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# Grade 5 Mathematics and Science Achievement Differences by Student Gender and Ethnicity/Race: A Multiyear, Statewide Study

By Pamela Bennett Anderson, George W. Moore & John R. Slate

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*Keywords: science achievement, mathematics achievement, asian, black, hispanic, white, gender, problem-based learning, stem.*

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*Strictly as per the compliance and regulations of:*

# Grade 5 Mathematics and Science Achievement Differences by Student Gender and Ethnicity/Race: A Multiyear, Statewide Study

Pamela Bennett Anderson [α], George W. Moore [σ] & John R. Slate [ρ]

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*Keywords: science achievement, mathematics achievement, asian, black, hispanic, white, gender, problem-based learning, stem.*

## I. Introduction

Numerous researchers (e.g., Harwell et al., 2015; Newman, Dantzler, & Coleman, 2015; Roehrig, Moore, Wang, & Park, 2012) have contended that the economic welfare of the United States is contingent upon developing a generation of Science, Technology, Engineering, and Math (STEM) professionals. The U.S. Department of Labor reported that 90% of the fastest growing employment fields in 2018 will demand at least a bachelor's degree with considerable instruction in mathematics and science (Hill, Corbett, & St. Rose, 2010). Employment in science and engineering will grow more swiftly than all other occupations, especially in engineering and computer-related fields. People who take advantage of these career fields as mathematics and science specialists will enjoy higher salaries and have better job stability than employees in other fields (Hill et al., 2010). Contradictory to the nation's need for STEM expertise, however, researchers (Atkinson, 2012; My College Options & STEM connector, 2013; President's Council of Advisors on Science and Technology [PCAST], 2010; Tank, 2014) acknowledged that American workers are not prepared to meet the needs of current STEM positions. Over one half of students who graduate with a science or engineering degree within the United States are from other countries (PCAST, 2010).

According to the National Science Foundation (NSF), science, technology, engineering, and mathematics are referenced as STEM disciplines (Koonce, Zhou, Anderson, Hening, & Conley, 2011). Education advocates have hailed STEM as a key program in the educational reform movement, and activists, politicians, and science and engineering proponents have been attracted to the idea of STEM education (Atkinson, 2012; The Whitehouse, 2015).

National organizations and business leaders have suggested an increased demand for science, technology, engineering, and mathematics (STEM) skills programs (National Research Council [NRC], 2011). Although this demand has increased, the intent and execution of the STEM curriculum is unclear and needs further interpretation (Bybee, 2013; Koonce et al., 2011). Moreover, the increased emphasis on elementary reading and mathematics skills has been on the political radar in the United States since the No Child Left Behind Act was issued in 2001 (Sikma & Osborne, 2014). As a result, instructional time has increasingly been devoted to basic skills rather than to science (Sikma & Osborne, 2014).

A particular challenge to STEM reform is the way that successes in STEM learning are assessed. Although STEM learning should include deeper analysis and critical thinking in all fields of science, technology, engineering, and mathematics, assessments to measure STEM knowledge are often determined through mathematics and science scores alone (NRC, 2011). Unfortunately, standardized tests, such as state, national, and international assessments, are the recognized norm for students to demonstrate academic prowess in science and mathematics (Bleich, 2012; NRC, 2011). The State of Texas Assessment of Academic Readiness (STAAR) tests are administered to students in Texas public schools to assess student college and career readiness, and to satisfy state and federal accountability requirements in several core subjects. Each school year STAAR Mathematics tests are given in Grades 3-8, and STAAR Science tests are administered in Grades 5 and 8.

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Students from the United States have historically scored lower in international assessments than students from other countries (Fleischman, Hopstock, Pelczar, & Shelley, 2010). In an assessment given to 15-year-old students, the United States ranked 35th in mathematics and 27th in science on the 2012 Program for International Student Assessment (De Silver, 2015). In another international assessment, U.S. students performed 27th in mathematics and 20th in science among the 34 countries that make up the Organization for Economic Cooperation and Development (De Silver, 2015). In addition to American students ranking lower than students from other countries in mathematics and science, American students are also graduating with STEM-related degrees at a much lower rate than students from other countries (NRC, 2011; Newman et al., 2015).

According to a report on the National Assessment of Educational Progress (NAEP), many high school graduates do not meet the standards for subject matter knowledge and analytical skills required for college-level studies (Venezia & Jaeger, 2013). Therefore, some advocates (e.g., Mac Ewan, 2013; Tank, 2014) of STEM learning recommended learners experience authentic, real-world connections to science and mathematics as averages of increasing knowledge and analytical skills. However, this approach is seldom used in classrooms (Tank, 2014).

Another issue that may contribute to a lack of participation in STEM degrees was reported by The National Science Board (2014). One half of first-time college students in the United States enrolled in some type of remedial course, and 42% of all college students needed at least one remedial mathematics course (National Science Board, 2014). Researchers (e.g., Gigliotti, 2012; U.S. Department of Labor, 2007) caution an imperative exists for students who graduate high school to be prepared for college-level work so they might compete in a global community.

Many researchers (e.g., Beasley & Fischer, 2012; Gaughan & Bozeman, 2015; PCAST, 2010; Valerio, 2014) have noted that students who are Black, Hispanic, and/or Girls demonstrate little interest in STEM subjects. Despite encouragement from government and corporate interests, women and Black and Hispanic individuals remain underrepresented in STEM jobs. Although girls represent one half of the U.S. population, only 18.5% of bachelor's degrees in engineering were awarded to women in 2008 (Gonzalez & Kuenzi, 2013). This lack of interest continues to be a concern for educators and government organizations (Diaz-Rubio, 2013; PCAST, 2010).

Additionally, an achievement gap persists among certain minority groups (e.g., Black and Hispanic) and students who are White (Chatterji, 2006; Christian, 2008; PCAST, 2010). Although the achievement gap between Black students and White students has narrowed since 1990, White students continue to outscore Black students by 26 points on the 2013 NAEP Mathematics assessments. No measurable decrease in the gap between White and Hispanic students was noted during that time (National Center for Education Statistics [NCES], 2016). Educational policymakers remain concerned about the consistent achievement gaps between White students and Black students and Hispanic students (PCAST, 2010). One positive approach has emerged; the increasing appearance of magnet schools has offered extraordinary opportunities for underrepresented students to study specific educational themes such as STEM (Sikma & Osborne, 2014).

## II. Purpose of the Study

The purpose of this study was to determine the degree to which boys and girls differ in their performance on the STAAR Mathematics and Science tests. Specifically analyzed were the STAAR Mathematics and Science test scores to determine whether differences exist in the test scores between Grade 5 boys and girls. A second purpose of this study was to determine the degree to which Asian, Black, Hispanic, and White Grade 5 students performed differently on the STAAR Mathematics and Science tests.

## III. Significance of the Study

Currently, no published articles exist in which the relationships of gender and ethnicity/race to performance on the STAAR Mathematics and Science tests for Grade 5 students have been addressed. The extent to which gender and ethnic/racial gaps documented on previous assessments would be generalizable to the new state-mandated assessment, the STAAR, is not known. Accordingly, it is important to ascertain the presence, if any, of achievement gaps on the STAAR Mathematics and Science assessments for Grade 5 students by their gender and ethnicity/race. Such information would be useful to determine the efficacy of any new interventions or program in the STEM curriculum and instruction. School administrators, teachers, and legislators could use the findings of this study when they envision policies and make decisions with respect to STEM education.

### *Research Questions*

The following research questions were addressed in this investigation: (a) What is the difference between Grade 5 boys and girls in their STAAR Mathematics test performance?; (b) What is the difference between Grade 5 boys and girls in their STAAR Science test performance?; (c) What is the difference in Grade 5 STAAR Mathematics test performance as a function of ethnicity/race (i.e., Asian, Black, Hispanic, White)?; (d) What is the difference in

Grade 5 STAAR Science test performance as a function of ethnicity/race (i.e., Asian, Black, Hispanic, White)?; (e) What trend, if any, is present in Grade 5 STAAR Mathematics test performance for boys and girls?; (f) What trend, if any, is present in Grade 5 STAAR Science test performance for boys and girls?; (g) What trend, if any, is present in Grade 5 STAAR Mathematics test performance for Asian, Black, Hispanic, and White students?; and, (h) What trend, if any, is present in Grade 5 STAAR Science test performance for Asian, Black, Hispanic, and White students? The first four research questions were examined for four school years of data (i.e., 2011-2012, 2012-2013, 2013-2014, and 2014-2015) and the last four questions constituted an analysis across the investigation study.

## IV. Method

### a) Research Design

For this study a non-experimental, causal-comparative research design was used (Creswell, 2009). Both the independent and dependent variables constitute past events. Due to the ex-post facto nature of the data, neither the independent variables nor the dependent variables could be manipulated. Archival datasets for the spring STAAR test scores from the Texas Education Agency Public Education Information Management System were obtained and analyzed for four school years (i.e., 2011-2012, 2012-2013, 2013-2014, and 2014-2015). The independent variables analyzed were student gender and ethnicity/race. The dependent variables were the Grade 5 STAAR Mathematics and Science test scores for boys and girls and by ethnic/racial membership.

### b) Participants and Instrumentation

Texas students in Grade 5 who were Asian, Black, Hispanic, or White were the participants in this study. Datasets were obtained from the Texas Education Agency Public Education Information Management System for the 2011-2012 school year through the 2014-2015 school year. A Public Information Request form was sent to the Texas Education Agency to obtain these data. Data were requested for (a) student gender, (b) student ethnicity/race, (c) STAAR Mathematics test scores, and (d) STAAR Science test scores.

Raw scores on the Grade 5 STAAR Mathematics and Science exams were analyzed in this investigation. Field (2009) reiterated the importance of test score reliability and test score validity. According to the Texas Education Agency (2015), "reliability for the STAAR test score was estimated using statistical measures such as internal consistency, classical standard error of measurement, conditional standard error of measurement, and classification accuracy" (p. 113). The Texas Education Agency adheres to national standards of best practice and collects validity confirmation each year of the STAAR test scores.For more detailed information on the psychometric qualities of the STAAR tests, readers are referred to the Texas Education Agency website.

## V. Results

Prior to conducting inferential statistics to determine whether differences were present in the STAAR Mathematics and STAAR Science test scores between boys and girls and among ethnic/racial groups (i.e., Asian, Black, Hispanic, and White), checks were conducted to determine the extent to which these data were normally distributed (Onwuegbuzie & Daniel, 2002). Although some of the data were not normally distributed, a decision was made to use parametric independent samples *t*-tests to answer the research questions. Field (2009) contended that a parametric independent samples *t*-test is sufficiently robust that it can withstand this particular violation of its underlying assumptions. Statistical results will now be presented by academic subject area and by school year.

### *Research Question 1*

For the 2011-2012 school year for Grade 5 students, the parametric independent samples *t*-test revealed a statistically significant difference in the STAAR Mathematics test scores by student gender, $t(374086.60) = 14.21$, $p < .001$. This difference represented a trivial effect size (Cohen's *d*) of 0.05 (Cohen, 1988). Grade 5 girls had an average STAAR Mathematics test score that was less than 1 point higher than Grade 5 boys. Revealed in Table 1 are the descriptive statistics for this analysis.

*Table 1:* Descriptive Statistics on the Grade 5 STAAR Mathematics Scores by Gender for the 2011-2012, 2012-2013, 2013-2014, and 2014-2015 School Years

| School Year and Gender | *n* | *M* | *SD* |
|---|---|---|---|
| 2011-2012 | | | |
| Girls | 183,132 | 32.96 | 10.30 |
| Boys | 190,972 | 32.47 | 10.67 |
| 2012-2013 | | | |
| Girls | 182,377 | 33.05 | 10.76 |
| Boys | 190,533 | 32.90 | 11.09 |
| 2013-2014 | | | |
| Girls | 185,941 | 34.01 | 10.42 |
| Boys | 193,474 | 33.64 | 10.82 |
| 2014-2015 | | | |
| Girls | 186,917 | 31.40 | 10.59 |
| Boys | 194,531 | 30.61 | 11.22 |

Regarding the 2012-2013 school year for Grade 5 students, the parametric independent samples *t*-test revealed a statistically significant difference in the STAAR Mathematics test scores by student gender, $t(372835.19) = 4.02$, $p < .001$. This difference represented a trivial Cohen's *d* effect size of 0.01 (Cohen, 1988). Grade 5 girls had an average STAAR Mathematics test score that was less than 1 point higher than boys. Presented in Table1 are the descriptive statistics for this analysis.

Concerning the 2013-2014 school year for Grade 5 students, a statistically significant difference was revealed in the STAAR Mathematics test scores by student gender, $t(379411.90) = 10.84$, $p < .001$. This difference represented a trivial effect size (Cohen's *d*)of 0.03 (Cohen, 1988). Grade 5 girls had an average STAAR Mathematics test score that was less than 1 point higher than Grade 5 boys. The descriptive statistics for this analysis are presented in Table 1.

For the 2014-2015 school year for Grade 5 students, a statistically significant difference was revealed in the STAAR Mathematics test scores by student gender, $t(381323.33) = 22.20$, $p < .001$. This difference represented a trivial Cohen's *d* effect size of 0.07 (Cohen, 1988). Grade 5 girls had an average STAAR Mathematics test score that was almost 1 point higher than Grade 5 boys. Readers are directed to Table 1 for the descriptive statistics for this analysis.

*Research Question 2*

With respect to the 2011-2012 school year for Grade 5 students, a statistically significant difference was yielded in the STAAR Science test scores by student gender, $t(373663.23) = 36.69$, $p < .001$. This difference represented a trivial effect size (Cohen's *d*)of 0.12 (Cohen, 1988). Grade 5 girls had an average STAAR Science test score that was almost 1 point lower than Grade 5 boys. Presented in Table 2 are the descriptive statistics for this analysis.

*Table 2:* Descriptive Statistics on the Grade 5 STAAR Science Scores by Gender for the 2011-2012, 2012-2013, 2013-2014, and 2014-2015 School Years

| School Year and Gender | *n* | *M* | *SD* |
|---|---|---|---|
| 2011-2012 | | | |
| Girls | 183,086 | 31.42 | 7.55 |
| Boys | 190,842 | 32.34 | 7.66 |
| 2012-2013 | | | |
| Girls | 182,286 | 29.33 | 7.83 |
| Boys | 190,414 | 30.31 | 7.95 |
| 2013-2014 | | | |
| Girls | 185,891 | 29.42 | 7.95 |
| Boys | 193,380 | 30.27 | 8.09 |
| 2014-2015 | | | |
| Girls | 190,112 | 29.09 | 8.28 |
| Boys | 199,217 | 29.57 | 8.53 |

Concerning the 2012-2013 school year for Grade 5 students, a statistically significant difference was yielded in the STAAR Science test scores by student gender, $t(372382.95) = 37.92$, $p < .001$. This difference represented a trivial Cohen's $d$ effect size of 0.12 (Cohen, 1988). Grade 5 girls had an average STAAR Science test score that was almost 1 point lower than Grade 5 boys. The descriptive statistics for this analysis are revealed in Table 2.

With respect to the 2013-2014 school year for Grade 5 students, a statistically significant difference was present in the STAAR Science test scores by student gender, $t(379068.90) = 37.92$, $p < .001$. This difference represented a Cohen's $d$ of 0.10, a trivial effect size (Cohen, 1988). Grade 5 girls had an average STAAR Science test score that was almost 1 point lower than Grade 5 boys. Readers are directed to Table 2 for the descriptive statistics for this analysis.

Regarding the 2014-2015 school year for Grade 5 students, a statistically significant difference was revealed in the STAAR Science test scores by student gender, $t(389220.21) = 18.00$, $p < .001$. This difference represented a trivial effect size (Cohen's $d$) of 0.06 (Cohen, 1988). Grade 5 girls had an average STAAR Science test score that was less than 1 point lower than Grade 5 boys. In Table 2 are the descriptive statistics for this analysis.

*Research Question 3*

To address the third and fourth research questions, an Analysis of Variance (ANOVA) procedure was calculated. Prior to conducting the ANOVA, checks for normality of data were conducted. With respect to the distribution of Grade 5 STAAR Mathematics test scores by ethnicity/race, the standardized skewness coefficients (i.e., skewness divided by the standard error of skewness) and the standardized kurtosis coefficients (i.e., kurtosis divided by the standard error of kurtosis) revealed departures from normality for the variable of interest as the standardized coefficients were not within the +/-3 range (Onwuegbuzie & Daniel, 2002). To check further for homogeneity of variance, Levene's test was performed and revealed a violation of this assumption. Field (2009), however, contends that the parametric ANOVA is sufficiently robust that these violations can be withstood.

For the 2011-2012 school year, a statistically significant difference was revealed in Grade 5 STAAR Mathematics test scores by ethnicity/race, $F(3, 365881) = 8405.30$, $p < .001$, partial $\eta^2 = .064$, a medium effect size (Cohen, 1988). Scheffe` post hoc procedures were used to determine which ethnic/racial groups differed from each other. As evidenced in Table 3, Asian students had the highest average STAAR Mathematics scores, followed by White, Hispanic, and Black students, respectively. Moreover, an achievement gap between Asian students and Hispanic students was revealed, and a larger achievement gap existed between Asian and Black students. Thus, a stair-step achievement gap by ethnicity/race (Carpenter, Ramirez, & Severn, 2006) was clearly evident. Readers are directed to Table 3 for the descriptive statistics.

*Table 3:* Descriptive Statistics on the Grade 5 STAAR Mathematics Scores by Ethnicity/Race for the 2011-2012, 2012-2013, 2013-2014, and 2014-2015 School Years

| School Year and Ethnicity/Race | n | M | SD |
|---|---|---|---|
| 2011-2012 | | | |
| Asian | 13,615 | 40.20 | 9.88 |
| White | 113,439 | 35.40 | 10.29 |
| Hispanic | 191,992 | 31.49 | 10.08 |
| Black | 46,839 | 28.78 | 10.17 |
| 2012-2013 | | | |
| Asian | 13,615 | 40.20 | 9.88 |
| White | 113,439 | 35.40 | 10.29 |
| Hispanic | 191,992 | 31.49 | 10.08 |
| Black | 46,839 | 28.78 | 10.17 |
| 2013-2014 | | | |
| Asian | 14,773 | 41.02 | 9.96 |
| White | 111,597 | 36.40 | 10.15 |
| Hispanic | 197,206 | 32.70 | 10.34 |
| Black | 46,720 | 29.85 | 10.63 |
| 2014-2015 | | | |
| Asian | 15,457 | 39.97 | 9.13 |
| White | 109,757 | 34.06 | 10.44 |
| Hispanic | 199,956 | 29.63 | 10.52 |
| Black | 46,785 | 26.37 | 10.64 |

Regarding the 2012-2013 school year for Grade 5 students, a statistically significant difference was revealed in Grade 5 STAAR Mathematics test scores by ethnicity/race, $F(3, 364407) = 8728.25$, $p < .001$, partial $\eta^2 = .067$, a medium effect size (Cohen, 1988). Scheffe` post hoc procedures were used to determine which ethnic/racial groups differed from each other. As evidenced in Table 3.3, Asian students had the highest average STAAR Mathematics scores, followed White, Hispanic, and Black students, respectively. Moreover, an achievement gap between Asian and Hispanic students was revealed, and a larger achievement gap existed between Asian and Black students. Clearly a stair-step achievement gap (Carpenter et al., 2006) was present with regard to ethnicity/race. Revealed in Table 3 are the descriptive statistics this analysis.

Concerning the 2013-2014 school year, a statistically significant difference was revealed in Grade 5 STAAR Mathematics test scores by ethnicity/race, $F(3, 370292) = 7833.87$, $p < .001$, partial $\eta^2 = .06$, a medium effect size (Cohen, 1988). Scheffe` post hoc procedures were used to determine which ethnic/racial groups differed from each other. As reported in Table 3, Asian students had the highest average STAAR Mathematics scores, followed by White, Hispanic, and Black students, respectively. Moreover, an achievement gap between Asian and Hispanic students was revealed, and a larger achievement gap existed between Asian and Black students. Thus, a stair-step achievement gap by ethnicity/race (Carpenter et al., 2006) was clearly evident. Table 3 contains the descriptive statistics for this analysis.

For the 2014-2015 school year, a statistically significant difference was revealed in Grade 5 STAAR Mathematics test scores by ethnicity/race, $F(3, 371951) = 11118.25$, $p < .001$, partial $\eta^2 = .082$, a medium effect size (Cohen, 1988). Scheffe` post hoc procedures were used to determine which ethnic/racial groups differed from each other. As evidenced in Table 3, Asian students had the highest average STAAR Mathematics scores, followed by White, Hispanic, and Black students, respectively. Moreover, an achievement gap between Asian and Hispanic students was revealed, and a larger achievement gap existed between Asian and Black students. In agreement with Carpenter et al. (2006) a stair-step achievement gap was clearly evident. Revealed in Table 3 are the descriptive statistics for this analysis.

*Research Question 4*

Regarding the 2011-2012 school year for Grade 5 students, a statistically significant difference was revealed in Grade 5 STAAR Science test scores by ethnicity/race, $F(3, 365711) = 10445.44$, $p < .001$, partial $\eta^2 = .079$, a medium effect size (Cohen, 1988). Scheffe` post hoc procedures revealed that Asian students had the highest average STAAR Mathematics scores, followed by White, Hispanic, and Black students, respectively. Not only was an achievement gap present between Asian and Hispanic students, an even larger achievement gap existed between Asian and Black students. Thus, revealed in this analysis was a stair-step achievement gap (Carpenter et al., 2006). Readers are directed to Table 4 for the descriptive statistics for this analysis.

