is the procedure a researcher uses to gather people, places or things to study. It is a process of selecting a number of individuals or objects from a population such that the selected group contains elements representative of the characteristics found in the entire group, [9]. The researcher used simple random sampling technique to select the study participants. The participants were chosen from both the face to face object oriented programming class in Java and the virtual classes conducted during the COVID-19 pandemic.

3.5. Methods of Data Analysis

The data collected were analyzed and coded using the statistical package for social sciences (SPSS) version 2.0 software. The SPSS is a windows based program that can be used to perform data entry and analysis; and to create tables and graphs among other things.

In order to find out whether or not any significant differences existed between the students' performance in OOP Java before and during COVID-19 pandemic, an independent sample t-test was performed.

4. Results

The independent samples t-test was used to analyze whether there were statistically significant differences in the mean scores of the students' performance before and during COVID-19 in Object Oriented Programming (Java). The results were analyzed based on the research objectives.

Objective one: *To determine whether there is a statistically significant difference between the academic performance of students before and during COVID-19 pandemic in Object Oriented Programming (Java).*

Table 1. T-test Results of the Mean Score of Student's performance before and during COVID-19.

Group	N	Mean Score (%)	SD	df	t-value	p-value
Experimental	33	66.91	14.60	64	8.11	0.03
Control	33	41.76	10.19			
Total	66					

The basis for this study were the achievement tests that were administered to students before and during COVID-19 pandemic. According to the results indicated in Table 1, the students test results during COVID-19 produced the mean of 41.76 and before COVID-19 it was 66.91. This difference was significant as can be seen by the t-value of $t_{(64)} = 8.11$, $p < 0.05$. The results show that the difference between the students' performance in Object Oriented Programming

(Java) before and during COVID-19 had a statistical importance of $p < .05$. Relating with this finding, it can be said that before COVID-19, students were more successful in their performance in Object Oriented Programming (Java).

Objective Two: To determine whether or not the performance of students in Java Programming during COVID-19 varied with respect to gender

The research additionally enquired whether or not the

gender of the respondents had any effect on their performance in Object Oriented Pprogramming (Java) before and during COVID-19 pandemic outbreak. Independent sample t-test was used to analyze whether there was significant differences between the mean scores of males and females in this course. Tables 2 and 3 below illustrate the performance of student's performance based on gender before and during COVID-19.

Table 2. t-TEST Results of the Mean Score in JAVA by Gender before Covid-19.

Gender	N	Mean Score (%)	SD	df	t-value	p-value
Male	45	62.57	13.36	64	0.19	0.19
Female	21	61.86	15.76			
Total	66					

The study also wanted to determine whether or not gender of the students had any impact on students' performance in Object Oriented programming (Java) before and during COVID-19. According to the results Object Oriented programming mean scores between male and female students were not statistically significant, t (64) = 0.19 and p > 0.05. These results indicate that gender had no significant effect in Java programming before COVID-19.

Table 3. t-TEST Results of the Mean Score in JAVA by Gender during Covid-19.

Gender	N	Mean Score (%)	SD	Df	t-value	p-value
Male	45	17.17	11.84	64	2.26	0.29
Female	21	10.52	9.44			
Total	66					

The study also sought to determine the performance of students in Java programming by gender during COVID-19. According to the results obtained, male students performed better than female students (Mean=17.17 for male and 9.44 for female respectively).

Java by students. This is attested by the results that were obtained by analyzing the results for students before and during COVID-19 outbreak. The p-value was greater than the recommended 0.05 (p> 0.05) for the performance before and during COVID-19.

5. Discussion

The study sought to compare the students' performance in Object Oriented Programming (OOP) Java before and during COVID-19 pandemic. To achieve the desired results, the study used the past results (before COVID-19) and compared to the results obtained during COVID-19 to determine the mean differences in their programming performance. According to the results obtained and as depicted in Table 1 above, it was observed that

During COVID-19 outbreak, the students results sequence mean was 41.76 and the mean before COVID-19 was 66.91. This difference was significant as can be seen by the t-value of t (64) = 8.11, p < 0.05. These results show that the difference between the students' performance in OOP Java before and during COVID-19 had a statistical importance of p <.05. Relating with this findings, it can be stated that students performed very well in OOP programming in Java before the outbreak of COVID-19 as compared to their performance during the outbreak of the pandemic. The study correlates with the one conducted by Ary, E. J., and Brune, [6] who considered a situation in which young men in Sweden have differing number of days to prepare for important tests. These differences were conditionally random allowing the authors to estimate a causal effect of schooling on skills. The authors show that even just ten days of extra schooling significantly raises scores on tests of the use of knowledge.

With regards to gender, it was revealed that gender had no significant effect when it comes to programming in OOP

6. Conclusion

The purpose of this study was to compare the performance of students in Object Oriented Programming using Java before and during COVID-19 pandemic, to this effect a total of 66 students were selected to take part in the study and their results compared. The results revealed that the performance of students in OOP Java before COVID-19 pandemic outbreak were better than during the pandemic. The reasons for this were that, before the outbreak, the students were taught in physical class and were able to use the university facilities such as Internet and Computer lab for their practice. On the other hand, during the COVID-19 pandemic, students were subjected to virtual learning which proved to be a challenge to most of them, especially those in rural areas with no access to the Internet and electricity. The study also established that gender had no effect on students' performance in OOP in Java regardless of the mode of learning used.

7. Recommendations

Based on the discussion and conclusions, the following recommendations are made:
1. That deliberate measures should be put in place to encourage online learning in order to encourage learners in embracing technology in learning, more especially during this second wave of the COVID-19 pandemic. This will ensure continuity in learning without any major changes to the learning ability.

2. More intensive interventions and strategies to teach practical courses such as programming online should be derived to provide a virtual classroom to students in order to take advantage of both mode of studies (online and face to face).

3. Flexible teaching and learning hours should be derived because students learn differently, and they underwent different challenges during the pandemic, this is because remote learning is less effective for students who are less prepared (i.e., without full access to computers and other equipment, without experience using devices for school work, with fewer supports, and with less likelihood of being engaged).

8. Further Research

Considering the fact that this is the first study to compare the performance of students in Object Oriented Java programming at the Copperbelt University, continued research is needed to improve this study and to address its limitations. Some of the avenues that can be pursued include:

1. Similar studies should be conducted to determine the effectiveness of online learning compared to face to face amid the second wave pandemic outbreak at the University.

2. Studies should be conducted to determine the performance of students in non-practical courses such as Computer Architecture.

Acknowledgements

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