*Table 4:* Descriptive Statistics on the Grade 5 STAAR Science Scores by Ethnicity/Race for the 2011-2012, 2012-2013, 2013-2014, and 2014-2015 School Years

| School Year and Ethnicity/Race | n | M | SD |
|---|---|---|---|
| 2011-2012 | | | |
| Asian | 13,601 | 35.98 | 7.19 |
| White | 113,346 | 34.55 | 6.97 |
| Hispanic | 191,968 | 30.62 | 7.44 |
| Black | 46,800 | 29.18 | 7.67 |
| 2012-2013 | | | |
| Asian | 13,806 | 34.13 | 7.77 |
| White | 111,553 | 32.77 | 7.32 |
| Hispanic | 192,180 | 28.48 | 7.64 |
| Black | 46,551 | 26.81 | 7.69 |
| 2013-2014 | | | |
| Asian | 14,751 | 34.73 | 7.34 |
| White | 111,515 | 32.76 | 7.22 |
| Hispanic | 197,135 | 28.52 | 7.88 |
| Black | 46,724 | 26.72 | 7.92 |
| 2014-2015 | | | |
| Asian | 15,860 | 34.27 | 7.63 |
| White | 111,850 | 32.43 | 7.72 |
| Hispanic | 203,710 | 27.94 | 8.17 |
| Black | 48,167 | 26.07 | 8.28 |

Concerning the 2012-2013 school year, a statistically significant difference was revealed in Grade 5 STAAR Science test scores by ethnicity/race, $F(3, 364086) = 11654.21$, $p < .001$, partial $\eta^2 = .088$, a medium effect size (Cohen, 1988). Scheffe` post hoc procedures revealed that Asian students had the highest average STAAR Science scores, followed by White, Hispanic, and Black students, respectively. Not only was an achievement gap present between Asian and Hispanic students, an even larger achievement gap existed between Asian and Black students. Revealed in this analysis was a stair-step achievement gap (Carpenter et al., 2006). Presented in Table 4 are the descriptive statistics for this analysis.

For the 2013-2014 school year, a statistically significant difference was revealed in Grade 5 STAAR Science test scores by ethnicity/race, $F(3, 370121) = 11927.73$, $p < .001$, partial $\eta^2 = .088$, a medium effect size (Cohen, 1988). Scheffe` post hoc procedures revealed that Asian students had the highest average STAAR Science scores, followed by White, Hispanic, and Black students, respectively. Consistent with the previous school years, a stair-step achievement gap was revealed (Carpenter et al., 2006). Descriptive statistics for this analysis are presented in Table 4.

Regarding the 2014-2015 school year for Grade 5 students, a statistically significant difference was revealed in Grade 5 STAAR Science test scores by ethnicity/race, $F(3, 379583) = 12234.20$, $p < .001$, partial $\eta^2 = .088$, a medium effect size (Cohen, 1988). Scheffe` post hoc procedures revealed that Asian students had the highest average STAAR Science scores, followed by, in rank order, White, Hispanic, and Black students. As such, clearly present in this analysis was a stair-step achievement gap (Carpenter et al., 2006). Revealed in Table 4 are the descriptive statistics for this school year.

*Research Question 5*

For the 2011-2012 through the 2014-2015 school years, differences in the STAAR Mathematics scores of Grade 5 students for boys and girls were analyzed. Of the 4 years investigated, results from all years were statistically significant. Figure 1 is a representation of average test scores by gender for the 2011-2012 through the 2014-2015 school years. Girls and boys had higher average test scores for the 2011-2012 through the 2013-2014 school years; however, the average scores of both groups were the lowest in the 2014-2015 school year. Girls outscored boys in all school years analyzed. The greatest average difference was 0.78 points and the smallest average difference was 0.14 points.

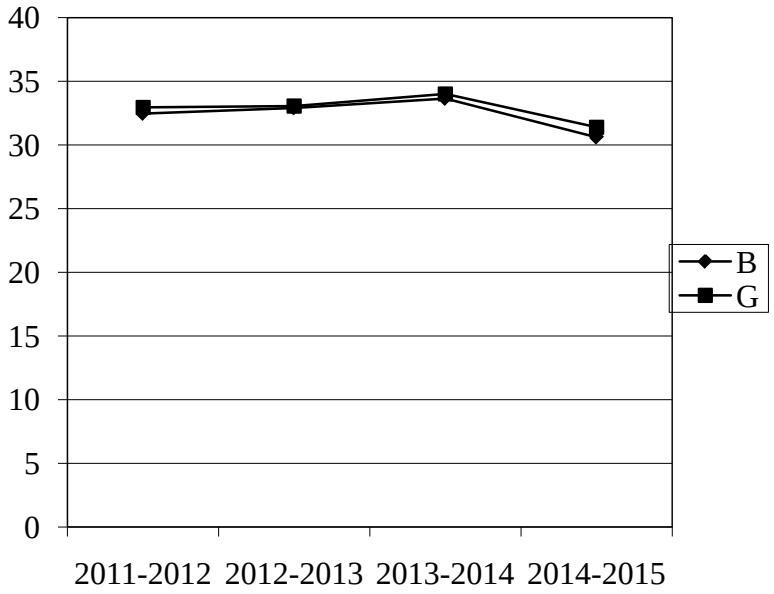


*Figure 1:* Average raw scores by gender for the Grade 5 State of Texas Assessment of Academic Readiness Mathematics test for the 2011-2012 through the 2014-2015 school years.

*Research Question 6*

For the 2011-2012 through the 2014-2015 school years, differences in the STAAR Science scores of Grade 5 boys and girls were analyzed. Of the 4 years investigated, results from all years were statistically significant. Figure 2 is a representation of average test scores by gender for the 2011-2012 through the 2014-2015 school years. Girls had lower average test scores in the 2011-2012 through the 2014-2015 school years. Boys had higher average test scores than girls in each school year. The greatest average difference was 0.98 points and the lowest average difference was 0.49 points.

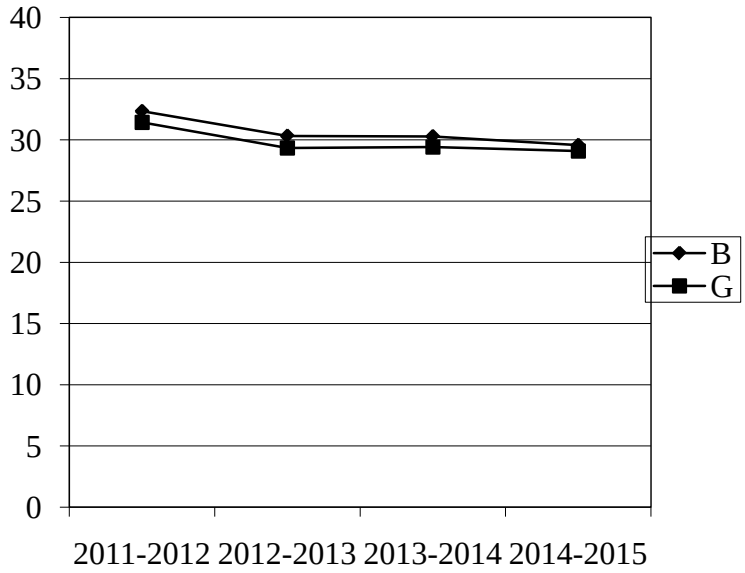


*Figure 2:* Average raw scores by gender for the Grade 5 State of Texas Assessment of Academic Readiness Science test for the 2011-2012 through the 2014-2015 school years.

*Research Question 7*

For the 2011-2012 through the 2014-2015 school years, differences in the STAAR Mathematics scores of Grade 5 Asian, Black, Hispanic, and White students were analyzed. Of the 4 years investigated, results from all years were statistically significant. Figure 3 is a representation of the average test scores by ethnicity/race for the 2011-2012 through the 2014-2015 school years. The average scores of each student group increased slightly each year between the 2011-2012 and the 2013-2014 school years, with the exception of Black students, who had a very slight decrease (i.e., 0.04 points) in their average score in the 2012-2013 school year. However, the average scores of all student groups decreased to the lowest average score during the last school year. In each school year, Asian students earned the highest average score, followed by White, Hispanic, and Black students, respectively. In each year of the study, a stair-step achievement gap was clearly present (Carpenter et al., 2006). The largest average score difference for each school year was between Asian and Black students, which included a minimum average difference of 11.18 and a maximum average difference of 13.61.

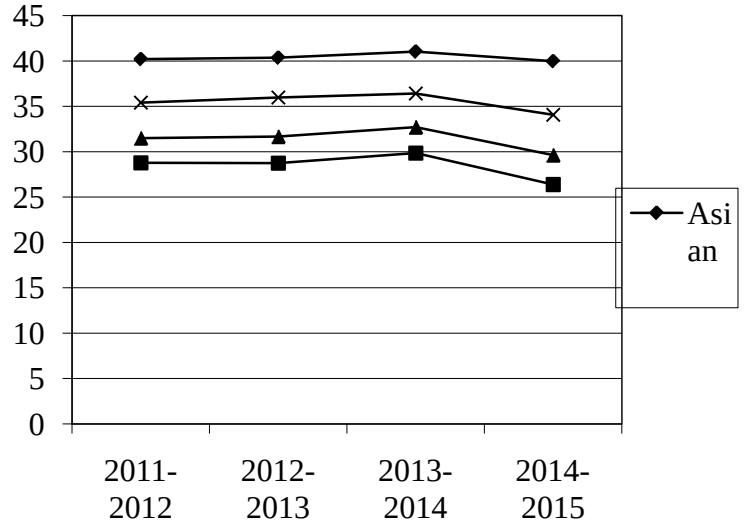


*Figure 3:* Average raw scores by ethnicity/race for the Grade 5 State of Texas Assessment of Academic Readiness Mathematics test for the 2011-2012 through the 2014-2015 school years.

*Research Question 8*

For the 2011-2012 through the 2014-2015 school years, differences in the STAAR Science scores of Grade 5 students by ethnicity/race were analyzed. Of the 4 years investigated, results for all school years were statistically significant. Figure 4 is a representation of the average test scores by ethnicity/race for the 2011-2012 through the 2014-2015 school years. The average scores of each student group decreased between the 2011-2012 school year and 2012-2013 school year; however, the average scores fluctuated under 1 point for each ethnic/racial group for the 2012-2013, 2013-2014, and 2014-2015 school years. In each year, Asian students had the highest average score, followed by White, Hispanic, and Black students, respectively. A stair-step achievement gap was clearly evident in each school year (Carpenter et al., 2006). The largest average score difference was between Asian and Black students, which included a minimum difference of 6.80 points and a maximum difference of 8.20 points. The average test score difference increased between the first and last school year of data analyzed herein.

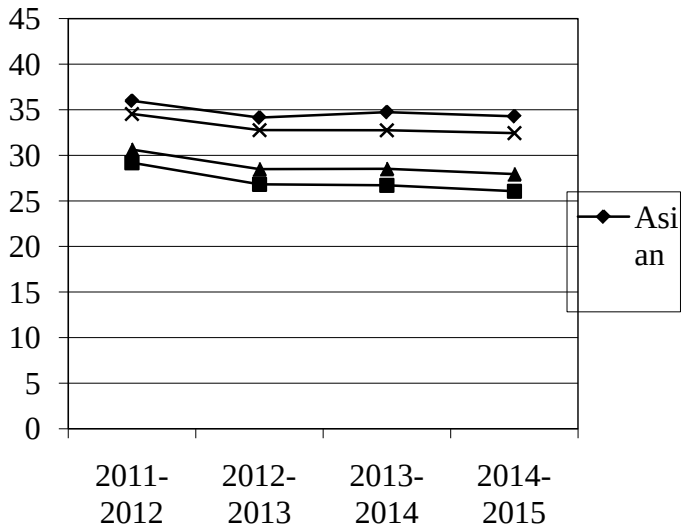


*Figure 4:* Average raw scores by ethnicity/race for the Grade 5 State of Texas Assessment of Academic Readiness Science test for the 2011-2012 through the 2014-2015 school years.

## VI. Discussion

In this multiyear statewide analysis, the STAAR Mathematics and Science test scores of Grade 5 students were obtained and analyzed. The degree to which differences were present in the STAAR Mathematics and Science test scores for Grade 5 students by their gender and by their ethnicity/race (i.e., Asian, Black, Hispanic, and White) were determined. Through analyzing four school years of Texas statewide data, any trends that might be present by student gender or by student ethnicity/race were identified.

Regarding Grade 5 STAAR Mathematics and Science exams by gender, all results were statistically significant, albeit with trivial effect sizes. The average Grade 5 Mathematics test scores of girls were consistently higher than for boys by under 1 point in all four school years. In contrast to the mathematics results, the average Grade 5 STAAR Science test scores of boys were consistently higher than for girls in all four school years, by less than 1 point difference each year.

With respect to the Grade 5 STAAR Mathematics test by student ethnicity/race, statistically significant differences were yielded for all four school years. Effect sizes were moderate for all analyses. Achievement gaps were documented among the four ethnic/racial groups on this exam. In each school year, Asian students had the highest average test score, followed by White, Hispanic, and Black students, respectively. Thus, a stair-step achievement gap (Carpenter et al., 2006) was clearly evident. The largest gap was between Asian and Black students with average score difference of between 11.18 and 13.61. Asian students had average scores that ranged from 39.97 to 41.02; White students had average scores that ranged from 34.06 to 36.40; Hispanic students had average scores that ranged from 29.63 to 32.70, and Black students had average scores that ranged from 26.37 to 29.85.

Regarding the Grade 5 STAAR Science exams for the 2011-2012 through the 2014-2015 school years, a stair-step achievement gap (Carpenter et al., 2006) was also clearly evident, although the gap was not as wide as in the Grade 5 STAAR Mathematics exam. Moderate effect sizes were present for all four school years. Asian students consistently had the highest average test scores, followed by White, Hispanic, and Black students, respectively. The largest gap was between Asian and Black students with average score differences ranging from 6.80 points to 8.20. For each

year of the study, Asian students had average scores ranging from 34.13 to 35.98; White students had average scores ranging from 32.43 to 34.55; Hispanic students had average scores ranging from 27.94 to 30.62, and Black students had average scores ranging from 26.07 to 29.18.

*a) Connections to Existing Literature*

Researchers (e.g., Beasley & Fischer, 2012; Gaughan & Bozeman, 2015; PCAST, 2010) have noted the underrepresentation of women in STEM fields of employment; however, only minimal achievement gaps were documented herein between the average test scores of boys and girls on the Grade 5 STAAR Mathematics and Science exams for all four school years. The average scores of girls were slightly higher than the average scores of boys each year on the STAAR Mathematics exam; however, average score differences all four years were under 1 point. Regarding the Grade 5 Science exams, the average test scores of boys were slightly higher than the average scores of girls, with also an average difference of under 1 point for all years.

As a result of this study, the existing research regarding achievement gaps among Black and Hispanic students (Chatterji, 2006; Christian, 2008; Diaz-Rubio, 2013; NCES, 2016; PCAST, 2010) is reinforced. The average scores of Black and Hispanic students were consistently lower than Asian and White students on both the STAAR Mathematics Scores and the STAAR Science Scores for Grade 5 students for all four school years. Asian students had the highest average test scores, followed by White, Hispanic, and Black students, respectively.

*b) Implications for Policy and Practice*

In this multiyear analysis of Grade 5 STAAR Mathematics and Grade 5 STAAR Science test scores, Black and Hispanic students consistently scored lower on all tests. Although large differences were not present in the average test scores between boys and girls on the Grade 5 STAAR Mathematics and Science exams, it is a concern that women are not more represented in STEM employment fields. Educational policymakers could ensure that STEM-related programs are available that give these underrepresented groups (i.e., girls, Black, and Hispanic students) multiple opportunities to learn and practice mathematics and science inside and outside of school. Additionally, how students are assessed in mathematics and science could be reevaluated, with consideration given to authentic assessments that measure skills that standardized tests cannot measure such as creativity, problem-solving, and collaboration.

*c) Recommendations for Educational Leaders*

Policymakers are encouraged to write and fund a state STEM curriculum that is comprised of project-based lessons with many opportunities for students to solve real-world problems using technology. School and district leaders are encouraged to advocate for authentic STEM learning for all students. Teachers are encouraged to build relationships with students while teaching them STEM subjects, particularly with groups of students who have shown a lower interest in STEM careers (i.e., girls, Black and Hispanic students). School leaders should ensure that girls, Black, and Hispanic students are enrolled in advanced mathematics and science courses with Asian and White students. All students must have opportunities to think critically and to solve problems, teachers are encouraged to develop lesson ensure this higher level of learning. Furthermore, school and district curriculum leaders, and state leaders, in conjunction with teachers are encouraged to find and/or develop alternative assessments to measure those skills related to thinking and real world or authentic problem solving.

*d) Recommendations for Future Research*

Researchers are encouraged to replicate this investigation each school year to determine the degree to which the achievement gaps documented herein continue to be present. Furthermore, researchers may want to continue examining differences in test scores regarding gender and ethnicity to determine if achievement gaps continue among certain minority students (e.g., Black and Hispanic). Additionally, because only Grade 5 Mathematics and Science STAAR Scores data were analyzed in this investigation, researchers are encouraged to extend this study to other grade levels, both early elementary grade levels as well as secondary grade levels. Another recommendation for future research is to extend this study to other states with different assessments than are present in Texas. Such research may provide information regarding the degree to which results from this study are generalizable to students in other states. A final recommendation would be for researchers to analyze the mathematics and science performance of students who are economically disadvantaged and English Language Learners, primarily because the percentage of these two groups of students with respect to student enrollment is rapidly increasing.

## VII. Conclusion

The purpose of this research study was to examine the extent to which differences existed in STAAR Mathematics and STAAR Science scores for Grade 5 students, based on gender and ethnicity/race. Data were analyzed for four school years of data (i.e., 2011-2012, 2012-2013, 2013-2014, and 2014-2015). Statistically significant differences were present for all four school years. On the STAAR Mathematics exam, girls outscored boys all years by under 1 point each year. On the STAAR Science exams, boys outscored

girls all years by under 1 point each year. Marked achievement gaps were present on the STAAR Mathematics and Science exams concerning ethnicity/race. All four years of the study, a stair-step achievement gap (Carpenter et al., 2006) was clearly evident. Each year, Asian students had the highest average scores, followed by White, Hispanic, and Black students, respectively. As such, results from this multiyear, statewide investigation are supportive that achievement gaps continue to exist among ethnic/racial groups and between boys and girls.

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# Cause and Effect of using Digital Content in Biology Subject at Grade IX-X in Dhaka City

By Sabbir Ahmed Chowdhury, Rahul Chandra Shaha & Rihana Afroze

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*Abstract-* Information and communication technologies (ICT) have become everyday entities in all spheres of life. ICT has fundamentally changed the pedagogy in education lend itself to more student-centred learning phenomena; hereafter, digital content, an ubiquitous part of ICT, is becoming more and more important. The purpose of the present paper is to examine the relationship between the use of digital content and students' performance and to give complementary explanations regarding causes and effects of using digital content in secondary education especially in biology subject. This study followed mixed method design including qualitative and quantitative data. The result of the study revealed that student's performance is mainly explained by student's characteristics, educational environment and teachers' characteristics and digital content have a concrete impact on these determining factors and consequently the outcome of education. The adoption of ICT equipment and use rates is relatively slow and differs from one institution to another. Henceforth, use of computer supportive instructional material need a change in the organisation of secondary education.

*Descriptors: digital content, cause, effect, biology subject, secondary level of education, mixed method.*

*GJHSS-G Classification: FOR Code: 139999*


*Strictly as per the compliance and regulations of:*

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Sabbir Ahmed Chowdhury [α], Rahul Chandra Shaha [σ] & Rihana Afroze[ρ]

*Abstract-* Information and communication technologies (ICT) have become everyday entities in all spheres of life. ICT has fundamentally changed the pedagogy in education lend itself to more student-centred learning phenomena; hereafter, digital content, an ubiquitous part of ICT, is becoming more and more important. The purpose of the present paper is to examine the relationship between the use of digital content and students' performance and to give complementary explanations regarding causes and effects of using digital content in secondary education especially in biology subject. This study followed mixed method design including qualitative and quantitative data. The result of the study revealed that student's performance is mainly explained by student's characteristics, educational environment and teachers' characteristics and digital content have a concrete impact on these determining factors and consequently the outcome of education. The adoption of ICT equipment and use rates is relatively slow and differs from one institution to another. Henceforth, use of computer supportive instructional material need a change in the organisation of secondary education. Government or PPP or school authority can take benign initiative to provide low-cost laptop, multimedia projector. Furthermore, continuous in-servicing training should be provided among teachers to ensure digitalized classroom and effective teaching-learning process.

*Descriptors: digital content, cause, effect, biology subject, secondary level of education, mixed method.*

## I. Background and Rationale of the Study

Information and Communication Technology (ICT) placed one of the most prominent parts in the modern education. The mission of the school has changed rapidly from only information dissemination to form educational environment for the teaching content to be perceivable and learnable. To create digital content and to develop modern teaching and learning services is the part and parcel of education strategies. However, for effective insight of such strategy, it is necessary to know under what circumstances digital content can be effectively used and so on. On the other hand, it is not pivotal to move all teaching/learning content into digital milieus. Quite often what is taught at school is not interesting, even is boring, dead. Thus, there is a need to pedagogical improvement in certain knowledge sphere to overcome the scenario. Then again, information communication technologies highly influence students' everyday life. Effective application and usage of new technologies in education practice are at the core of attention of internal and external stakeholders of education. One of such ways is digitalization of education. Digital resources can make teaching-learning process more interesting, more effective. Various research works carried out in foreign countries prove the effectiveness of digital teaching content. It is affirmed that digital content develops the abilities of corporation (Bennett, Sandore, Miller, 2001), strengthens motivation, being interested in general, develops thinking abilities (Miyata, Ishigami, 2007). In general, digital content application in teaching-learning process together with other technologies strengthens and deepens learners' understanding (Dani, Koenig, 2008).

The vital aspect of such transition is to recognize the inter-relation between traditional teaching content and digital content. Digital teaching-learning infrastructure, teaching-learning process, program plan can play effective role to achieve better results, however, inclusion of digital content into education process is prioritization of endless continuation of computer supportive learning. Teachers' views and perceptions can play effective role to move forward to technology supported educational arena. Nevertheless, it is not right to refer only to research works carried out in other countries. It is necessary to assess the context of the country, to accomplish representative evaluations in the population of Bangladeshi students and teachers. As such, we are motivated to analyze the need of digital content in Biology teaching-learning process as well as to justify the improvement of educational process after such adoption. Even so, it is matter of great challenge to manage infrastructure as well as adopt effective pedagogy to turn monotonous classroom into pleasant one through proper match between traditional classroom and technology based modern classroom.

## II. Literature Review

Today, the use of digital content-based education is getting more popular in many areas of learning and training as it stimulates new ways in information delivery with the concerns of accessibility, reusability and individualization to fulfil the needs for

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different types of learners, but not just limited to conventional teaching and learning methods (Haque, Raihan& Clement, 2016).Basically, digital content refers all types of content like audios, videos, virtual text; eBooks etc. exists in the form of digital data in a digital storage system. So, it is easily used in the purpose of education in this digital age.

One of the most vital contributions of digital content in the field of education is- easy access to learning. With the help of ICT, students can now browse through e-books, sample examination papers, previous year papers etc. and can also have an easy access to resource persons, mentors, experts, researchers, professionals, and peers-all over the world.

ICT provides opportunities to access digital content based information using multiple information resources and viewing information from multiple perspectives, thus fostering the authenticity of learning environments. Digital content may also make complex processes easier to understand through simulations that, again, contribute to authentic learning environments. Thus, digital content may function as a facilitator of active learning and higher-order thinking (Alexander, 1999; Jonassen, 1999). The use of digital content may foster co-operative learning and reflection about the content (Susman, 1998). Furthermore, digital content may serve as a tool, providing opportunities for adapting the learning content and tasks to the needs and capabilities of each individual pupil and by providing tailored feedback (Mooij, 1999; Smeets & Mooij, 2001). As Stoddart and Niederhauser (1993) point out, digital content may fit into a spectrum of instructional approaches, varying from traditional to innovative. Digital content can help deepen students' content knowledge, engage them in constructing their own knowledge, and support the development of complex thinking skills (Webb & Cox, 2004).

Viewing the previous studies is important for providing scientific facts which serve this study. A number of researchers are dealing with this field. Some of the most important studies are presented here for understanding the glimpse about this topic.

Haque, Raihan& Clement (2016) conducted a study namely 'Compare the Effectiveness of Digital Content Teaching and Traditional Teaching to Academic Achievement: Reference to the Selected Technical School and College in Bangladesh'. In their study, the statistical data analysis result proved that digital content teaching is more effective to learning higher level of learning skills like comprehension level, application level than the traditional teaching. In knowledge level digital content teaching and traditional teaching are similarly effective to academic achievement.

Jena (2013) study result reveals that smart class learning environment is better to teach both low achievers and high achievers than traditional class.

Beach, R. (2012) found relatively high levels of students' engagement through their uses of digital tools for the social purposes of accessing, sharing, communicating, and reflecting on knowledge as part of a shared learning commons.

Similarly, Lamanauskas, Slekiene, Raguliene & Bilbokaite (2011) study results' asserted that digital teaching/learning content is a perspective way searching to improve education process.

A study namely 'Innovative teaching: Using multimedia in a problem-based learning environment' conducted by Neo & Neo (2001). The purpose of that project was to access the students' skills in framing and solving problems using multimedia technologies. Results showed that the students were very positive toward the project, enjoyed teamwork, able to think critically and became active participants in their learning process.

Hong et al. (2001) conducted a study which aimed at finding out the impact of multimedia software on students' academic achievement. The results showed that statistically-significant differences between the average marks of the experimental group students' achievement and that of the control group in favour of the experimental group (as cited in Aloraini, 2012). In the same way Beichner (1994) study's found out that the multimedia have a positive effect on the knowledge and emotions of the students who study scientific subjects.

Abu Yunus (2005) conducted a study entitled as "The effectiveness of multimedia software to teach Geometry in the school grade of pre-paratoryschools" aimed at identifying to what extent multimedia software helps in the academic achievement of the preparatory school students in the subject geometry and its remembrance. The results of this experimental study showed significant statistical differences in the average of academic achievement of the experimental and control groups in the test conducted after the experimental in favour of experimental group. Likewise, Alorani (2012) study showed that the multimedia has effective use compared to the traditional methods of teaching.

In the other way, Menon (2015) study analyzes the effectiveness of smart classroom teaching on the achievement in chemistry of secondary school students. The results revealed that students achieved higher when taught in smart classes as compared to conventional mode of instruction. Learning styles of students did not affect their achievement in experimental and control group.

Youssef, A. B. & Dahmani, M. (2008) in their study entitled "The Impact of ICT on Student Performance in Higher Education: Direct Effects, Indirect Effects and Organisational Change" showed that ICT whereas digital content also included has an edit effect in terms of quality of student work and practical examples through visualisation, allowed students to

learn independently, which has enabled more work to be completed, enhanced achievement due to the reinforcement and practice, encourages independent learning and individual preferences for process, layout, style and format.

## III. Research Objectives

Current research is limited to cause and the almost immediate and after impact of the incorporation of digital content in Biology subject. The following research objectives were designed to expand existing research concerning use of digital content in the biology subject to:

- find out the causes of using digital content in the Biology subject;
- trace out the effects of using digital content in the Biology subject;
- identify the challenges of using digital content in the Biology subject.

## IV. Methodology

The research framework led us methodologically to design a mixed method according to research objectives where qualitative and quantitative data were collected to compile the whole picture.

*Data source, sample size, sampling process and research tools*

For accomplishing the study, data were collected from eight purposively selected secondary science teachers (Biology teachers) and 150+ randomly selected students from grade IX-X science students who had taken biology subject. Total six secondary schools were chosen through convenient sampling process from the Dhaka city where three schools were government and three were private schools. Data was collected as per the instruction of the school authority. The participants were not required to write their names on the questionnaire. As the nature of this study was mixed method, so it demanded to collect both qualitative and quantitative data at a time. Thus findings from the research are based on semi-structured interview schedule for teachers and semi-structured questionnaires for students to ensure valid and quality data as well as to find the complete picture about the research field.

## V. Analysis and Discussion of the Findings

This segment discusses findings of research objectives under three sub-sections wherein detailed analysis and discussion was carried out.

a) *To find out the causes of using DC in the biology subject*

Biology is a science of life and living matter defined by organisms, rudimentary chemistry of life, biological molecules, plants, building-block of all life, the cell, functions of tissues, organs, diversity of life etc. Naturally, students struggle to visualize the complexity of these processes and their interrelation is often difficult for the student to understand. For example, RNA transcription involves RNA polymerase, but RNA polymerase itself is complex to understand. A major challenge to biology educators is to teach these processes to students to comprehend and understand. Because of this challenge, teachers are looking for new approaches such as visualization to enhance student learning of biological processes instead of only lecture in the class room or reading text books.

On the other hand, digital learning tool namely digital content expresses topics lively which contains digital photo, videos, audios, animation etc. and displays any ideas/thoughts visually popularly known as power point presented through projectors. According to $Student_1$, *"Digital content is an ICT based thing by which many analog or theoretical contents can be showed much effectively and precisely through digital equipment."* and $Student_2$ utters a digital content means text, pictures or information in a digital form which is visually representable. $Teacher_1$ says, digital content may be extended from slides to online contents ensuring linkage with information gateway to form multimedia based blended classroom or to make resources available beyond time and space. It enhances quality of teaching-learning process in all subjects especially science and technology at all levels of education.

From our collected data it is revealed that several causes make the use of digital content in Biology subject as essential. Among the reasons, greater attention and engagement, easier presentation of complex content are more dominating (Figure-1).

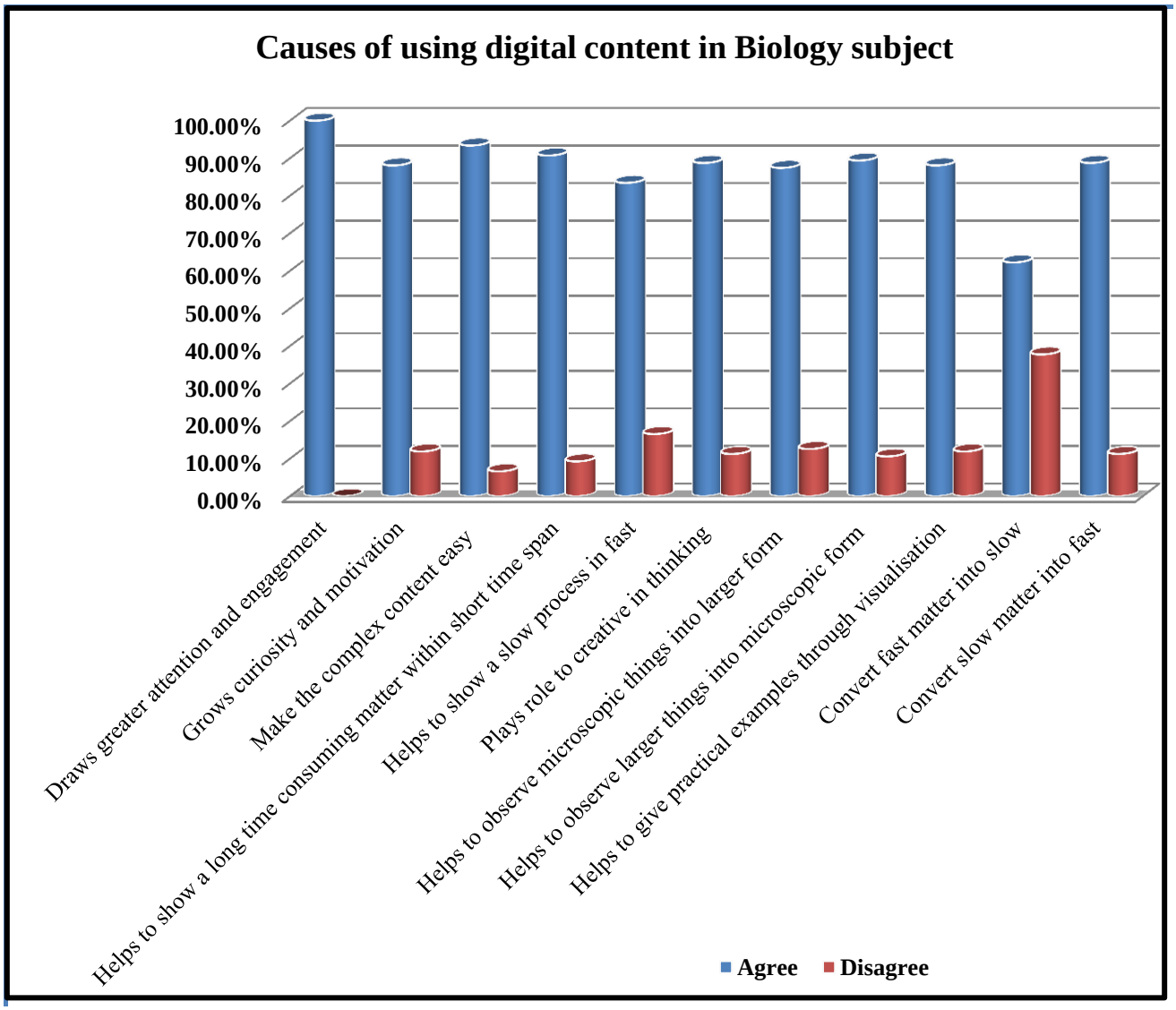


*Figure-1:* Students' opinions about the causes of using digital content in Biology subject

Moreover, students of digital age use digital content for multiple causes. As, there are some limitations in school at biology class, so maximum students who have digital technological equipment like personal computer, laptop, tab, smart phone etc. use biology related various digital content. Most of the students mentioned that they get advantages by using digital content personally at outside classroom in terms of: improvement of skills, easier visualization of invisible thinks, to comprehend in a short time by themselves.

According to Student$_3$, *"In our country we do very little in practically, but if we can use digital content in our studies it will help to realize the facts of every experiment."*

Furthermore, Student$_4$ denotes that-

*"Our biology textbook has many complex things that are written in short and information is not sufficient, it may confuse me sometimes but using digital content transforms clear idea about concepts as well as transforms understanding to application, hence make the learning easily plausible, enjoyable and everlasting."*

Interestingly it can be said a video is more effective than reading a topic. It seems to them as the supplementary of biology lab. Henceforth, source of learning has been diversified, rather than only dependency on books.

When teachers were inquired in their interview session that what the reasons behind the usage of digital content in their biology class. In response, they mentioned some remarkable causes that are: instructional materials can be used repeatedly by making once that reduces wastage of time which leads them to teach freely and effectively. Some topics in biology subject are so critical that it takes longer time to teach and sometimes tends to impossible for students

to effectively realize, in contrary, digital content shapes complex topics into easily understandable format through using multimedia such an imperative manner that students become curious to learn more and more, inherit their latent talent.

Teacher$_2$ is so exultant about using digital content by mentioning *"It is quite impossible to teach biology subject without touch of digital content in modern age. It is obviously crucial need for biology subject compare to other subjects."* Some teachers also claimed that usage of digital content in biology class makes controlled classroom in turn makes the assessment system efficient and effective.

Teachers along with students solemnly feel that digital content is vital for easier illustration of various biological topics. We have collected their opinion about wherein digital content crucially needed and categorize their responses into chapter wise (Table – 1).

*Table-1:* Topics where digital content is more important according to students' and teachers' view

| Chapter no. | Chapter name | Content/Topics |
|---|---|---|
| 1 | Lesson of life | Branches of biology, Classification of plant kingdom, Classification of animal kingdom, System of Binomial Nomenclature. |
| 2 | Cell and Tissue of Organism | Various types of cells, Plant tissues, Animal tissues. |
| 3 | Cell Division | Parts of flower, Works and parts of trees, Cell divide. |
| 4 | Bioenergetics | Blooming of flowers, Photosynthesis, Respiration |
| 5 | Food, Nutrition and Digestion | Living style and food receiving process, nutrition produce and acquiring process, Nutrition, Digestive system. |
| 6 | Transport in Organisms | Blood, Blood circulation Hormones, WBC, RBC, platelets, Process of transpiration. |
| 7 | Exchange of Gases | Respiration system, Structure and function of lungs. |
| 8 | Human Excretion | Structure and functions of kidney, Structure and functions of nephron. |
| 9 | Firmness and Locomotion | Human skeleton, Bone, cartilage and bone joint, Tendon and ligament. |
| 10 | Co-ordination Process in Animal | Co-ordination system in plants, Co-ordination system in animals, Structure and functions of a neuron, Nervous system, Hormone and gland. |
| 11 | Reproduction | Reproduction in organism, Life cycle of flowering plants, Embryonic growth and development. |
| 12 | Heredity in Organisms and Evolution | DNA replication, Theory of evolution. |
| 13 | Environment around Life | Ecosystem, Food chain and food web, Bio-diversity. |
| 14 | Biotechnology | Bio technology, Preparation of DNA or GMO, Steps of tissue culture, Genetic engineering. |

*b) To trace out the effects of using DC in the biology subject*

Teachers show central tendency to explain the effects of digital content in biology subject. They are highly agreed that digital content helps to develop conceptualization through avoiding memorizing as well as uplifting thinking level of students that increases realization among students; in a nutshell, It makes learning outcome fruitful and longer which is reflected in case of evaluation. In addition, it develops confidence among students to answer against creative questions.

Students also coincide with the opinions of teachers regarding effect of digital content in biology subject. Digital content influences the students so vividly that they are interested to understand the ins and outs of topics rather cramming. Through segregation / modularization of pictures/figures they get the flavour of hands-on activity at biology laboratory. Due to visibility improvement, their confidence level reaches to peak to think creatively, to be spontaneous to solve many things as well as to achieve expected grade in the examination. In this regard student$_5$ positively says-

*"Digital content helps us to apprehend difficult parts of biology when I see some video related to biology which keeps a permanent place in my mind. I never forget it. So I write it in examination promptly with resilience."*

Digital content has changed the paradigm of teaching-learning process along with views and perceptions of teachers and students. To clarify the cause and effectiveness of using digital content, respondent teachers and students categorized the biology class' changing scenario as follows:

*Table-2:* Comparison between biology class with and without digital content

| Biology class without digital content | Biology class with digital content |
|---|---|
| Conventional:<br>Text , Poster presentation/Chart/Board etc. | Digitalized presentation:<br>Combination of audio, video, image, animation etc. along with text. |
| Students are sometimes passive, thus lower rate involvement and engagement of them. | Higher rate of students' involvement and engagement. |
| Lecture based class presentation. | Elaborate explanation in graphical mode. |
| Typical and marks oriented. | Interesting and knowledge oriented. |
| Need imagination in some cases. | Effective visualization in most cases. |
| Emphasis on memorizing. | Easier to show trivial matter. |
| Class room dependency. | Anytime, anywhere learning. |
| Tendency to read books more and more. | Deviation from reading text books. |
| Monotonous in some cases. | Lively in maximum cases. |
| Laboratory related tasks are overlooked due to lack of infrastructure. | Laboratory related tasks are taught through digitalized simulation. |
| Rigid, teacher dependent. | Flexible, self-assisted and teacher facilitated. |

*c) To identify challenges of using digital content in the Biology subject*

Bangladesh is moving forward towards technology based classroom. Transition is really crucial in context of expertise, infrastructure, and mind-set. Expertise of teacher is highly needed to use digital content aptly. It is really tough for teacher to match the hurdles of small time duration and large class size. Teachers have heavy class load and in a tremendous pressure to complete the syllabus. So, the above contradictory situations make them puzzled whether they should go for digital content or not. Still most of schools are not equipped with digital content because of financial constraints. Electricity crisis and negative comments from colleagues (who are not interested to use digital content) sometimes bind them to stop. However, access to digital content still not convenient for all students due to unavailability of digital content supported device. Figure-2 shows that 88.74% students pointed out that lack of technological infrastructure is the most noticeable obstacle of using digital content in biology subject. As well, Lack of skilled & trained teachers also a big hinder of using digital content.

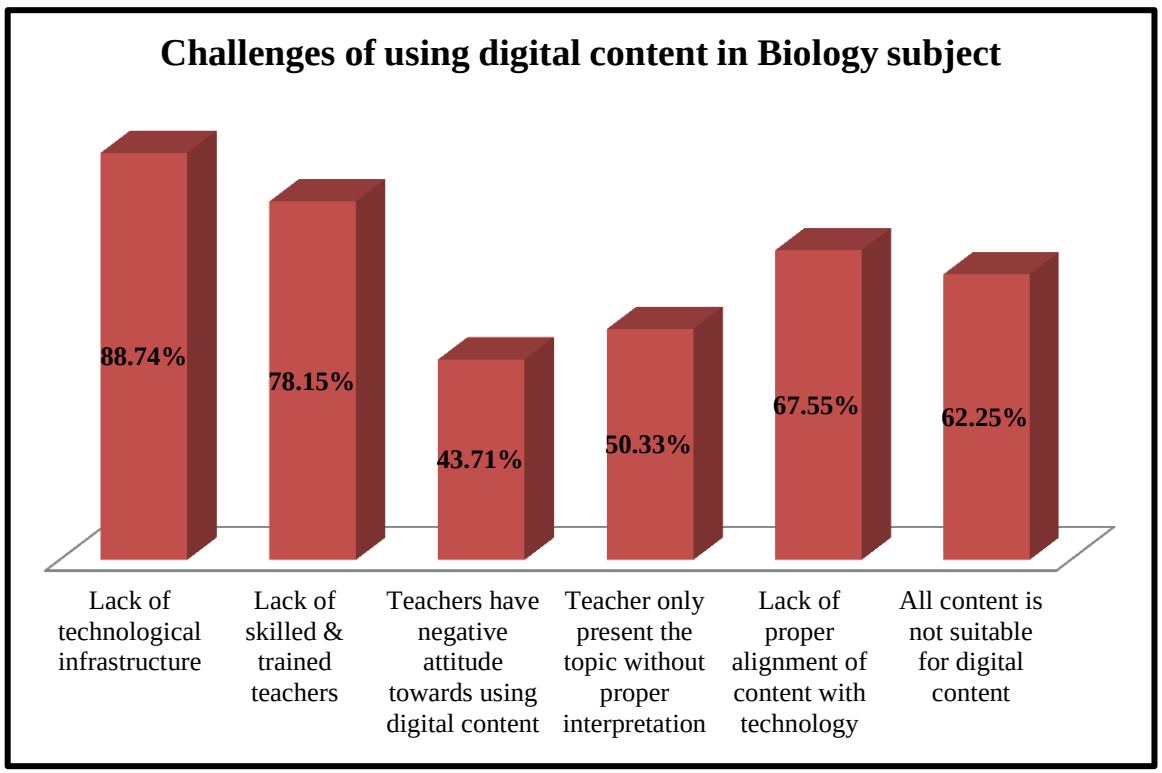


*Figure-2:* Students' perception about challenges of using digital content in Biology subject

## VI. Recommendation and Conclusion

In-service training can change the mentality as as well as expertise of teachers. Training should be sound enough so that can find the scope in which topic they can use digital content because it is vital to ensure the best inter-relation between traditional teaching content/ tasks and digital content. Continuity of in-service training can make the teachers upgraded in accordance with the latest innovation of technology.

Government or PPP (Public-Private Partnership) or school authority can take benevolent initiative to provide low-cost laptop like 'Doel Laptop' to each teacher. Education can only change the nation. So, corporate houses may extend their helping hand through Corporate Social Responsibilities (CSR) by providing multimedia projectors to schools to ensure digitalized classroom and effective teaching-learning process.

The researcher tend to be suggested to conduct further study on comparing between effectiveness of digital content and traditional content/materials; to conduct study on cause and effect of using digital content in various subjects at other grade in a large scale.

Beyond doubt that by integrating digital content into the biology teaching and learning process enable students to equip with greater visualization, critical thinking, problem-solving skills and to experience on digital mediated learning situation, hence, lead to student-centered learning approach. At the same time, the role of the teacher drives from the "sage on the stage" to a "guide on the side" providing students with assistance and facilitation to explore a subject area instead of imparting knowledge through lecture.

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# An Evaluation of the Performance of Higher Educational Institutions using Data Envelopment Analysis: An Empirical Study on Algerian Higher Educational Institutions

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*Keywords: data envelopment analysis method, efficiency, performance indicators, performance evaluation.*

*GJHSS-G Classification: FOR Code: 130103*

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## I. Introduction

One of the most common conceptualizations of performance was the evaluation of this concept based on the financial outcomes using the income statement or so-called profit and loss account. However, complexity of business structures and transactions along with the multiplicity of financial reporting standards make the identification and evaluation of performance harder (ICAS, 2016), which in turn led to question the efficiency and effectiveness of using the rest of the institution's resources, i.e., non-financial resources in the process of performance evaluation. Hence, new approaches and methods used to evaluate the performance of profit-oriented or non-profit institutions using different institutional resources have been considered. In fact, the simplest and oldest method utilized to evaluate performance depends on calculating the technical efficiency index that goes along with Farrell's (1957) definition of efficiency, which deemed efficiency as a ratio of outputs to inputs, provided that all inputs as well as outputs are assessed correctly. Farrell's (1957) definition evinces that a highly efficient institution is the one that has succeeded in producing as many outputs as possible using a specified amount of inputs. Thereupon, one can considers that the definition of Farrell remains acceptable and valid if an institution have a multiple homogeneous outputs and multiple homogeneous inputs withknown relative weights. Consequently, performance can be evaluated by calculating the efficiency index, which equals the ratio of total homogeneous output to total homogeneous inputs (Kaftroodya & Aminnaserib, 2014) as shown in the following equation:

Performance (efficiency) index = $(U_1Y_1+U_2Y_2+\ldots+UrYr) / (V_1X_1+V_2X_2+\ldots+VmXm)$, where

Y: outputs

X: inputs

U1, U2, … Ur: relative weights of outputs

V1, V2, … Vm: relative weights of inputs

Even though clarity and accuracy of the above equation, the process of measuring the performance of higher education institutions is not easy, especially as they fall within the complex organizations that use multiple and different inputs to produce multiple and different outputs. In this sense, the current study aims at clarifying the extent to which the performance of higher education institutions can be measured and evaluated using a relatively modern method known as data envelopment analysis, which is based on benchmarking and is widely used in assessing the performance of many non-profit institutions.

For the purpose of the current study, the detailed overview of data envelopment analysis and how this analysis can be used to evaluate the performance of institutions in general, was included in the theoretical framework. The empirical part of the study

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demonstrated how data envelopment analysis was used in the current study to evaluate the performance of Algerian higher education institutions during 16 consecutive academic years.

## II. Theoretical Framework: A Detailed Overview of Data Envelopment Analysis

The method of data envelopment analysis is a result of a doctoral dissertation prepared by Edwardo Rhodes under the supervision of William Cooper at Carnegie Mellon University's School of Urbanand Public Affairs. The dissertation was designed to evaluate educational programs provided to disadvantaged and underprivileged students, through conducting large-scale studies on a sample of similar public schools in the United States, with the support of the federal government. Rhodes was able to access the largest quantitative database with multiple input variables and outputs related to the target group. No information on the prices was available. Consequently, the researcher found it difficult to measure efficiency in an effective manner. Even after several attempts and the use of a set of standard statistical approaches, the researcher did not obtain satisfactory results to evaluate the efficiency of this program in each school (Cooper et al., 2011). Hence, the researcher began to think about a more effective method by re-focusing on Farrell's work published in 1957 in order to develop new models to assess productivity, in addition to reviewing a previous work conducted by the supervisor of the thesis and Charnes, which the researchers presented an applicable mathematical model known as Tjalling Koopmans. A model that falls under the concepts of activity analysis used by Farrell (1957). With the combined efforts of the three researchers, it was concluded that input prices and output quantities could be determined by their ability to meet final demand (identifying inputs through outputs). More importantly, the performance of other decision-making units (public schools) can be used to assess the behavior of each decision unit on all outputs and inputs of other decision-making units used in the study. This enables them experimentally to determine their relative efficiency (Cooper et al., 2011). In 1978, Charnes, Cooper, and Rhodes published a scholarly article in the European Journal of Operations Research, in which the term Data Envelopment Analysis (DEA) was first coined (Cooper et al., 2011). From that time on, the use of this technique spread and many attempts were made to modernize its models. The DEA method is one of the most widely methods used to analyze the efficiency of government organizations (Abbott & Doucouliagos, 2003). A review of the literature revealed that DEA was utilized to evaluate the performance of hospital departments, banks, military institutions, courts, industrial and commercial companies as well as educational institutions, in addition to evaluation of economies of countries.

## III. The Concept Data Envelopment Analysis

The method of data envelopment analysis is a modern mathematical method used in the field of quantitative management models (Kaftroodya & Aminnaserib, 2014). It is a linear programming technique viewed as a data-oriented approach employed to assess the performance of a group of entities (Cooper et al., 2011). This method is one of the best-known and used approaches to evaluate and compare the relative efficiency of a group of similar decision-making units. It also helps to determine the best practice of resource use among a similar set of organizations or decision-making units. As a technical analysis, the DEA method depends on analyzing a group of decision-making units (DMUs), identifying a group of these units that are fully efficient. This group is regarded as a reference unit for the other inefficient units. Mathematically, DEA is a linear programming procedure for the input and output frontier analysis. The DEA assigns a balance of 1 or 100% for the fully efficient input / output unit compared to the other units and assigns a different balance from one (1) for inefficient units (Rosenmayer, 2014). The group of highly efficient units form a belt that encapsulates all inefficient units. This is actually, why this analysis is named data envelopment analysis (Fahmi, 2009).

### *a) Basic models of data envelopment analysis*

#### i. *Charnes, Cooper and Rhodes (CCR) Model*

The CCR model is the first applied model used the DEA method, which was presented in the research paper that was conducted by Charnes, Cooper and Rhodes in 1978. The short name of this model is the first letters of the names of the three researchers. The model was used to evaluate a program called "Follow through Program" and provided a new definition of the efficiency used in assessing the contribution of non-profit organizations' activities in public programs. A model in which several inputs and outputs of decision-making units participated in this program is monitored in order to extract a numerical scale of the efficiency of each unit, which provides a new way to estimate and identify shortcomings (Charnes at al., 1978).This model calculates the total efficiency and combines it into a single value. It is valid for units that operate at their optimal size. Thereupon, the efficiency index on this model represents CRS as an abbreviation for Constant Returns to Scale. This assumption indicates that the decision-making units (DMU) operate under constant return to scale. That is, any increase in the inputs will result in a proportional increase in the outputs (Marti et al., 2009).

ii. *Banker, Charnes, and Cooper Model*

Due to the widespread use of data envelopment analysis and its related research, the researchers Banker, Charnes and Cooper developed a model in 1984. This model was abbreviated as BCC based on the first letters of the three researchers' names. It is a model that includes the concept of variable returns to scale rather than constant returns to scale. The reason for this is that it is illogical for all institutions to operate at optimal volumes, especially in the face of competition and restrictions on organizations, whether governmental, financial or otherwise restrictions. Under this mode, a new variablehas been added, (ε), which can be used to identify variable returns to scale of the decision-making unit under study (Mahmoud and Madhar, 2010). This model distinguishes between two types of efficiency, namely, technical efficiency and efficiency scale. The latter is expressed by the following possibilities: First, the change in the results of outputs or inputs is regarded as incremental for the other one, and this known as increasing return to scale (IRS). Second, the increased inputs result in increased outputs, in a percent greater than the increase in the outputs, and this is known as decreasing variable return to scale (DRS). These models can be applied according to the quality of the decision-making units whose performance will be measured, either by input-oriented or output-oriented directing (Fahmi, 2009). Input-oriented directing means measuring efficiency by minimizing inputs, i.e., using a possibleminimum amount of inputs to produce a certain amount of services or outputs. In order to conduct benchmarking using this type of directing, one of the two models can be used. A model known as CCR-I that assumes constant returns to scale by minimizing inputs, or the model known as BCC-I that presumes variable returns to scale by minimizing outputs. On the other hand, output-oriented directing refers to the measurement of efficiency based on maximizing outputs, i.e., the measurement of the efficiency of decision-making units that aim at producing a larger amount of services or outputs using the available amount of inputs. In this case, one of two models can be adapted. A model known as CCR-O that assumes constant returns to scale by maximizing outputs, or the model known as the BCC-O model that postulates variable returns to scale by maximizing outputs.

*b) The difference between the models of returns to scale*

The first difference that can be derived from the concept of each model is that CCR model theorize that all enterprises operate at their optimum size, either by input-oriented or output-oriented directing. In contrast, BCC model considers the change in the return to scale, which may be decreasing, constant or increasing. On the other hand, the efficiency indicators according to the CCR model are determined by input-oriented directing and output-oriented directing are same. Therefore, the application of one direction is adequate. However, one can find that evaluations often differ according to the type of direction, input-oriented or output-oriented in case of BCC application. In fact, the main reason behind this is that the different assumptions of each model (Marti et al., 2009). In most assessments, an efficient decision unit in one model, i.e., CCR, is also found to efficient in the other model, i.e., BCC model. Hence, this unit of decision meets the requirements of the efficient constant returns to scale, or in other words operates at its optimum size (Fahmi, 2009). Finally, the efficiency measurement results from BCC model represents the net efficiency of the internal processes. While the efficiency measurement results from CCR model refers to the overall efficiency. In this case, both models are compared in order to identify the sources of inefficiency of inefficient units; is it due to inefficient internal processes of these units, due to environmental conditions surrounding the work of these units, or due to both reasons size (Fahmi, 2009).

*c) Advantages of using data envelopment analysis*

On the basis of the above-mentioned literature related to DEA, one can said that this method represents the best method based on the idea of benchmarking. According to Marti et al. (2009), examples ofDEA advantages include: a frontier-based methodology, analyze every decision making unit alone based on the minimum or maximum scale of performance of each unit. The author regarded DEA as a main alternative that can be used to avoid the use of the limits of random cost, due to the fact that DEA is a non-boundary method. DEA is characterized by a random frontier approach that does not require the development of any mathematical formula related to the functional form of the best mathematical formula of the function that links input and output variables. Cooper et al. (2011) provided additional advantages of DEA such as: the definition of decision making unit is characterized by comprehensiveness and flexibility, DEA requires very few assumptions in order to illustrate the relationship between multiple inputs and outputs correlated to decision making units, the relative effectiveness is defined in accordance of DEA avoids the need for other prices or other assumptions of variables' weights, which must be identified in advance and which are presumed to reflect the relative importance of different inputs and outputs. Finally, DEA enables to avoid the need for clarifying the supposed relationships between inputs and outputs.

Fahmi (2009) identified the following advantages of DEA: this method combine both internal efficiency, either quantitative or qualitative, and external efficiency. Therefore, the method deals with descriptive variables that are difficult to measure, such as quality, customer

satisfaction with services provided, in case of the availability of sufficient as well accurate qualitative data. On the other hand, DEA deals with factors that are beyond the control of the unit to be measured, determines sources and amounts of constant capacity of inputs used by the less efficient units, determines sources and amounts of excess capacity or the possibility of increasing outputs in less efficient units without increasing inputs. Finally,DEA determines the nature of the return on the volume of production at the limits of efficiency (fixed or variable return).

*d) Limitations of using DEA*

Despite the above-mentioned features of DEA, this method has its own shortcomings, such as the identification of identify input and output variables, especially in the higher education sector, which includes multiple and overlapped variables. Montoneri (2014) indicated that the basic models of DEA, i.e., CCR and BCC model, assess the relative efficiency of decision-making units based on benchmarking. However, these models do not permit any ranking or classification of the efficiency of these units. Abbott and Doucouliagos (2003) highlighted that the common practice of the DEA method is to utilize inputs that can only be controlled by senior level officials, usually focused on quantitative inputs, thus eliminating the use of input data and intangible outputs, such as experiences, competencies, quality ... etc., in the process of efficiency analysis and evaluation, despite the possible use of such outputs in case of sufficient data availability. For Rosenmayer (2014), the DEA method reveals the efficiency of inputs used to achieve the required outputs, but does not tell how costs can be reduced or how the value of outputs can be increased using different combinations of inputs and used outputs.

*e) Basic conditions and rules for measuring and comparing performance using the DEA method*

It was conclude that meeting the conditions of evaluation and comparing efficiency using DEA requires an available set of symmetric and homogenous decision making units in terms of inputs, outputs with a same objective or same output function. Furthermore, in order to get efficiency in the form of numbers, either coefficients or ratios, the inputs as well as the outputs under DEA method should be positive and quantifiable values. Finally, the relationship between inputs and outputs should be linear, so that an increase in input units results increased units of output and vice versa. Rosenmayer (2014) added that the measurement and comparison of the relative efficiency can be done in one of these cases: a time period for the same entity, multiple entities in the same year, time period and multiple cases.

Concerning the basic rules required to ensure the successful implementation of DEA models, Manzoni (2007) identified three rules. First, the number of decision making units involved in the study should be greater than or equal to the return of inputs and outputs. That is $S_s \geq I*O$, where "I" refers to inputs and "O" represents outputs. Second, the number of decision making units involved in the study should be greater than or equal to the sum of inputs and outputs. That is $S_s \geq 2(I+O)$. the third rule indicates thatthe number of decision making units with full efficiency based onconstant returns to scaleshould be less than or equal to one third of the decision-making units involved in the study. That is, Eff DMUs$\leq$ 1/3*$S_s$,where "I" refers to inputs,"O" represents outputs, Ss represents the sample size, and EffDMUs stands for decision making units with full efficiency. Among various programs designed specifically to measure the performance of a set of similar decision making units using the DEA method, DEAP Version 2.1 will be used to achieve this goal.

## IV. Assessment of Algerian Higher Educational Institutions Performance

In order to connect the theoretical framework presented above in the first part of this paper, and to give the study an applied character that proves or rejects the extent to which the DEA models can be used to evaluate performance, this method was appliedto evaluate the performance of the Algerian higher education institutions in each academic year . To achievement of this goal, a series of stages were followed.

*a) Identification of input and output indicators*

The precise identification of the basic input and output group required for the application of data envelopment analysis provides a precise results of performance measurement which facilitate their analysis and subsequent interpretations. For the current study, three inputs and four outputs were selected:

*Inputs:* three inputs were selected, which represents fundamental bases for any educational institution and reflect teaching and learning process. These inputs are: (1) students enrolled in graduation stage, which comprise the total number of students enrolled in the bachelor's degree. (2) students enrolled in postgraduate stage, which consist all students enrolled in Masters and doctorate programs. (3)Permanent instructors (or academic staff), which include the total number of full-time members from all academic levels.

*Outputs:* two outputs were selected, which represents academic processes and scientific research. These outputs are: (1) degrees' holders of graduates, which include the total number of students in the graduation stage. (2) scientific publications, which refer to the total number of scientific papers published every year in addition to theses, articles presented in conferences and available on the websites.

*b) Identification of decision making units*

Decision making units that reflect the sample of the study to which the data analysis method will be applied, a group of similar entities may be set within one year or may be set within several years related to one entity, or may be set as several entities that reflect a period of time. The present study used decision-making units of 16 academic years, including indicators of inputs and output of all institutions of higher education in Algeria.

*c) Summarizing data*

Table 1 shows a summary of the aggregated data of all higher education institutions in Algeria during 16 academic years.

*Table 1:* Indicators of aggregated data of higher education institutions in Algeria for 16 years

| Academic year | Decision-making unit | Inputs indicators | | | Output indicators | |
|---|---|---|---|---|---|---|
| | | Input 1 | Input 2 | Input 3 | Output 1 | Output 2 |
| | | Total number of students in graduate stage | Total number of students in post graduate stage | Total number of permanent instructors | Total number of degrees holders | Total number of scientific publications |
| 2000 | $DMU_1$ | 407995 | 20846 | 17460 | 52804 | 518 |
| 2001 | $DMU_2$ | 466084 | 22533 | 17780 | 65192 | 593 |
| 2002 | $DMU_3$ | 543869 | 26060 | 19275 | 72737 | 642 |
| 2003 | $DMU_4$ | 589993 | 26279 | 20769 | 77972 | 883 |
| 2004 | $DMU_5$ | 622980 | 30221 | 22650 | 91828 | 1162 |
| 2005 | $DMU_6$ | 721833 | 33630 | 25229 | 107515 | 1299 |
| 2006 | $DMU_7$ | 743054 | 37787 | 27067 | 112932 | 1811 |
| 2007 | $DMU_8$ | 820664 | 43458 | 29062 | 121905 | 2011 |
| 2008 | $DMU_9$ | 952067 | 48764 | 31703 | 146889 | 2471 |
| 2009 | $DMU_{10}$ | 1048899 | 54924 | 34470 | 150014 | 3108 |
| 2010 | $DMU_{11}$ | 1034313 | 58975 | 37688 | 199767 | 3163 |
| 2011 | $DMU_{12}$ | 1077945 | 60617 | 40140 | 246743 | 3583 |
| 2012 | $DMU_{1»}$ | 1090592 | 64212 | 44448 | 233879 | 4276 |
| 2013 | $DMU_{14}$ | 1124434 | 67671 | 48398 | 288602 | 4943 |
| 2014 | $DMU_{15}$ | 1119515 | 70734 | 51299 | 271430 | 5160 |
| 2015 | $DMU_{16}$ | 1165040 | 76510 | 53622 | 283430 | 5171 |

*Source: DDP/SDPP, ANNUAIRE STATISTIQUE, N° (39-40-41-42-43-44), MESRS, REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE, (2009-2015), & http://www.scimagojr.com/countrysearch.php?country=dz (Date Found : 17/10/2017)*

*d) Evaluation of the correct use of DEA method in assessment of higher education institutions in Algeria*

Since the input and output indicators shown in Table (1) represent positive quantitative values concern the indicators of the total Algerian higher education institutions over 16 successive academic years, from 2000 to 2015, this allows to initially employ the DEA method to evaluate and compare the performance of these institutions in each year. Before inserting the data in Table 1 into the DEAP program and conducting the DEA method, one should ensure that correct selection of the method and the availability of the conditions of the estimation power of the method. Consequently, following steps were followed:

i. *Assessment of the positive relationship between inputs and outputs*

In order to ensure a positive correlation between the variables of the study, we should ensure that inputs and outputs of the total number of the higher educational institutions in Algeria, which is already organized in Table (1), are correlated. Since we have quantitative variables, Pearson correlation Coefficients (r) were calculated. Table 2 displays the matrix correlation between inputs and outputs of Algerian higher educational institutions.

*Table 2:* Correlation Matrix of inputs and outputs of higher education institutions in Algeria for 16 years

| Variables | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Total number of students in graduate stage | 1 | | | | |
| Total number of students in postgraduate stage | **9800. | 1 | | | |
| Total number of permanent instructors | **9460. | **9880. | 1 | | |
| Total number of degrees holders | **9330. | **9720. | **9840. | 1 | |
| Total number of scientific publications | **9490. | **9870. | **9960. | **9820. | 1 |
| ** Significant at p-value ≤ 0.01 | | | | | |
| Source: results of SPSS statistics, V. 22 | | | | | |

The findings shown in Table 2 reveal that all correlation coefficients are statistically significant at 0.01. The table shows that there is a strong positive correlation of more than 0.9 (90%) among all input and output variables. This indicates a strong positive correlation between the output variables and the three input variables, i.e., the increase in one or all inputs will inevitably lead to an increase in the quantity of outputs. In addition, there is a strong positive correlation coefficient greater than 0.9 (90%), among the three input variables and among the output variables.

ii. *Assessment of the positive relationship between inputs and outputs*

Before analyzing the data presented in Table 1, the extent to which the initial rules of DEA method should be investigated. The first rule was met due to the result that the return of inputs and outputs is less than the number of decision making units included in the study:

$$[Ss \geq I*O] \longrightarrow [16 > 3*2] \longrightarrow [16 > 6]$$

Where O: number of outputs, I: number of inputs, Ss: number of decision making units.

Additionally, the second rule was met by reason of the result that the number of decision making units is greater than the twice of the total of inputs and outputs.

$$[Ss \geq 2(I+O)] \longrightarrow [16 > 2(3+2)] \longrightarrow [16 > 10]$$

On the strength of the previous steps it was concluded that the basic requirements for applying DEA model as well as estimation power rules of DEA are all available, which means thatwe have input and output indicators covering 16 academic years (a time period) for one entity, which means the ability to measure the performance and to compare the achieved performance between years. On the other hand, the values of inputs and outputs are positive. The correlation coefficient between the selected indicators of inputs and outputs are positive, which indicates their homogeneity and the existence of a positive relationship between these indicators. The sample size (number of decision-making units) is greater than the return value of inputs and outputs. Moreover, the sample size (number of decision-making units) is three times greater than the values of inputs and outputs. Finally, the sum of outputs and inputs are less than one-third of the number of decision-making units.

## V. Results of the Measurement of the Performance of Algerian Higher Education Institutions Using DEA

After the data entry of the quantitative values of the input and output variables into the analysis software, DEA method was applied by selecting BCC model using output-oriented directing, in order to measure the performance of Algerian higher education institutions during 16 academic years, constant return to scale technical efficiency (Crste), variable return to scale technical efficiency (Vrste), efficiency scale (ES), return to scale (RS), decision making units (DMU). The results are shown in Table 3.

*Table 3:* Results of the assessment of Algerian higher education institutions during 16 years based on BCC-I and BCC-O

| DMU | | | BCC-I | | | | | | BCC-O | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Crste | Vrste | IV | ES | REP | RS | RDMU | Vrste | IV | ES | REP | RS | RDMU |
| $DMU_1$ | 2000 | 0.594 | 1.000 | 0.000 | 0.594 | 40.6 | Increased | 1 | 1.000 | 0.000 | 0.594 | 40.6 | Increased | 1 |
| $DMU_2$ | 2001 | 0.678 | 1.000 | 0.000 | 0.678 | 32.2 | Increased | 2 | 1.000 | 0.000 | 0.678 | 32.2 | Increased | 2 |
| $DMU_3$ | 2002 | 0.654 | 0.971 | 0.029 | 0.674 | 32.6 | Increased | 12 2 | 0.941 | 0.059 | 0.696 | 30.4 | Increased | 2 12 |
| $DMU_4$ | 2003 | 0.696 | 0.963 | 0.037 | 0.722 | 27.8 | Increased | 2 1 14 | 0.931 | 0.069 | 0.747 | 25.3 | Increased | 14 2 |
| $DMU_5$ | 2004 | 0.712 | 0.959 | 0.041 | 0.743 | 25.7 | Increased | 10 2 14 | 0.908 | 0.092 | 0.785 | 21.5 | Increased | 12 2 14 |
| $DMU_6$ | 2005 | 0.750 | 0.927 | 0.073 | 0.808 | 19.2 | Increased | 12 2 14 | 0.896 | 0.104 | 0.836 | 16.4 | Increased | 2 12 14 |
| $DMU_7$ | 2006 | 0.701 | 0.966 | 0.034 | 0.726 | 27.4 | Increased | 14 2 10 | 0.933 | 0.067 | 0.751 | 24.9 | Increased | 14 10 2 |
| $DMU_8$ | 2007 | 0.698 | 0.943 | 0.057 | 0.741 | 25.9 | Increased | 2 14 10 | 0.897 | 0.103 | 0.778 | 22.2 | Increased | 2 14 10 |
| $DMU_9$ | 2008 | 0.774 | 0.967 | 0.033 | 0.801 | 19.9 | Increased | 2 14 10 | 0.945 | 0.055 | 0.819 | 18.1 | Increased | 14 10 2 |
| $DMU_{10}$ | 2009 | 0.883 | 1.000 | 0.000 | 0.883 | 11.7 | Increased | 10 | 1.000 | 0.000 | 0.883 | 11.7 | Increased | 10 |
| $DMU_{11}$ | 2010 | 0.876 | 0.955 | 0.045 | 0.917 | 08.3 | Increased | 12 2 14 | 0.934 | 0.066 | 0.938 | 06.2 | Increased | 12 2 14 |
| $DMU_{12}$ | 2011 | 1.000 | 1.000 | 0.000 | 1.000 | 0.00 | Constant | 12 | 1.000 | 0.000 | 1.000 | 0.00 | Constant | 12 |
| $DMU_3$ | 2012 | 0.942 | 0.978 | 0.022 | 0.963 | 03.7 | Increased | 14 10 1 | 0.969 | 0.031 | 0.972 | 02.8 | Increased | 114 10 |
| $DMU_{14}$ | 2013 | 1.000 | 1.000 | 0.000 | 1.000 | 0.00 | Constant | 14 | 1.000 | 0.000 | 1.000 | 0.00 | Constant | 14 |
| $DMU_{15}$ | 2014 | 1.000 | 1.000 | 0.000 | 1.000 | 0.00 | Constant | 15 | 1.000 | 0.000 | 1.000 | 0.00 | Constant | 15 |
| $DMU_{16}$ | 2015 | 0.981 | 1.000 | 0.000 | 0.981 | 01.9 | Decreased | 16 | 1.000 | 0.000 | 0.981 | 01.9 | Decreased | 16 |
| Mean | | 0.809 | 0.977 | 0.023 | 0.827 | 17.3 | | | 0.960 | 0.04 | 0.841 | 15.9 | Increased | 1 |

Crste: constant return to scale technical efficiency, efficient indicator of constant return to scale, Vrste: variable return to scale technical efficiency, IV: inefficient value, ES: efficiency scale, REP: ratio of expansion possibility, RS: return to scale, RDMU: reference decision making units,

Before the discussion of performance results based on BCC-I and BCC-O models, which we explained in detail in Table 3, we should assess the extent to which the third rule of the DEA method is achieved.

$$EffDMUs \leq 1/3*Ss \longrightarrow 3 \leq 1/3*16 \longrightarrow 3 < 5.33$$

The third rule was met, which means that the sample size is acceptable because of the number of decision-making units or the number of academic years with full efficiency according to the Vrsteindicator is less than one-third of the academic years in the study. Since all the requirements and rules of the estimation power were met, this makes the performance measurement results obtained using the DEA method accurate and valid. These results will be analyzed, interpreted and compared as follows:

## VI. Discussion of the Results of the Performance of Algerian Higher Education Institutions based on BCC-I and BCC-O

We first applied the BCC-I model, which takes into account the change in returns to scale in terms of using the least amount of inputs to achieve a certain amount of outputs. Then, we applied the BCC-O model, which assumes a change in returns to scale , in terms of maximizing outputs using the inputs already available. The BCC model gives both directions one value (1.00 or 100%) for a full efficiency academic year, and a value different from one for the academic year that is not efficient. Through the various indicators of relative efficiency and efficiency scale shown in Table (3), we noted the following: (1) there is a variance in efficiency ratios (performance) of Algerian higher education institutions between academic years either by input-oriented or output-oriented directing. (2) Algerian higher education institutions achieved full efficiency in seven academic years according to the Vrste indicator in both models: 2000, 2001, 2009, 2011, 2013, 2014 and 2015. (3) Higher education institutions have not achieved full efficiency in nine academic years, neither in terms of Crste or Vrste in both input-oriented and output-oriented directing: 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2010 and 2012. (4) Higher education institutions in 2000, 2001, 2009 and 2015 achieved full efficiency in terms of Vrste and did not achieve the efficiency of the Crste, which confirms that Algerian higher education institutions are subject to change in returns to scale from one academic year to another. (5) The Vrste indicators for inefficient academic years were varied in both models and relatively close to the full efficiency rate (i. e., close to 1.00). (6) Algerian higher education institutions from 2000 to 2010, in addition to 2012 (i. e., 12 academic years), were operating at increased returns to scale, which means that the increase in their annual inputs led to an increase in their annual output by a ratio greater than the rate at which inputs increased. Thus, in these years, the Algerian higher education institution could expand its production. This expansion is in varying proportions between an inefficient academic year and another, as shown in the seventh column and the thirteenth column of Table (3). (7) Higher education institutions in 2011, 2013 and 2014 achieved full efficiency according to Crste, Vrste, and even efficiency scale of institutions of higher education in these years is 1.00, which is the best three academic years in terms of internal processes efficiency, and the overall efficiency of Algerian higher education institutions, and that the institutions of higher education in these years used all inputs to achieve their actual outputs, and it was not in their interest to expand in 2012 and 2015 and had to maintain their optimum performance. (8) Algeria's higher education institutions are working at a decreasing return to scale in 2015, which means that the increase in output of this year required institutions to use more of its inputs.(9) According to the BCC-I model, the year 2000 was a reference academic year for twice; while 2001 and 2013 were repeated as a reference year for eight inefficient academic years, while 2009 was repeated five times as a reference academic year, while 2011 was repeated only three times.(10) According to the BCC-O model, 2000 was repeated for one time as a reference academic year. While 2001 was repeated eight times. On the other hand, 2009 and 2011 was repeated four times as a reference unit for inefficient academic years. The year 2013 was repeated eight times as a reference year for inefficient academic years. (11) 2014, and 2015 have not been repeated as academic reference year for the rest of the academic years is not efficient according to the both models. The above observations, which we obtained by reading the results of Table 3 can be explained by Table 4, in which we explained the quantities of excess inputs and constant outputs according to inputs minimization or output maximization.

*Table 4:* Values of excess inputs and constant outputs based on BCC-I and BCC-O models

| DMU | | Excess inputs | | | Constant outputs | | Excess inputs | | | Constant outputs | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Input 1 | Input2 | Input 3 | Output 1 | Output 2 | Input1 | Input2 | Input3 | Output 1 | Output2 |
| $DMU_1$ | 2000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| $DMU_2$ | 2001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $DMU_3$ | 2002 | 36393.5 | 1179.3 | 0.000 | 0.000 | 75.2 | 36875.6 | 980.6 | 0.000 | 0.000 | 110.3 |
| $DMU_4$ | 2003 | 69999.1 | 0.000 | 136.1 | 0.000 | 0.000 | 69272.5 | 0.000 | 448 | 0.000 | 5.76 |
| $DMU_5$ | 2004 | 33569.3 | 183.6 | 0.000 | 0.000 | 0.000 | 48966.3 | 382.9 | 0.000 | 0.000 | 0.000 |
| $DMU_6$ | 2005 | 72965.4 | 0.000 | 0.000 | 0.000 | 78.2 | 92624.5 | 0.000 | 0.000 | 0.000 | 197.7 |
| $DMU_7$ | 2006 | 24733.6 | 0.000 | 0.000 | 5501.3 | 0.000 | 32330.1 | 0.000 | 0.000 | 4480.6 | 0.000 |
| $DMU_8$ | 2007 | 19376.1 | 1428.2 | 0.000 | 0.000 | 0.000 | 41385.1 | 1837.8 | 0.000 | 0.000 | 0.000 |
| $DMU_9$ | 2008 | 103218 | 3048.1 | 0.000 | 0.000 | 0.000 | 117985.2 | 3319.3 | 0.000 | 0.000 | 0.000 |
| $DMU_{10}$ | 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| $DMU_{11}$ | 2010 | 117981.7 | 6466.6 | 0.000 | 0.000 | 0.000 | 115715.1 | 6137.8 | 0.000 | 0.000 | 0.000 |
| $DMU_{12}$ | 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| $DMU_{13}$ | 2012 | 0.000 | 686.2 | 0.000 | 9879.1 | 0.000 | 0.000 | 575 | 0.000 | 9464.3 | 0.000 |
| $DMU_{14}$ | 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| $DMU_{15}$ | 2014 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| $DMU_{16}$ | 2015 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

For quantities of excess inputs and constant outputs in the academic years 2002 to 2008, as well as 2010 and 2012, Algerian higher education institutions did not achieve full efficiency, in accordance with the goal of minimizing inputs and the goal of maximizing output as shown in Table 4.That is, the possibility of achieving outputs in larger quantities than the actual outputs actually shown in Table 3 by using less inputs than actually used, because higher education institutions operate at increased returns to scale. The excess number of first and second entries represented in the total number of students enrolled in the gradate stage, and the total number of students registered in the post-graduate stage, show that the general policy of higher education in Algeria aims to increase the annual quantities of these two inputs, while ignoring the need to maximize outputs, particularly those of total scientific publications.

In our review of the results of the measurement of the quantitative performance of higher education institutions as a unit according to Vrste model in terms of input-oriented or output-oriented directing, we can say that the performance of the higher education institutions in Algeria varies between years. The Algerian higher education institutions were able to use their actual inputs to achieve their actual outputs , i.e., more efficient in 2011, 2013 and 2014 and were operating at their optimal size levels. In the years 2000, 2001 and 2009, although they achieved their actual outputs using their actual inputs, institutions were able to expand their output to achieve the possible outcomes through the use of more than the actual amount of inputs. For the rest of the academic years in which higher education institutions did not achieve full efficiency and were able to use fewer inputs to achieve the same outputs or even maximize these outputs, it was clear through the results of excess inputs, constant outputs, that in the period from 2002 to 2010 there was a large surplus in the number of students enrolled in the graduate stage, and in the years 2002, 2004, 2007, students enrolled in the graduate stage, and in the years 2002, 2004, 2007, 2008, 2010, 2012 there were surplus in the number of students enrolled in the postgraduate phase. the third input represented by permanent academic staff, there were surpluses registered in 2003 only. In the rest of the years, all quantities were used to achieve the actual output possible to use the same quantities to maximize the amount of output as well.

## VII. Conclusion

This paper aims to explain the effectiveness of using the method of data envelopment analysis in the evaluation of the performance of Algerian higher education institutions, and despite the use of five indicators of inputs and outputs of quantitative values and limited to reflect only the dimensions of teaching and scientific research only, and does not reflect the service of the community and the quality of scientific research. However, the results of the study are useful to various stakeholders and policy makers in the Algerian higher education sector and in other institutions of higher education in the Arab world, because the results this study revealed will facilitate the process of distribution and allocation of resources in future. It also provides institutions with an ideal way to measure and compare the performance of universities, institutes, colleges, and departments and stand on the reasons for the inefficiency of each of them and try to improve its performance in future.

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# Ghanaian Mathematics Teachers' use of ICT in Instructional Delivery

By Farouq Sessah Mensah

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*Abstract-* *Purpose:*The purpose of the study was to investigate the extent of ICT use among Ghanaian mathematics teachers in their instructional delivery.

*Design/methodology/approach:* A cross-sectional survey design was adopted in the present study. A stratified sampling technique was used to select 120 mathematics teachers from 24 public Senior High Schools (SHS) with 12 schools each located in the rural and urban areas respectively. The study employed questionnaires in data collection.

*Findings:* The findings of the study indicated the use of Word Processing, Internet and Calculators as very high. The study also revealed that mathematics teachers had favorable attitudes towards the use of ICT in teaching mathematics.

*Keywords:* *teachers, mathematics, information communication technology, instructional delivery, senior high school (SHS).*

*GJHSS-G Classification:* *FOR Code: 930299*


*Strictly as per the compliance and regulations of:*

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*Findings:* The findings of the study indicated the use of Word Processing, Internet and Calculators as very high. The study also revealed that mathematics teachers had favorable attitudes towards the use of ICT in teaching mathematics. The study further showed that most teachers were competent in the use of ICTs such as Microsoft office word ($\boldsymbol{mean = 2.9}$), PowerPoint($\boldsymbol{mean = 2.6}$), Excel ($\boldsymbol{mean = 2.6}$), and Calculators($\boldsymbol{mean = 3.1}$). The findings showed that there is a positive correlation between mathematics teachers' use of ICT and competences ($\boldsymbol{r = 0.421, p < 0.05}$).

*Research Limitations/Implications :* In common with others, the study is limited to public SHS mathematics teachers in the Central Region of Ghana. The results may differ if replicated in private SHS and other geographies.

*Practical implications:* A number of significant implications are drawn from this study, for example using,the Curriculum Research Development Division (CRDD) of the Ghana Education Service in collaboration with the related agencies in the Ministry of Education should carry out research to review critically the mathematics curriculum and revise the existing syllabus to explicitly state what ICT tools must be used and how it should be used in the teaching and learning process.
Social Implication –The teaching institutions should endeavor to make the necessary provisions for more females to pursue mathematics in their pre-service education and also train them to develop the skills in ICT in order to integrate it in their instructional delivery.

*Originality/ value:* The paper provides valuable insights, from the key educational stakeholders' perspectives, into the use of ICT in instructional delivery. It has empirically shown the extent to which Ghanaian mathematics teachers use ICT.

*Keywords: teachers, mathematics, information communication technology, instructional delivery, senior high school (SHS).*

## I. Introduction

A catch phrase in education today is Information Communication and Technologies (ICT) use. The rapid growth in ICT have brought remarkable changes in the twenty-first century, as well as affected the demands of modern societies. The call to integrate ICT in education has become a major concern to many countries all over the world. Until recently, the primary teaching resources available to teachers were the books in libraries. However, ICT has provided a new kind of support for instruction through the development of facilities that supports the teaching and learning process.

According to the Ministry of Education, Youth and Sports (MOEYS) and Ghana Education Service (GES) (2002), integrating technology in classroom instruction ensures greater motivation, increases self-esteem and confidence, enhances good questioning skills, promotes initiative and independent learning, improves presentation of information/outputs, develops problem solving capabilities, promotes better information handling skills, increasing focus time on task, and improves social and communication skills.

Several studies have revealed that ICT plays important role in teaching and learning mathematics. For instance, Becta (2003) assert that the use of technology in mathematics classroom allows the students to focus on strategies and interpretation of answers rather than spend time on tedious computational calculations. ICT use in mathematics instruction assists the learner in visualizing the process and concept role of symbols, which reaches great heights in calculus (Tall & Ramos, 2004). Ittigson and Zewe (2003) also opine that technology improves the way mathematics should be taught and enhances students understanding of basic concepts. It deemphasizes algorithmic skills resulting in an increased emphasis on the development of mathematical concepts.

Integrating ICT tools such as computers and scientific calculators in mathematics instruction have the potential to change pedagogical approaches radically and to improve individual student learning outcome by transforming the classroom social practices (Forgasz& Prince, 2004; Goos, 2005). It is therefore essential for Senior High School (SHS) mathematics teachers to use ICT tools in teaching and also urge students to use ICT tools in learning mathematics. This will enable the students to better understand the mathematical concepts taught.

## II. Statement of the Problem

The government of Ghana in collaboration with the Ministry of Education Science and Sports has made

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provisions to ensure that Senior High School (SHS) students get access to quality education which takes into accounts the integration of ICT in instruction (MOESS, 2010). In view of this, education stakeholders and policymakers have made a remarkable step towards the introduction of ICT in SHS that will contribute to knowledge production, communication and information sharing among students and teachers in the school system. For instance, there has been an ICT for Accelerated Development (ICT4AD) policy which seeks to provide a framework in which ICT will be used to transform the educational sector, allowing all Ghanaians to pursue quality life-long learning opportunities regardless of their geographicallocation (Republic of Ghana, 2003). Besides, the new educational reforms in Ghana, there is also high emphasis placed on the integration of ICT in all subject areas (MOESS, 2010).

Also, there has been a sudden increase in computer laboratories at all levels of the school system and this testifies to the potency of the use of ICT in education delivery (Yidana & Asiedu-Addo 2001). Furthermore, ICT has currently become a compulsory (core) subject for every SHS student in Ghana. Pre – service mathematics teachers are trained to integrate ICTs in the teaching and learning of mathematics with practicing teachers been trained through workshops (to promote acquisition of technological pedagogical content knowledge (TPACK) (Mishra & Koehler 2006).

With such an increased emphasis on ICT and a large investment in its infrastructure, teachers are expected to be competent and effective in using it. However, with teachers' increasing knowledge of and familiarity with ICT and there being infrastructure to support it, many mathematics teachers are still not effectively and efficiently integrating ICT into their teaching (Buabeng-Andoh, 2015).

Evidence from other countries in the world, however, reveals that such commitments and investments in ICT in education do not lead to technology adoption (Gulbahar, 2007). Rather, technology adoption in educational settings is a complex process that is influenced by many other factors such as teacher-level, school-level, and system-level factors (Balanskat, Blamire & Kefalla, 2006). Sherry and Gibson (2002) argued that technological, individual, organizational, and institutional factors should be considered when examining technology adoption in educational systems.

There has been quite a number of research to investigate Ghanaian mathematics teachers and students' use of technology in teaching and learning and the factors that support or inhibit their effective integration into classroom practices (Boakye and Banini, 2008; Omollo, 2011, Agyei and Voogt, 2011). However, Mereku, Yidana, Hodzi, Tete-Mensah, Tete-Mensah, and Williams (2009) asserted that for Ghana, and Africa as a whole, to be able to fully integrate ICT into teaching and learning there is the need for frequent collection and analysis of data on ICT usage. It was therefore essential to conduct an empirical study to investigate ICT use among Ghanaian SHS mathematics teachers. Besides, the researcher also intended to investigate factors that influence ICT use in teaching mathematics at the SHS level.

## III. Purpose of the Study

The purpose of this study was to determining the extent of ICT integration in the teaching of mathematics at the SHS level in Ghana. Investigating ICT use in teaching and learning SHS mathematics was crucial because this knowledge could provide guidance for ways to enhance technology integration and encourage greater use of technology in teaching and learning mathematics.

*Research questions*

1. To what extent do SHS mathematics teachers use ICT in teaching and learning mathematics?
2. What are the attitudes of mathematics teachers towards the use of ICT in teaching and learning of mathematics?
3. How competent are mathematics teachers in using ICT?
4. What factors influence the use of ICT in teaching and learning of mathematics?

## IV. Significance of the Study

The study is significant because it provides insights into teachers ICT use at the SHS level that is sustainable and transferable to other levels in educational ladder. The study provides empirical evidence on ICT use among mathematics teachers at the SHS level in Ghana. This might provide guidance for policy makers and stakeholders in education when structuring and introducing ICT integration policies in Senior High Schools. The study also adds to knowledge by providing new evidence about ICT use among mathematics teachers in Ghana.

### *a) Theoretical Framework*

In a bid to understand the ICT use among Ghanaian mathematics teachers, the Diffusion of Innovations theory put forward by Rogers (2003) guided the study. The Innovation Diffusion Theory seeks to explain how innovations are taken up in a population. An innovation is an idea, behavior, or object that is perceived as new by its audience. ICT use by mathematics teachers and students is an innovation whose use depends on several considerations.

The theory, as mentioned above, purports to describe the patterns of usage, explain the mechanism, and assist in predicting whether (and how) a new invention will be successful making it a more fitting theory in this context. Achieving complete success (if at

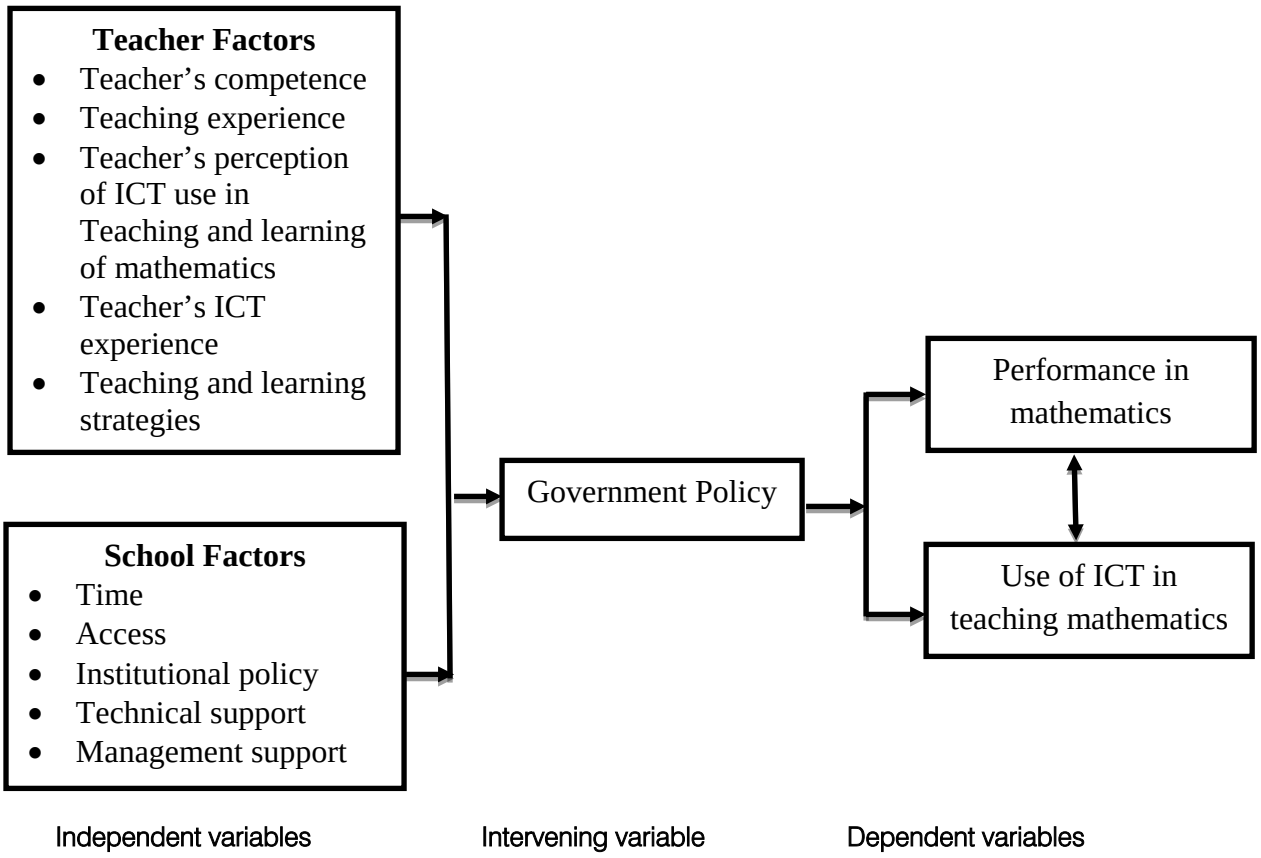
all) in the adoption of a new innovation might usually take a considerably long time and sometimes this adoption is met with a lot of resistance from certain quarters of the society in which the innovation is to be diffused. Niccolo Machiavelli (1513) succinctly explains: "There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new order of things…" The "old order" of things in academic insofar as knowledge dissemination goes is the teacher standing in front of a class facing the students and imparting knowledge (Kuh 2001). The teacher in this old order is the "all-knowing" custodian of knowledge and the student the passive receiver or in some instances just a knowledge repository. In this old order, the use of chalk and talk method, variously referred to as the exposition method of teaching, has been the predominant way of this kind of knowledge dissemination.

The use of ICT in teaching and learning therefore is a relatively new innovation in this regard within the educational sector and indeed a fundamental change in the way SHS teachers and student conduct their core activities qualifying it to be "the new order of things" (Rogers 2003). SHS are known to be systems that are virtually hard to change. This is not only because of their inherent characteristic of bottom-heaviness but also for the fact that the latter usually find themselves stuck in path dependencies and historical legacies that they try to uphold and protect making change in the way they conduct their core activity an evolution and not a revolution; a process rather than an event (Clark 1983). Notwithstanding this characteristic of being resistant to change, there has been a proliferation of ICTs in most if not all campuses around the world (Selwyn 2007; Adam 2003).

*b) Conceptual Framework*

According to Ogula, (1998) conceptual framework is a description of the main independent and dependent variables of the study and relationship among them. The study was conceptualized on the variables used in the objectives. This study isolated teacher and school factors as the main factors that may influence integration of ICT in teaching and learning of mathematics in particular (Becta, 2004). Teacher related factors are those that directly influence teachers' use of ICT in the teaching-learning process and include: teachers' knowledge and skills in the use of ICT, attitudes of teachers towards teaching using ICT and teacher's experience, among others. School factors on the other hand, refer to factors influenced by the institution. They include: support given to teachers by the school management which has a bearing on access to ICT facilities, school ICT policy, technical support in terms of availability of experts, spare parts and software required to keep the ICT tools functioning. Government policies influence both the adoption of new technologies by the teachers and the schools, which in turn, will affect the extent of integration of ICT in teaching and learning of mathematics. Figure 1 summarises the conceptual framework for this study

Adoption of ICT in teaching and learning will depend on both the teacher and school factors. For instance, if a teacher has the necessary skills and knowledge on how to integrate ICT in pedagogical practice, then he or she will be willing to try out this innovation and with time, he or she becomes confident in using ICT in teaching. Moreover, the teacher's pedagogical beliefs will influence the teaching strategy adopted when teaching a given lesson. The attitude of the teachers towards integrating ICT in classroom instruction could be influenced by the level of support by the school management. This study investigated how teacher and school related factors influence the use of ICT in the teaching and learning of mathematics.




*Source: Adapted fromMaithya R. and Ndebu S. (2011)*

*Figure 1:* Conceptual Framework of the Study

## V. Methodology

*a) Research design*

The study used a cross-sectional survey to collect information on ICT use among SHS mathematics teachers and the factors that influence its' usage. Lavrakas (2008) opines that cross-sectional data are usually collected from respondents making up the sample within a relatively short time frame (field period). In a cross-sectional study, time is assumed to have random effect that produces only variance, not bias. Creswell (2012) argues that cross-sectional survey design has the advantage of measuring current attitudes or practices. Cross-sectional survey was preferred as a method of data collection over others in this particular study due to the fact that many questions were asked and it was possible to reach the entire SHS mathematics teachers within a short period of time (Fowler, 2002).

*b) Population*

The population of the study comprised of all public Senior High School (SHS) Mathematics Teachers in the Central region of Ghana. Central region was chosen for this study because on of the researchers has been teaching in the region for the past seven years and is familiar with the academic environment in the region. Mathematics teachers were used in the study because the mathematics curriculum in particular emphasizes the use of ICT in the teaching and learning process.

*c) Sample and sampling technique*

Stratified sampling technique was used to select 120 mathematics teachers from the Central region of Ghana. According to Mason, Lind and Marchal (1999) a stratified random sampling is when the population is first divided into subgroups, called strata. A sample is then selected from these subgroups and then the sample for the study is thus selected from the stratum. Stratified sampling technique was used in this study because most of the SHS in Central region are located in both rural and urban districts. Therefore to be able to get equal representatives of SHS from both rural and urban settings, stratified sampling technique was employed. The distribution of the sampling procedure is presented in Table 1.

*Table 1:* Stratified Sampling of Participants

| Strata | Number of SHS | Number of Teachers |
|---|---|---|
| Urban districts | 12 | 60 |
| Rural districts | 12 | 60 |
| Total | 24 | 120 |

*Source: Field Data, 2017*

*d) Instrument*

After a careful review of appropriate literature, questionnaire was chosen as the instrument to collect data to answer the questions set for this study. Questionnaire was chosen because it took less time to administer them and also ensured the anonymity of respondents (Fraenkel & Wallen, 2000).

## VI. Data Analysis

All the questionnaires were checked to ensure they had all been correctly filled. Then the data collected was coded appropriately and then analysed using Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive statistics including percentages, means and frequency tables were employed in the analysis. This was used to find out the extent to which SHS mathematics teachers use ICT in teaching mathematics, mathematics teachers IC competence and the attitudes of teachers towards the use of ICT in teaching of mathematics.

To identify the factors that influence ICT usage in teaching of mathematics, Pearson Product Moment Correlation was used to find the relationships between dependent variable and independent variables. This is one of the two mainly used measures of association or correlation among variables in educational research (Cohen et al., 2011).

## VII. Results and Discussion

*a) Background Information of Mathematics Teachers*

The background information regarding the mathematics teachers is presented in Table 2. The result of the study it indicated that 72.5% and 27.5% of the mathematics teachers in the sampled schools were males and females respectively (see Table 2). This skewed ratio is a reflection of the low population of girls pursuing mathematics at the tertiary level of education. Pertaining to the age of the teachers as shown on Table 2, the findings indicate that, cumulatively most teachers are 40 years and below, 108 (90.0%) and only a small proportion of teachers 12 (10.0%) were above 40 years. According to Muchiri (2008) younger teachers are more open to use of ICT than most but not all older teachers. The results showed that the majority of the teachers have a working experience of above six years (Table 2). Long experience of teaching a particular subject is important because it could contribute to good content mastery by the teacher.

This study showed that all mathematics teachers in the sampled schools are professionally qualified with 67.5% and 21.7% having Bachelors and Masters Degrees respectively. This is an important aspect since according to Allison (1997) skilled and knowledgeable workforce is closely linked with successful implementation of technology. The study showed that 60.0% of the teachers in the study sample have interacted with computers for between one and six years while 40.0% have computer experience of more than six years (Table 2). From Table 2, a good proportion (77.5%) of the teachers in the sampled schools have been trained on use of computers. Some of the teachers were trained during their pre-service teacher training since computer studies are offered in teacher training institutions and universities as a service subject. The study showed that 85.0% of the mathematics teachers in the sampled schools have been trained on how to integrate ICT in the teaching and learning of mathematics.

*b) Extent of ICT integration in Teaching and Learning of Mathematics*

The first research question raised in this study was to find out the extent to which SHS mathematics teachers use ICT in teaching and learning of mathematics. To answer this question, the mathematics teachers' use of ICT in teaching mathematics was examined. The mean ratings were interpreted using the guide; $2.25 < x \leq 3.0$ (Very high), $1.5 < x \leq 2.25$ (high), $0.75 < x \leq 1.5$ (moderate) and $0 < x \leq 0.75$ (low).

Use of word processing, Internet and Calculators were rated very high (mean ratings $= 2.33, 2.73,$ and $2.41$respectively). This is consistent with the findings of Becker, Ravitz and Wong (1999) who established that word processing and World Wide Web (WWW) browsing software were the most commonly used applications by teachers regardless of the subject they taught. The use of PowerPoint, Excel, Computer and Mobile Phones were rated high (mean ratings $= 1.76, 1.94, 1.99$ and $2.10$ respectively). The use of the other ICT tools, including Projector and Educational CDs were rated moderate (mean ratings $= 1.32,$ and $1.31$ respectively). This could mean that teachers are yet to realise that Projector and Educational CDs s were useful ICT tools that could be used in the teaching and learning of mathematics. The use of Radio, Television, Digital Camera and Video camera were rated low (mean ratings $= 0.22,\ 0.41, 0.34$ and $0.44$ respectively).

*c) Attitudes of Mathematics Teachers towards the Use of ICT in Teaching and Learning*

The second research question raised in this study was to find out theattitudes of mathematics teachers towards the use of ICT in teaching of mathematics. To answer this question, the mean scores

of positive and negative statements were calculated. The mean scores $(x)$ ranged from $3 < x \leq 5$ for favorable feelings and $1 < x \leq 3$ for unfavorable feelings for positive statements and vice versa for negative statements. Tables 4 shows the mean ratings for both positive and negative statements.

*Table 2:* Demographic Information of Mathematics Teachers

| Variable | Category | Frequency | % |
|---|---|---|---|
| Gender | Male | 87 | 72.5 |
| | Female | 33 | 27.5 |
| | **Total** | **120** | **100.0** |
| Age | 20-30 years | 58 | 48.3 |
| | 31-40 years | 50 | 41.7 |
| | 41-50 years | 11 | 9.2 |
| | 51-60 years | 1 | 0.8 |
| | **Total** | **120** | **100.0** |
| Teaching Experience | Less than one year | 9 | 7.5 |
| | 1 - 3 years | 25 | 20.8 |
| | 4 – 6 years | 42 | 35.0 |
| | 7 – 10 years | 31 | 25.8 |
| | 11 years and above | 13 | 10.8 |
| | **Total** | **120** | **100.0** |
| Professional Qualification | Diploma | 13 | 10.8 |
| | Bachelor's degree | 81 | 67.5 |
| | Masters | 26 | 21.7 |
| | **Total** | **120** | **100.0** |
| Experience in using Computers | Less than one year | 4 | 3.3 |
| | 1 - 3 years | 12 | 10.0 |
| | 4 – 6 years | 56 | 46.7 |
| | 7 – 10 years | 31 | 25.8 |
| | 11 years and above | 17 | 14.2 |
| | **Total** | **120** | **100.0** |
| Training on Computer Use | Yes | 93 | 77.5 |
| | No | 27 | 22.5 |
| | **Total** | **120** | **100.0** |
| Training on ICT Integration in Mathematics | Yes | 102 | 85.0 |
| | No | 18 | 15.0 |
| | **Total** | **120** | **100.0** |

*Source: Field Data, 2017*

*Table 3:* Mean Rating of Extent of ICT Use in Teaching/Learning of Mathematics

| ICT Tools | N | Mean $(Max = 3)$ | Std. Deviation |
|---|---|---|---|
| Word (or equivalent software) | 120 | 2.33 | 0.96 |
| PowerPoint (or equivalent software) | 120 | 1.76 | 1.02 |
| Excel (or equivalent software) | 120 | 1.94 | 1.07 |
| Calculators | 120 | 2.73 | 0.73 |
| Projector | 120 | 1.32 | 1.09 |
| Internet | 120 | 2.41 | 0.92 |
| Educational CDs | 120 | 1.31 | 1.03 |
| Radio | 120 | 0.22 | 0.54 |
| Television | 120 | 0.41 | 0.85 |
| Computer | 120 | 1.99 | 0.99 |

| | | | |
|---|---|---|---|
| Mobile phones | 120 | 2.10 | 1.06 |
| Digital camera | 120 | 0.34 | 0.93 |
| Video camera | 120 | 0.44 | 0.64 |
| Overall mean rating = **1.48** | | | |

*Source: Field Data, 2017*

*Table 4:* Mean Rating for Both Positive and Negative Statements

| ICT Tools | N | Mean ($Max = 5$) | Std. Deviation |
|---|---|---|---|
| Use of ICT makes me more effective as a teacher | 120 | 4.32 | 0.97 |
| I think that using ICT makes it easier to source for teaching/learning materials | 120 | 4.78 | 0.92 |
| Use of ICT increases the interest of students towards mathematics | 120 | 4.54 | 0.99 |
| Use of ICT enables students to understand mathematics concepts better | 120 | 4.12 | 0.83 |
| Lesson planning using ICT is time consuming | 120 | 2.98 | 1.23 |
| Use of ICT may slow down syllabus coverage in mathematics | 120 | 2.33 | 1.22 |
| Use of ICT may in the long run replace the teacher | 120 | 2.41 | 1.37 |
| I can do what a computer can do equally well | 120 | 2.29 | 1.15 |
| Use of computers in teaching and learning of physics is time consuming | 120 | 2.36 | 1.21 |

*Source: Field Data, 2017*

From Table 4, the mean ratings for all the positive statements were in the range $3 < x \leq 5$while those for the negative statements were in the range $1 < x \leq 3$. This implies that mathematics teachers in the sampled schools have favorable attitudes towards the use of ICT in teaching mathematics. However, this positive attitude towards use of ICT in teaching mathematics is not reflected in actual use of ICT especially in lesson delivery. This revelation is inconsistent with other findings which have reported that teachers' actual ICT use is related to their perceptions (Altun, Alev&Yigit, 2009; Keengwe & Onchwari, 2008; Lau & Sim, 2008). This finding, on the other hand, is in confirmation with Eugene (2006) who explored the effect of teachers' beliefs and attitudes towards the use of ICT in classrooms. The study revealed that there was inconsistency between teachers' beliefs and their actual use of technology in classroom. Teachers' beliefs and teaching practices were found not to match. The inconsistency between teachers' actual use of ICT and perception can be attributed to inadequate supply of ICT resources, lack of access to the right kinds of technology, inadequate ICT pedagogical training and insufficient administrative support.

*d) Mathematics Teachers' ICT Competency*

The third research question raised in this study was to find out mathematics teachers' ICT competence. To answer this question, the mathematics teachers' ICT competence in teaching mathematics was examined. The mean score $(x)$ for competence was calculated based on the items in the questionnaire and interpreted based on the guide; $3.4 < x < 4$ – excellent, $2.4 < x < 3.4$ – very good, $1.4 < x < 2.4$ –good, $0.4 < x < 1.4$ –fair and $0 < x < 0.4$ – poor. Table 5 shows the results.

The study showed that most of the teachers perceive themselves as very good in use of software such as Microsoft office word $(mean = 2.9)$, PowerPoint$(mean = 2.6)$, Excel $(mean = 2.6)$, and Calculators$(mean = 3.1)$. They also rated themselves as being very good in use of computer $(mean = 2.4$. The result is in agreement with Jegede et al., (2007), and Lau and Sim (2008) who found teachers to be more proficient in word processing than the other computer applications. This could mean that teachers lack skills in other computer application programmes. Evidence reveals that teachers' mastery in ICT skills is critical to successful integration of ICT into teaching (Rosenfield et al., 2005). Most of the teachers are fairly competent in use of the computer as an ICT tool. However, most of them seem to be less skilled in the use of essential ICT tools such as digital and video cameras, and projectors which could be used together with a computer when integrating ICT in teaching mathematics.

*Table 5:* Mathematics Teachers ICT Competence

| Extent of Knowhow in use of | N | Mean $(\boldsymbol{Max} = \mathbf{4})$ |
|---|---|---|
| Extent of Knowhow in use of Word (or equivalent software) | 120 | 2.9 |
| Extent of Knowhow in use of PowerPoint (or equivalent software) | 120 | 2.6 |
| Extent of Knowhow in use of Excel (or equivalent software) | 120 | 2.6 |
| Extent of Knowhow in use of Calculators | 120 | 3.1 |
| Extent of Knowhow in use of Projector | 120 | 1.7 |
| Extent of Knowhow in use of Internet | 120 | 3.4 |
| Extent of Knowhow in use of Computer | 120 | 2.4 |
| Extent of Knowhow in use of Digital camera | 120 | 1.6 |
| Extent of Knowhow in use of Video camera | 120 | 1.4 |
| Overall mean $= \mathbf{2.41}$ | | |

*Source: Field Data, 2017*

Most of the teachers rated themselves as 'very good' in using Internet $(mean = 3.4)$ which is an important ICT tool. Using Internet, teachers can access up to date information on various concepts in mathematics and ways of teaching some concepts perceived to be challenging by teachers. Internet can facilitate collaboration among mathematics teachers and hence creating a platform where they share ideas on how to teach mathematics better. Generally, the mathematics teachers in the sampled schools are fairly competent in the use of various ICT tools.

The last research question raised in this study was to find out the factors influencing the use of ICT in teaching mathematics. To answer this question, the correlation between ICT use and the factors that influence its' usage were examined. The main factors which came out as responsible for influencing teachers in the use of ICT in teaching were: perception, competency, teaching experience, access to ICT facilities and experience in computer use. Table 6 shows correlation matrix based on the teachers responses $(N = 120)$.

*e) Factors Influencing the use of ICT in Teaching of Mathematics*

*Table 6:* Correlation Matrix of ICT Use and Independent Variables

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Use of ICT (1) | 1 | 0.052 | 0.421* | -0.051 | 0.016 | 0.372* |
| ICT perception (2) | | 1 | 0.276 | -0.234 | -0.053 | 0.312 |
| Teacher competence (3) | | | 1 | -0.412* | 0.141 | 0.522** |
| Teaching experience (4) | | | | 1 | 0.054 | -0.213 |
| Experience in computer use (5) | | | | | 1 | 0.124 |
| Access to ICT facilities (6) | | | | | | 1 |

**Correlation is significant at the 0.05 (2-tailed)*
***Correlation is significant at the 0.01 (2-tailed)*
*Source: Field Data, 2017*

The findings showed that there is a positive correlation between mathematics teachers' use of ICT and competences $(r = 0.421, p < 0.05)$. Newhouse (2002) found that many teachers who lacked the knowledge and skills to use computers were not enthusiastic to use them in teaching. The analysis revealed a low positive correlation between mathematics teachers' perceptions and ICT use, although not statistically significant. The study further revealed a positive correlation between mathematics teachers' access to ICT tools and use of ICT $(r = 0.372, p < 0.05)$. This is in support of Empirica's (2000) European study which found that lack of access is the largest barrier to using ICT in teaching.

The study also showed positive relationship (although not statistically significant) between computer experience and ICT use. Petrogiannis (2010) examined 396 kindergarten teachers' perceived preparedness for computer use in the pre-school classes and the potential difference between computer experienced and non-experienced teachers. They concluded that computer experienced teachers were more ready to use ICT in their classes than non-experienced teachers.

Finally, the study revealed inverse correlation between ICT use and teaching experience although not statistically significant. This finding supports Van Braak et al., (2004), Inan and Low ther (2010), Roberts et al., (2003) assertions that ICT use falls with teaching experience and that younger teachers integrated ICT into their teaching more than experienced teachers. This study also revealed inverse correlation between teaching experience and competence. Therefore, the veterans' less use of computers could be attributed to limited computer competence (Bingimlas, 2009).

## VIII. Conclusions and Recommendations

*a) Conclusions*

This study investigated the extent of ICT integration in the teaching mathematics. In addition, the study established a number of factors that influence the integration of ICT in teaching mathematics in the sampled schools in the Central region of Ghana.

On the extent of ICT integration in teaching of mathematics, this study revealed that ICT use in instructional delivery was minimal despite the fact that most of the mathematics teachers in the sampled schools had been trained to integrate ICT in their profession. ICT will benefit both the learners and teachers if it is made use of during lesson planning, lesson delivery and in assessment. For this to be realised, all the factors identified should be taken into account, especially provision of relevant training on how to integrate ICT in lesson delivery. The following factors were identified to influence ICT integration in the teaching of mathematics.

The possession of the necessary skills and knowledge in use of ICT is an important consideration that determines the extent of ICT integration in teaching mathematics. Although a good proportion of the mathematics teachers in the sampled schools rated themselves as 'good' in the use of ICT tools, they moderately employed ICT in the teaching and learning process. This could mean that mathematics teachers lack the skills to integrate ICT in actual lesson delivery.

The attitude of teachers towards use of ICT in teaching mathematics influence ICT use in teaching mathematics. Mathematics teachers were found to have positive attitudes towards use of ICT in teaching although this was not reflected in actual use. The mismatch between the actual use of ICT by mathematics teachers and positive attitude could be due to other barriers such as lack of inadequate ICT facilities, lack of time, inadequate skills among others.

The study revealed inverse relationship between teaching experience and ICT use. This implies that the older the teacher, then the less they are likely to integrate ICT in their lessons. The study further established inverse relationship between teaching experience and competence. This means that the older teachers are less competent in use of ICT and therefore they use less of it in their lessons. This could be due to the fact that when the older teachers were being trained in colleges, use of computers had not picked up in educational institutions and therefore they did not get the opportunity to interact with computers.

*b) Recommendations*

A number of recommendations were made in this study. Some of the recommendations are for action by stakeholders in education while others are for further research.

*c) Recommendations for Action by Stakeholders*

- The Heads of the various SHS should organize in-service training in professional development courses related to the integration of ICT in teaching and learning mathematics for their teachers.
- The Curriculum Research Development Division (CRDD) of the Ghana Education Service in collaboration with the related agencies in the Ministry of Education should carry out research to review critically the mathematics curriculum and revise the existing syllabus to explicitly state what ICT tools must be used and how it should be used in the teaching and learning process.
- The Heads of the institutions should make budgetary allocations annually to maintain, replace and expand ICT facilities and resources in the schools in order to promote effective integration in the teaching and learning process.
- The Ministry of Education should endeavor to equip both rural and urban SHS with well-furnished computer laboratories to enable both the teachers and students to get high access to technology resources.
- The teaching institutions should endeavor to make the necessary provisions for more females to pursue mathematics in their pre-service education and also train them to develop the skills in ICT in order to integrate it in their teaching.

*d) Recommendations for Further Research*

It is suggested that this study should be replicated to include Form one students in Ashanti region.

- It is recommended that this study should be replicated to include private SHS in the Central region of Ghana.
- Similar study should be conducted in other regions in Ghana and the results compared with our research.

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# Review on Graduates' Unemployment in Sri Lanka and the Globe

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*Abstract-* Graduate employability is a key concept in political, economic and social discourse. There is no generally accepted definition of graduate employability. In this regard, researcher critically review the graduates' unemployment in the Sri Lankan and the Global context. Extensive review strains to focalize on the factors influencing graduate unemployment such as skill mismatch, education mismatch. In addition with the general factors, the lack of coordination and cooperation among the various stakeholders of universities become a root cause for unemployment.

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# Review on Graduates' Unemployment in Sri Lanka and the Globe

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## I. Introduction

Policy makers in the private and State sectors have realized the contribution made by universities in regional and national economic development due to the growing importance of a knowledge-based industry. Despite initiatives taken by universities and government, graduate unemployment is a major problem of public policy in Sri Lanka and elsewhere (Pinikahana, 2011). Therefore, this paper reviews the literature pertaining to graduate unemployment, the attributes of graduates, and the reasons for graduate unemployment across the globe.

Universities all around the world are becoming concerned about their graduates' skills and the qualities which are essential to make them productive citizens in their societies (Barrie, 2007). In the USA, UK, and Australia, the increasingly vocational role of universities has led the governments and businesses to pressurize universities to ensure that their graduates are both employable and professional (Green, et al., 2010). Hence, the current global business environment emphasizes the importance of education for employability, focusing on the development of key skills and experience which is only possible through the proper coordination and cooperation between university and the industries. Although producing employable graduates is the main function of universities, nearly 40 percent of graduates in the world are unemployed or are looking for jobs more than six months after graduate.

## II. Unemployment in Sri Lankan Sates Universities

The unemployment rates among the Sri Lankan graduates are high, compared to developing countries such as Singapore, Malaysia and Thailand (Wickramasinghe, 2010). Moreover, the average overall employability ratio of Universities in Sri Lanka is 54% (Nawaratne, 2012). The Faculties of Arts and Management have higher rates of unemployment in the country and accounted for 76% and 36% of unemployed graduates respectively, whereas Medicine and Engineering accounted for 10% and 7% respectively in 2012. It has been repeatedly noted in the literature that Sri Lankan Universities, are far behind, compared with developed and even in some developing countries (Wickramasinghe, 2010).

This study has sought to answer the research question as to why the Faculties of Sri Lankan State universities continue to produce graduates who find it hard to obtain jobs in the employment market. Problems regarding unemployed and underemployed graduates in Sri Lanka are not a new phenomenon, which has been reported since the academic year 1959/60. The first batch of unemployed graduates was recruited as Development Assistants by the United Front Government in 1970. The last batch of unemployed university graduates was recruited by the previous regime in 2012. Unfortunately, after four decades, the products of local universities are continuously employed mostly within the State sector. While the first batch of recruits comprised a few thousand graduates, the last batch has exceeded 50,000 unemployed graduates. Even today, unemployed graduates are continuously picketing and demanding the government to recruit them in different parts of the country. Therefore, graduate unemployment is a chronic socio-economic problem that has become worse over time.

## III. Conceptualizing Graduates Employability and Unemployability

Graduate employability is a key concept in political, economic and social discourse. There is no generally accepted definition of graduate employability. Nanayakkara (1998) defines it as follows: "Employed persons are all household members who during the reference period have performed some work for a wage or salary, or profit or family gain, in cash or in kind." If a persons has worked (i.e. has been engaged in any economic activity) for at least one hour during the reference period ("one week" is considered, when

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measuring the 'current' status of employment), he/she is defined as an 'employee'.

Employability is defined as the ability to acquire a job and to carry out the duties pertaining to the job effectively to the satisfaction and benefit of one's self, the employer and the society at large. (Perera, and Perera, 2009). Employability is also defined as the ability of an individual to gain employment appropriate to his/her educational standard. Yorke and Knight (2004) define employability as "a set of achievements/skills, understanding and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations, which benefit themselves, the workforce, the community and the economy." Employability was further defined by the University of Exeter as the establishment of clear mechanisms by which students can develop their ability to use and deploy a wide range of skills and opportunities to enhance their own academic learning and enable them to become more employable (Lee, 2000). According to the views of another set of researchers, employability is now largely looked upon as an 'attribute' covering a spectrum of meanings such as 'getting a graduate a job' and being a 'product of skilful career planning and interview techniques' (Yorke& Knight, 2004). In fact, employability skills are considered the skills required by almost everyone to do almost any job, 'skills that make specific knowledge and technical skills fully productive' ( Watts, 2006). Being employed means having a job, being employable means having the quality needed to obtain and maintain employment and progress in the workplace.

The concept of graduate employability developed by Yorke & Knight (2004) is widely used by different researchers. According to Yorke, graduates employability is a set of achievements, skills, understandings and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy. This definition is very appropriate for this study as well.

Meanwhile unemployment is defined as the total lack of employment (here engagement below one hour during the reference period is the total lack of employment as defined by (Nanayakkara & Nanayakkara2004). Unemployed graduates have been defined by the International Labour Organization as "those who are underemployed or unemployed and looking for jobs after graduation for a period of time" (Labour Force Surveys, 2013). Another definition of unemployment is that "the unemployed are only those individuals who did not work in the week preceding the survey and declared that they would be willing to take "any job", meaning by that either a full-time job or a part-time job" (Sri Lanka Labour Survey, 2010). Therefore, the present study adopts the definition of unemployed graduates given by the Sri Lanka Labour Force Survey. The context of the present study, "unemployed graduate" refers to a graduate who is waiting to get a suitable job for his/her qualifications currently being without a job or underemployed.

The existing literature suggests that there are three key elements of employability: the ability to (a) gain initial employment, (b) maintain employment and make transitions between jobs and roles within the same organisation to meet new job requirements, and (c) obtain new employment, if required, by being independent in the labour market and being able to manage employment transitions between organisations (Athula, 2011).

## IV. Reasons for Unemployment

Most contemporary research has highlighted that the skills of educated youth, especially those of Sri Lankan graduates, are not suited to private sector employment opportunities and private sector job requirements . Another set of researchers believes that, although the economy has employment opportunities, for some job categories, since seekers are not adequately found and for majority of the other jobs that are available, job seekers do not have the necessary skills (Gunatilaka, 1989; Dickens & Lang, 1996; Rodrigo, 1994; Kelly, 1994; Chandrasiri, 2008). Accordingly, the answers to the pertinent question "reasons for unemployment" are skills mismatch and education mismatch.

## V. Skills Mismatch

The work readiness of higher education graduates is a concern for governments, higher education providers and graduate employers. Higher education administrators are under pressure to provide degree programs more closely aligned with graduate employer and industry needs in terms of general employability skills. The research conducted by Freudenberg, Brimble, and Cameron (2010) discovered a general concern amongst employers in government and private industry regarding the "mismatch" of accounting, commerce and business graduates. Concern over the mismatch displayed by graduates in accounting, in particular, has pointed academic as well as industry-based research (Freudenberg et al,. 2010; Tindale, Evans, Cable, & Mead, 2005) towards how tertiary accounting curricula can improve in relation to developing accounting graduates' employability and professional work skills. Previous researchers also identified practical skills, multi-skilling, computer literacy, communication skills, management skills, personal skills, and problem solving skills as the most important skill deficiencies amongst graduates. Including Australia and the UK, published research in other global growth regions, indicates a mismatch between employers'

expectations and graduates' skills - particularly with problem solving, communication, team skills and management skills. Such research includes examples from New Zealand (Hodges & Burchell, 2003), Malaysia (Chang et al., 2004; Daud, Abidin, Sapuan, & Rajadurai, 2011). Japan (Sugahara & Coman, 2010), South Africa (Pop & Barkhuizen, 2010), and China (Rose, 2013).

The existing literature mentions that the skills required by the employer are different from those the graduates possess. According to the study conducted by Nawaratne, (2012) and Nanayakkra (1998), there is a mismatch between employers' expectations and the quality of graduates. Therefore, there is a need to match the skills of graduates with the needs of industry. Graduates should develop not only skills, but also practical experience. Graduates would have a competitive advantage where universities incorporate employability skills in their curricula.

Another study was conducted by Herath (2009) on the employability of graduates within the Sri Lankan context. According to her findings, while the level of satisfaction of employers with business graduates is relatively low, especially regarding their soft skills, as she further pointed out, Sri Lankan business graduates should have both academic and professional qualifications, along with soft skills, in order to meet employer satisfaction. There is a gap between the existing skills of the graduate and the skills expected by the employer (Ariyawansa, 2008). This clearly explains that skill mismatch in the country is an issue involving the supply of graduates- i.e the University. However, Senarath (2006) has revealed that the university education system has now geared itself better towards skills development.

Previous research that clearly indicates a lack of employability skills among the graduate and mismatch between the skill levels of graduates and the expectations of their employers towards graduates. Another research study focused on employability skills which are defined as: communication, interpersonal, teamwork, problem solving, research and analytical, planning and organizing, technology, and lifelong learning skills (Bilsland et al., 2014).

Skills mismatch as identified by the previous study conducted by the Central Bank of Sri Lanka and other researchers, also reveal there is a gap between the skill requirements for entry level graduate employment and the skill level possessed by the entry level graduate (job applicants) (Central Bank of Sri Lanka, 2003; Ranasinghe, 1992; Davison, 1993). These studies further support the view that a proper supply of skilled employable graduates is essential for national, economic and social wellbeing whereas the failure to imbue young people with employability skills has far reaching negative consequences (Central Bank of Sri Lanka, 2003). It is also argued that providing young people with essential employability skills is an ethical responsibility of each university.

Recent experience reveals that even talented graduates have to wait for a long time to obtain employment after graduation. Some graduates, including Management graduates, have been waiting to gain employment from government recruitment schemes for several months (Wickramarachchi, 2008). Many of the graduates, having passed out, obtain a degree certificate, which does not help them to find suitable employment. Even though one of the main objectives of university education is to improve the skills of students to face challenges in society, they are forced to leave the university without having sufficient self-confidence and assurance of better employment (De Silva &Pownall,2014). Under these circumstances, graduate unemployment has become a severe problem in Sri Lanka during the last few decades (Ariyawansa, 2008).

Swiatek (2000) found there are differences in the importance given to employability skills by graduates and employers. However, the researcher highlighted that regarding the Sri Lankan university education system is that universities are not producing suitable graduates, especially in the areas of Social Sciences and Management. Since the economy has been unable to absorb graduates into the development process smoothly during the last few decades, the government found it was necessary to implement special massive recruitment schemes (Wickramarachchi, 2008). The general attitude of educationists, as well as employers, is that the economic system of the country has not been able to absorb its graduates into the development process of the country because of the limited relevance of curricula and lack of quality of degree programs. This situation is especially evident among graduates of Social Sciences and Humanities, and even some Management graduates.

According to the views of the private sector, the mismatch is primarily due to the problems of the educational structure, quality and content of the educational system, and particularly because the university system has failed to provide the required skills, aptitudes, and job orientation for the graduate workforce (Amarasinghe, 1996). Stated in brief, the previous research uncovered the reason for graduate unemployment or underemployment as being a mismatch between the aspirations of graduates and the employment opportunities available to them (Wickramasinghe, 2010). High rates of unemployment and underemployment among university graduates point to a mismatch between supply and demand conditions for graduate employment, reflecting a supply driven education system with little relevance to labour market conditions (Ariyawansa, 2008: Wickramarachchi, 2008). Further, Weligamage and Siengthai (2003) made the point that skill mismatch leads to a large number of unemployable graduates in the Sri Lankan economy.

The majority of graduates prefers to obtain white colour jobs, but these jobs are comparatively limited in small and medium level organizations. Therefore, this reflects negativity or limited job opportunities for graduates, since university graduates are finding it difficult to find job opportunities after graduation.

Unemployment among the graduates is seen in many countries, including industrialized countries. Previous researchers, particularly in the developed countries such as the USA, UK and Europe, have found that job-educational mismatch (education mismatch) is a more prominent problem among graduates than skill mismatch or skill gap( Allen& Van-der-Velden, 2001; Di Pietro & Urwin, 2006 )

## VI. Education Mismatch

'Education Mismatch' is another dimension of skills mismatch. When a person is educationally mismatched, he or she will be unable to utilize the skills acquired through learning and also unable to gain real output from the investment made on the education (Green & McIntosh, 2007). Vertical mismatch occurs when the level of education that an individual has is not suitable for his/her job. Vertical mismatch can occur in two ways, over education or under-education. Over education exists when an individual is recruited for a job which requires a lower level of education than that possessed by the individual. On the other hand, under education exists where the individual has a lower level of education than that expected for the job. The logical end result of vertical mismatch is either the presence of over educated workers who bring skills in excess of the skills required for that job, or under-educated workers, whose skills are inferior compared to those required for that particular job. According to Cedefop (2010), both these situations may result in negative consequences for the job market.

Senarath (2012) and Senarath & Patabendige (2012) have found that the formal economy in Sri Lanka (public sector and formal private sector) has failed in generating enough jobs to absorb the graduates of local universities and, therefore, it has created an excess supply of graduates. This excess supply of graduates will not have the proper job opportunities and therefore, have to take up jobs which require a low level of education and of skills and competencies than they have acquired.

However, the most significant finding was that 16 percent of the graduates in the sample were horizontally mismatched (Senarath and Patabendige; 2012). Additionally, there was a positive correlation between horizontal mismatch and skill underutilization. This implies that horizontal mismatch is the more significant mismatch among graduates. This further implies that, the higher education system in Sri Lanka does not suit the job market. It results in low employability in the graduate labour market due to information asymmetry and lack of experience. Especially with regard to graduates in the management field, it can be seen that job opportunities which are most relevant to their field of study are scarce. Because of this mismatch they are unable to utilize their expertise and skills that they have acquired from the learning requirements (Senarath and Patabendige, 2012).

An article by Coulon (2002) noted the drastic increase in participation in education in recent decades across industrial nations, and argued that it had resulted in a population of over-educated graduates who were unable to secure employment at their expected credential level, hence creating a perception of graduate underemployment, where graduates identified gaps between their qualifications and the work they performed (Coulon, 2002).

Universities are now seriously engaging in changing their teaching-learning package to be consistent with the current requirements of a challenging business environment. Accordingly, student centered teaching methods are being practiced, instead of teacher centered teaching methods. This permits students to develop greater initiatives for self-learning through investigation and analysis, project work of different sorts, which involves not only individual work, but also team or group work.

Authorities have taken steps to reduce the supply area skill mismatch issues during the past decade in Sri Lanka. However, even after these actions have been implemented, the issue of skill mismatch still exists. By reviewing the literature of other countries, it has been identified that skill mismatch is not always a problem due to inefficiency in the supply side. The literature clearly argues that skill mismatch can take place due to demand area issues as well. For instance, if the number of graduates in the job market exceeds the demand, the reverse scenario will occur. If the economy is unable to produce enough job opportunities to absorb the excess supply of graduates, it may be difficult to find suitable jobs for graduates. Due to this disparity, the educated youth have to either wait until they can find a suitable job to match their qualifications or accept any job without considering their qualifications or field of study (Cedefop, 2010). As described by Cedefop (2010), when a person engages in a job that doesn't tally with the level or field of study it is called Job Educational Mismatch.

According to the preceding literature, it can be concluded that education mismatch is a common phenomenon in many countries. Moreover, it is important to review prior arguments and findings relating to the nature of the education mismatch. Garcia-Espejo & Ibanez (2006) have found that lower level returns to education may also incur some non-transitory costs i.e.

lower level of job satisfaction, frustration and higher turnover rate.

Allen and Weert (2007) have also done a cross country analysis regarding educational mismatch and identified great differences between the types of educational mismatches across the countries. They revealed that over-education is most common in Japan and under-education is the biggest problem in the UK. Spain experienced both the problem of over-education as well as that of under-education. Japanese and British graduates were more likely to work in a different field, whereas German and Dutch graduates are mostly likely to select work with a perfect match in terms of the level and field of education (Allen & Weert, 2007).

Many countries in the world, irrespective of their economic and political strengths, have been analysing the problem of the competency gap between expected industrial needs and the skills of graduates. Right from the USA to India, many countries have been generating research reports periodically on this concept. For example, Shujaat et al. (2009) agreed that most university graduates were less knowledgeable, less skilled and were not in accordance with the needs of the industry. Employers and industrialists also mentioned that the curriculum at higher educational institutions needed to be revamped as many of the graduates produced by the institutions did not meet a satisfactory level of job competency. Similarly, Mursidi and Sundiman, (2014) stated that mismatch, which has occurred in education and skills, represents the gap that occurs between the criteria and requirements needed by industry, which are not fulfilled with the educational levels and skills of graduates. This mismatch affects the educational investment, job satisfaction, wages and job mobility (Shujaat et al. 2009).

Therefore, the above discussion clearly shows that graduates are expected to act as acceptable graduates by the employers, but the present attributes of the graduates do not meet that expectation. Previous researchers who studied graduate unemployment in Sri Lanka and other parts of the world, clearly showed that the key reasons for this phenomenon are skills mismatch and education mismatch. All the stakeholders know about this including employers and academics, but the problem still remains. The existing gap between the skills required by employers and the profile of the graduates has been reported as a reason for unemployment in Sri Lanka as well. (Weligamage & Siengthai, 2003). Then the question arises as to "why the problem is unsolved?" This problem was further investigated and the reason was found to be one which is rooted in the lack of coordination and cooperation between the main stakeholders.

## VII. Lack of Coordination and Cooperation; Moving Deeper into the Issue

Coordination is the act of organizing different people or things to work together for a goal or to effect, or fulfill desired goals in an organization. Coordination terms and models have been developed in different fields to coordinate the interaction among components and objects, and are nowadays used to model and analyze organizations, as well. Moreover, organizational concepts are used to enrich the existing coordination languages and models (Boella& van der Torre, 2006). Most modern day organizations are characterised by complexities where organizational performance is very important (Gilliland, Steiner, & Skarlicki, 2005). Cooperation is defined as a common effort and an association for the purpose of common benefit and for helping one another in specific ways (Forest, 2003). Therefore, coordination and cooperation are key activities in the organizational lifecycle, and these two terms are used interchangeably.

Coordination is a formal process, because it is scientific; coordination is an informal process, because it is human relations oriented; and coordination is a systemic process, because it is arriving at the most appropriate decisions that can have good internal and external effects. Fayol, Gullick, and Urwick are some notable administrative scholars who have dealt with coordination as a principle of organization. But little has been done to explicate the centrality of coordination to other principles of administration. Accordingly, POSCORB; an acronym that stands for planning, organizing, staffing, directing, coordinating, reporting, and budgeting. In brief, coordination is a part of planning, because it tells what to include in a good plan and how to execute it. Coordination is part of organizing, because it takes the first lead (Gulick & Urwirck, 1957). The pioneer authors in management, Taylor (1993) and Clark (1996) emphasized the need of coordination in their research findings. Coordination among the stakeholders is important to any organization in order to achieve its goals. Coordination is a central concept in organization theory. Mintzberg (1979 ) has developed a typology of organizational configurations that is based on a particular view of coordination mechanisms. Coordination means the sharing of information, resources and responsibilities to achieve particular outcomes.

The components of coordination are goals, activities, actors and interdependencies. When these are not manipulated properly, especially the actors, the purpose of coordination cannot be achieved. In the context of the present study, it can be stated that the pursuit of academy -industry relations is absolutely necessary.

Internally, coordination means setting rules and standards based on cooperation; externally, coordination means fostering relationships and interest aggregation. Due to the nature of internal and external complexities that go with organization, coordination becomes a relevant element. Internally, organization comprises management, employees, tools, structures etc. Externally, an organization comprises the environment, culture, competitors etc. Coordination is part of network analysis, because of its emphasis on interdependence, cooperation, trust and performance. Chester Barnard argues that an organization comes into being when certain conditions are met: (a) when people are able and willing to communicate with one another (b) when the same people are also willing to do something to contribute action, as he puts it, in order (c) to accomplish a common purpose. The two important things here are that when individuals are able to cooperate and derive satisfactions in the process of cooperation, organizations become efficient and effective, because performance is gladly. However, in order to make the concept of coordination more tangible, it is relevant to investigate the design of actual coordination instruments and their underlying mechanisms.

Numerous studies have shown that coordination and cooperation lead to improved interpersonal and inter-group relations. This is because they create advanced approaches in dealing with problems that emanate from intra-link and cross cultural contexts in relation to an organization (Kramer, 2010). A special focus on coordination gives a good answer to the question of performance. The more efficient coordination is at all levels of administration, the common outcome, cohesion, will be reached in a more efficient manner, because coordination is a tool of cohesion . Every activity in an organization requires coordination of a variety of functions within and between firms in order to avoid the complexities and unintended losses. Studies have shown that top placement in an organization has a better tendency of affecting coordination, because there are top management responsibilities engrossed. Top management employees in an organization assign responsibilities or delegate authority to lower level employees in order to accomplish collective or stated organizational goals. Lower level employees are also relevant to the coordination scheme, because without them the network is not be complete (Hossain & Wu, 2009). Both the higher and lower level employees are relevant in their own relative ways to the goals of an organization.

Furthermore, previous researchers (Denti, Omicini and Ricci, 2002) have advanced two observations about coordination: (a) the rationale behind coordination is the existence of dependencies between activities or entities, and (b) the goal of coordination is to manage these dependencies in such a way that the activities become part of a purposeful whole (Holt, 1988). Both points deserve more attention in this study. The need for coordination arises from the existence of dependencies. If there is no interdependence, then there is nothing to coordinate (Malone and Crowston, 1990). As Galbraith (1995) noted, one can reduce the need for coordination by reducing the interdependence. However, this can be done only to some extent.

Interdependencies are a fact of human life, although it is not so obvious where they come from. Economists typically refer to the need for a division of labour (Douma and Schreuder, 2002). The existence of interdependence between humans can also be explained by their social orientation. Taking part in collaborative practices contributes to the meaningfulness of life. Yet another reason for the existence of dependencies can be drawn from Simon's theory of bounded rationality (Simon, 1976). Complex organizations simply cannot be handled by a single man's perspective and therefore a completely centralized control is simply infeasible. From this, it follows that organizations have multiple loci of control and multiple stakeholders, who are relatively autonomous in the goals they pursue, but are still interdependent (Weigand, et al., 2003).

According to previous researchers, unemployment among the graduates is specifically illustrated. For example, Katooli and Rahmani (2005) have undertaken to highlight the challenges facing the employment of university graduates in Iran. The researchers argue that a lack of coordination between universities and government has resulted in unemployed graduates. Similarly, other research findings also revealed that the lack of coordination between two different stakeholders - university and government (Marzban et al., 2014), university and employers (Daniel Schiller and Ingo Liefner, 2007), students and employers and the university and others (Chak Sopheap, 2012), is the cause of graduate unemployment. Similarly, poor coordination and collaboration among university, government and industry leads to graduate unemployment issues (Chanthes, 2010 and Etzkowitz and Leydesdorff, 2000)

An additional study conducted by Mc Goldricket, .al (2013) indicated the coordination and cooperation maintained among students and postgraduate students and between students and alumni. For example the students appreciated the meetings with their mentors and postgraduate coordinators (Mc Goldrick et al., 2013). Similarly, other studies revealed that there exists collaboration between undergraduates and postgraduate bodies, not only within the same university, but also within a whole student union (for example, the students' union of the Management faculties in the country). Megehee, Hyslop and Rosso (2005) explain how chemistry students

collaborated with each other by using one another's compounds in different chemical studies. Accordingly, this allowed the students to work not only with others in their branch of chemistry, but also with other students from other branches of chemistry, namely, organic, physical, and inorganic chemistry.

According to another the study, the idea behind this approach was "to mimic what is found in an industrial or research setting" (Megehee et al., 2005, p1345). For example, researchers working for the same organisation may be working on compounds that are structurally similar; and hence, may have common shared knowledge of each other's field of work. By simulating this form of work amongst the chemistry students, the results and compounds were shared in class and with students in other courses for further study and experimentation. Overall, students and staff found this experience to be positive, confirming that this model of interdisciplinary work promotes communication skills, teamwork and understanding, and appreciation of other people's work – the skills which happen to be the ones that employers seek in today's graduates (Megehee et al., 2005).

According to the another study conducted by Hans Weigand and de Moor (2013), the success of innovation projects is critically dependent on trust between the participants and the quality of the communication, which includes inside groups and between groups. Furthermore, any initiative that spans the organisation is bound to require significant amounts of energy for coordination: identifying the key stakeholders, gaining their support, harnessing participant collaboration, gathering requirements and establishing the roles and responsibilities of the right set of people to make the goals of organisations successful.

The issues surrounding graduate employment are multi-sectorial and involve many stakeholders: governments, educational and training institutions, employers and industries, employees, parents and families, communities, and of course, the youth themselves. It is clear that the three Cs – communication, collaboration and coordination – among the various sectors and stakeholders are extremely important to ensure the positive outcomes of any strategy or approach developed and implemented in the organisation. Further, Hodges and Burchell (2003) recommended that cooperative education programs can help students understand that the workplace is a place where they must take responsibility for identifying their own learning needs and then do something about it.

Khare (2014) highlighted that universities are having less and less connectivity with other stakeholders. He has suggested the development of networking and connectivity in order to improve the employability among graduates. A four- point networking may be intensified both at the university and the institutional levels. Industry networking: develop academic networking with global and national academia and industries, Alumni networking: stronger and proactive alumni to provide financial support to bright and needy students, placement guidance, personality grooming, and industry exposure. Alumni-student interaction has two way benefits - students gain by developing contacts, pride and perspective while alumni are able to find future employees. Global networking: global experience of different countries and cultures where group internship through institutional collaborative arrangements, transfer and mutual recognition with foreign universities are required, and social networking: generating awareness regarding the local and global issues related to social, environmental, religious and political spheres but also give a real life experience to graduates in improving the world around them. Further, government networking is also important to obtain benefits from the government and provide advisory services to the government related to socio-economic, political and technological development of the region or nation. Most developed countries have geared themselves to create a huge network of existing universities for the transition from education to work to become easier and smoother.

## VIII. Conclusion

This paper is designed to explore and analyse the expected attributes of management graduates. An in depth review of the literature revealed that there are divergent views about graduates' attributes among industrialists, students, academics and the government. However, there a remains a mismatch between the attributes of graduates and those needed in the workplace. Most of the studies have consistently identified that communication, interpersonal skills, ethics and teamwork are competency gaps which exist among management graduates finally results in unemployment among the graduates, the main reasons for unemployment among graduates is weak coordination and cooperation among stakeholders. Therefore, a lack of coordination and cooperation in the university system is experienced particularly in Management Faculties, which leads to the production of graduates who are continually ignored by the labour market.

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# Women and the Drama of Social Reformation in African Fiction

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*Abstract-* A remarkable feature of feminist criticism in postcolonial Africa is the representation of female characters in African fiction. Within this context, this paper explores women characters' attitude to oppression in marriage in selected African novels. The aim is to investigate the nature of their heroism. Chidi Maduka's concept of heroism and liberal feminism form the theoretical framework. The paper demonstrates that women characters are not monolithic in their attitude towards oppression in marriage. Those whose 'inner forces' compel the 'outer forces' to succumb are the heroines. The anti-heroines are those who remain in marriage but achieve self-definition and, those who acquiesce to the status quo. The dynamics of heroism highlighted in this paper shows that the African woman does not whole-heartedly accept the patriarchal denigration of her worth. The paper concludes that the novelists under study have used art to advocate for change in the society.

*Keywords:* *women, drama, social reformation, African fiction.*

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# Women and the Drama of Social Reformation in African Fiction

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*Abstract-* A remarkable feature of feminist criticism in postcolonial Africa is the representation of female characters in African fiction. Within this context, this paper explores women characters' attitude to oppression in marriage in selected African novels. The aim is to investigate the nature of their heroism. Chidi Maduka's concept of heroism and liberal feminism form the theoretical framework. The paper demonstrates that women characters are not monolithic in their attitude towards oppression in marriage. Those whose 'inner forces' compel the 'outer forces' to succumb are the heroines. The anti-heroines include those who remain in marriage and achieve self-definition, and those who acquiesce to the status quo. The dynamics of heroism highlighted in this paper shows that the African woman does not whole-heartedly accept the patriarchal denigration of her worth. The paper concludes that the novelists under study have used art to advocate for change in the society.

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## I. Introduction

The representation of female characters in African fiction especially in male-authored works has generated a lot of criticism in postcolonial Africa. Gloria Chukukere for instance, argues that "male novelists, especially have either tended to play down the social significance of women in their writings or otherwise extolled only those traditionally accepted virtues that confine women within family hood" (79). Iniobong Uko posits that the woman is recreated as an "unthinking, uncritical and a helpless being" (83) walking behind her husband, who in Buchi Emecheta's words, "kneels down and drinks the dregs after husband" (qtd in Kumah 7). Amina Bashir avers that "the way male writers treat their female characters reflects the disdainful, indifferent, or cruel manner in which women have been held and are still being regarded in African …society" (66). However, in the wake of feminism, female writers such as Flora Nwapa, Buchi Emecheta, Mariama Bâ and Aminata Sow Fall voice their opposition to the patriarchal flow of discourse and begin to push back the boundaries of sex-role stereotyping to carve a niche for themselves. Rose Acholonu confirms that "the advent of feminism…has meant new visions or concepts of realism, involving the creation of female characters who are fascinating in their variety, contrariness and complexity" (54). Godwin Uwah asserts that "female writing is replete with characters who have overcome or transcended their stations in life" (127). There are also male novelists like Ousmane Sembène, Henri Lopes, Ayi Kwei Armah and Ngugi wa Thiong'O who lend a hand in delineating a more balanced and plausible image of female characters in African literature. This paper explores the strategies female characters adopt in coping with pressures generated by the drama of social reformation in selected works of Anglophone and Francophone male and female novelists. The aim is to investigate the nature of their heroism. Chidi Maduka's concept of heroism in conjunction with liberal feminism provide the theoretical framework of this study.

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## II. Theoretical Framework

Chukwuma argues that "when the term feminism is applied to literature, it stands for female assertion, an effort by women to claim proper treatment and places in society and the home not out of pity and consideration but by right" (44**).** There are many strands of feminism but the one chosen for this paper is liberal feminism. Liberal feminism according to Lucy Brookes "is an individualistic form, concentrating on women having the ability to maintain their equality through being responsible for their own actions and choices" (n.p). Put differently, liberal feminists fight against cultural homogeneity and encourage women to arrive at self-definition through making informed decisions and choices both at the private and public spheres of life.

Maduka delineates the intellectual as a hero-type in works dealing with the phenomenon of social change. He argues that the dynamics of the intellectual's heroism depends on the nature of the tension between the intellectual's "inner forces" and the "outer forces" which could take any form within the spectrum of non-conformity and conformity. Thus, an intellectual involved in the process of social change could be a conformist or a non-conformist, a hero, an anti-hero or a mixture of the two (Maduka 77-82). This study will adopt this framework to investigate the different forms of strategies employed by the woman in her struggle against patriarchal oppression in marriage. It would throw some light on whether the woman participating in the drama of social reformation is a heroine or an anti-heroine. This will be discussed under two main categories: non-conformity and conformity.

## III. Non-Conformity

Here, there is a radical confrontation between the woman's "inner forces", i.e. her feminist consciousness and the opposition from the "outer forces", i.e. patriarchy. Her "inner forces" succeed in compelling the "outer forces" to move at their own rate. She triumphs and becomes a heroine. Examples include Arinola and Enitan in Sefi Attah's *Everything Good Will Come*, Beatrice in Chimamanda Adichie's *Purple Hibiscus,* Aissatou in Mariama Bâ's *Une si Longue Lettre* and Rama in Sembène Ousmane's *Xala.*

Arinola married Bandele Sunday Taiwo when she was working as a chartered secretary. Soon after their marriage, Sunday Taiwo stops her from working making her economically dependent on him. Meanwhile, he does not care much about her general wellbeing. Abandoned by Taiwo especially after the death of their only son coupled with his uncaring attitude, Arinola becomes disenchanted with marriage. Her inner forces propel her to get a divorce. Enitan, says this about her mother:

> my mother had given her reason for falling out with my father; a neglectful and uncaring attitude; withheld housekeeping allowance, on several occasions did not return home and gave no reasonable answer as to his whereabouts… influenced her child to disregard her…made wicked and false allegations about her sanity…colluded with family members to alienate her…caused her much embarrassment and unhappiness. (277).

Arinola, drawing from her experience advises her daughter, Enitan, not to "make sacrifices for a man. By the time you say, 'look what I've done for you. It's too late…men never remember" (173). Enitan marries Niyi against her parents' will. Though in love, Enitan refuses to assume the object status that patriarchy imposes on the woman. She muses: "…And the expectation of subordination bothered me most. How could I defer to a man whose naked buttocks I had seen? Touched/ obey him without choking on my humility, like a fish bone down my throat" (184). She does not also believe in giving respect to a man just because he is a biological male. She comments: "In my 29 years no man ever told me to show respect. No man ever needed to. I had seen how women respected men and ended up shouldering burdens…" (184). On domestic drudgery, she comments: "…too many women ended up treating domestic frustrations like mild cases of indigestion…It is an overload of duties, sometimes, self-imposed" (184). Accordingly, when her husband asks her to prepare food for his brothers, she tells him: "you have hands" (197). Niyi displeased, asks her to show him some respect. She retorts: "go to hell" (197). Again, when Niyi asks her to get some drinks for his brothers, she asks him: "… why can't you ever get them drinks for once? Why can't you go to the kitchen? What will happen if you go? Will a snake bite you?" (198). She also maintains this stance of defiance by refusing to be the cook her mother-in-law expects her to be.

Enitan is also an activist determined to fight all forms of institutionalized oppression of women in her milieu. She fights "to tear every notion they had about women…I would not let go until I am heard" (197). The husband tries to dissuade her from this course but she sticks to it. Seeing that marriage constitutes a threat to her zeal for self-definition, she opts out of it saying "I was lucky to have survived what I believe I wouldn't, the smell of my mother's death. I couldn't remain as I was before, otherwise my memory of her would be in vain, and my survival would certainly be pointless. Anyone who experienced such a trauma would understand …One life was gone and I could either mourn it or begin the next…this was the option I choose" (323). Enitan emerges a heroine surmounting the hurdles on her way to self-identity. Beatrice, wife of Eugene, is subjected to continual assaults by her husband. For instance, he slings her "over his shoulder like the jute sacks of rice his factory workers brought in bulk at the Seme border" (41) leading to the abortion of the baby she was carrying. However, despite Eugene's irrational acts of torture, Beatrice retains the posture of a good wife who must be silent and passive in the face of tyranny (Udumukwu 3). She adores Eugene especially "for not choosing to have more sons with another woman, of course, for not choosing to take a second wife" (28). So, she feels obliged to honour him in return by keeping mute in the face of death. Beatrice recounts to her children another act of violence against her by Eugene when she visits them in Nsukka: "you know that small table where we keep the family Bible, …? Your father broke it on my belly…My blood finished on the floor even before he took me to St. Agnes. My doctor said there was nothing he could do to save it…" (248). On hearing this, Ifeoma, Eugene's sister, advises Beatrice to quit the marriage, but she refuses saying "where would I go if I leave Eugene's house? Tell me, where would I go?" (225). Her attitude corroborates Ander Bergara, Josetxu Riviere & Ritxar Bacete's submission that "the gender based process of socialization… conspires to create a fabric of social expectations and images of what "ought to be' which is the reference system…" (22). However, in due course, Beatrice's inner forces compel her to act against her husband's tyrannical behaviour. With the aid of her cook, Sisi, she poisons Eugene to death. She confesses to the children: "I started putting the poison in his tea before I came to Nsukka. Sisi got it for me; her uncle is a powerful witch doctor" (294). In this way, Beatrice negotiates her freedom from oppression in marriage. Beatrice's violent action corroborates Mezu's argument that "women's voices even when vocally silent can yet make powerful statements through silent "action" (339).

Aissatou marries Mawdo Bâ and both live happily until his mother, Tante Nabou, a princess, imposes a new wife on him not approving of Aissatou because she is a goldsmith's daughter. Consumed with caste pride, she decides to groom her niece, young Nabou, to be a befitting wife to her son. Mawdo falls prey to his mother's antics and marries young Nabou. Mother and son fail to take into cognizance Aissatou's feelings and dignity. The test for Aissatou at this juncture is whether to remain a good woman by playing the role of the first wife as sanctioned by patriarchy or to become a 'real' woman who speaks out in the face of tyranny (Udumuku 3). Her inner forces dominate positively the identity-construction dialogue and she turns her back on polygamy. She leaves as an explanation a letter which reads: "Je me dépouille de ton amour, de ton nom, vétue de seul habit valable de la dignité, je poursuis ma route" (50.) (I am stripping myself of your love, your name, clothed in the only valuable garment, my dignity, I go my way.) She leaves for the United States with her four sons. She secures a good job and lives a fulfilled life. In this way, "Aissatou burst the fence of subjugation and nihilism and turned her back to its oppression" (Chukwuma45).

Rama's fictional world is a Muslim one where polygamy is celebrated. But she is "une musulmane moderne" (3) (a modern Muslim) and is completely alienated from this culture. Speaking against her father's third marriage, she asserts: "jamais, je ne partegerai mon mari avec une autre femme. Plutôt divorcer" (25). (I will never share my husband with any woman. It's better to get a divorce.) Rama appears to be Sembène's mouth piece with regard to polygamy. For Sembène states in an interview: "Le jour où les femmes auront le courage de dire à leur mari, si tu prend une autre femme, je m'en vais alors, et alors seulement que la polygamie disparaître (qtd in Opara 89). (the day women would have the courage to tell their husbands, if you marry another wife, I would leave, it is only then that polygamy would be a thing of the past.) When her father invites her to the ceremony of his third marriage, she turns down the invitation telling him adroitly "je ne viens pas… Je suis contre ce mariage. Un polygame n'est jamais un homme franc" (27). (I will not come…I am against this marriage. A polygamist is never an honest man.) To Pathé, her fiancé, she states her position clearly: "Sache que je suis contre la polygamie" (77). (Know that I'm against polygamy.) Rama's inner forces aid her to effectively challenge the power structure that celebrates polygamy.

The inner forces of each of these characters: Arinola, Enitan, Beatrice, Aissatou and Rama compel them to triumph over the pressures of patriarchy that assail them. "They strike a synthesis between thought and action" (Maduka 75) in their journeys towards self-definition. They make choices and do not flinch from them the consequences notwithstanding. These are the heroines who reflect changes that are taking place in their different milieus, changes that dramatise the increasing feminist-consciousness of the African woman.

## IV. Conformity

Here, there is no radical confrontation between the woman's "inner forces" and the "outer forces". The result can be two-fold:

I. The "inner forces" of the female may slow down to adjust themselves to the "outer forces". In playing the social reformer, the character chooses the path of compromise to enable her carry out the reform from within. Female characters that fall under this category are Mumbi in Ngugi wa Thiong'O's *A Grain of Wheat*, Li in Zaynab Alkali's *The Stillborn* and Mam Fatou in Ousmane Sembène's *Xala.*

Mumbi dreams of a blissful marriage. Here are her words: "I longed to make my husband happy…" (120). After much competition between Gikonyo and Karanja for her love, Mumbi eventually chooses and marries Gikonyo. Not long after their marriage, Gikonyo is taken to the detention camp. Karanja tries to take advantage of this but she rebuffs his sexual overtures saying "I would wait for him, my husband, even if I was fated to rejoin him in the grave" (131). However, in the course of breaking the news of Gikonyo's homecoming to Mumbi, Karanja takes sexual advantage of her which results into pregnancy. Gikonyo eventually returns from the camp and he, like Elechi Amadi's Ibekwe in *Estrangement*, refuses to forgive his wife despite all her protracted attempts to win his forgiveness. Matters come to a head when one day Gikonyo maliciously pushes away Karanja's child. Mumbi explodes saying "... what sort of a man do you call yourself? Have you no manly courage to touch me? Why do you turn a coward's anger on a child... you think I am an orphan do you? You think the gates of my parents' hut would be shut against me if I left this tomb? (146). Gikonyo slaps her saying "I'll make you shut this mouth of a whore..." (146). She retorts: "you would have told me that before" (146). She strides out of her matrimonial home into her parents' house. Her parents urge her to go back to her husband but Mumbi's inner forces refuse to give in to the pressure. She says to them "I may be a woman but even the cowardly bitch fights back when cornered against a wall" (158). However, despite the estrangement, she nurses Gikonyo when he falls sick though not without apprehension. She says: "He thinks I am bribing him to take me back... but I will not go back to his house, not even if he kneels before me, she had resolved'' (201).

Gikonyo realises his folly eventually and suggests to Mumbi to come back home but she refuses saying "we need to talk, to open our hearts to one another, examine them and then together plan the future

we want'' (213). Gikonyo recognises the change in his wife and "... knew at once that in future, he would reckon with her feelings, her thoughts, her desires, a new Mumbi" (213). Mumbi's self-assertiveness brings a concomitant change in her husband. He has become a new African man who is ready to cope with the ideals of the new African woman. Mumbi believes in marriage but is not willing to sell her self-worth. Okafor posits that the creation of Mumbi, "underscores Ngugi's view of the woman as a fully individualized person whose humanity and self-worth cannot be compromised" (137).

Li like Ngugi's Mumbi longs to be married. So when the occasion arises, her "world was full of wonderful and existing things…eager and ready to enjoy life to the fullness" (207). Unfortunately, her husband, Habu, abandons her shortly after the marriage. Li expects Habu to send for her but seeing that it is becoming a mirage, her inner forces make her to look at life from a different perspective. She wonders: "was she to spend the rest of her life waiting for a man like a dog waiting for a bone from his master's plate …?" (85). She decides to further her education and completes her studies in a teacher's college. But Li like Bâ's Ramatoulaye (*Une si longue lettre*) feels unfulfiled outside marriage. She "knew now that the bond that tied her to the father of her daughter was not ruptured" (104-105). So she resolves to give marriage a second chance. She forgives Habu and decides to search for him. Meanwhile, Habu has become lame as a result of a motor accident. Her sister tries to dissuade her from taking that step saying "Why, Li? The man is lame" (105). But Li resolved, answers: "…I will just hand him the crutches and side by side we will learn to walk" (105). Udumukwu submits that Li "finally recognizes her own potential, appreciates forgiveness and learns to rebuild" (211).

Mam Fatou is a woman who does not hide in her husband's shadow. She reverses the power structure in the family and becomes the one "qui enfourchait les pantalons" (15). (who wore the trousers.) Though from a Muslim background, Mam Fatou is "foncièrement contre la polygamie" (20) (is passionately against polygamy). She makes her husband come to terms with that. Thus, Babacar, though a Muslim, "…n'irait jamais pris une deuxième épouse'' (20). (would never have a second wife.) In this way, Mam Fatou negotiates her freedom from polygamy. Further, seeing through her daughter, N'Gone, a soothing solution to their poverty, she negotiates with Ya Bineta for a possible rich man as husband for N'Gone. She only informs her husband about her scheme and he "souservait à la décision de sa femme" (15). (submitted to the decision of his wife.) This seems to validate Chinweizu's assertion that "if the essence of power is ability to get what one wants, then women are far from powerlessness" (11). Mam Fatou's inner forces condition her to triumph over oppression in marriage.

Though Mumbi, Li and Mam Fatou operate within the patriarchal constructs, the inner forces of each of them cause them to dispel the myth of subordination associated with the African woman. They remain in marriage but strive for self-definition. Their attitude recalls Chukwuma's submission that "…women need to stand, pitch camp, and fight instead of just bolt away" (xvii). They are the rebellious conformists, the anti-heroines.

II. Unlike women characters in the first category under conformity, those in this group have no conflict between their "inner forces" and the "outer forces". Their "inner forces" are in harmony with the exigencies from the patriarchal social order. They are in Maduka's words, "the conformists through and through". Examples include Ugadiya in Ikonne's *Our Land*, Ma'Shingayi in TsiTsi Dangaremgba's *Nervous Conditions* and N' Deye Touti in Ousmane Sembène's *Les Bouts de Bois de Dieu.*

Ikonne's Ugadiya is a victim of arranged marriage. Her father believes that "any man who was genuinely interested in his daughter 's future should marry her off as soon as she could recognize the difference between her and her brothers, if not sooner" (27). Accordingly, she is given as fourth wife to Okpanku at age 14. She raises no objection to it. Her only source of worry is her inability to conceive after her first son. She takes it "as her personal failure as a wife" (48). When Okpanku died, she is subjected to traditional ways of mourning a husband. She does not like it but does nothing about it so that she will not be termed a bad wife or be accused of killing her husband. She laments: "it was a terrible period…I was not allowed to comb my hair let alone to wash and plate it…And every morning at the first cockcrow, whether I felt like doing so or not, I had to weep in remembrance of my husband. That was the custom" (30). She is also subjected to levirate marriage after her husband's death as tradition demands. She is inherited as wife by Ezumezu, her husband's son, a much younger man to her. Her inner forces do not agitate against this either.

Ma' Shingayi, wife of Jeremiah, farms to provide for the family while Jeremiah wastes his life away drinking. Lucia, Ma' Shingayi's sister's remark is to the point: "this man, this Jeremiah… he has a roving eye and a lazy hand. This man who has given her nothing but misery since the age of fifteen" (147). Ma' Shingayi silently carries her burden of womanhood because silence is the virtue of a good wife. Her daughter, Tambu, says this of her: "my mother, lips pressed tight …would continue silently at her labours…" (7). When she is subjected to a belated wedding by Babamukuru, her husband's brother, Ma'Shingayi though she hates it, is tongue-tied. She ignores the stirring of her inner forces to reject the offer. Rather, she laments: "To wear

a veil, at my age, to wear a veil! Just imagine – to wear a veil..." (184). Her repetition of the phrase "to wear a veil" shows the degree of her disproval but she remains passive even in this apparent violation of her privacy. Again, when Lucia tries to talk her into quitting the marriage or taking a stand on the wedding that is being imposed on her, she says with self-pity: "Lucia… why do you keep bothering me with this question? Does it matter what I want? Since when has it mattered what I want. So why should it matter now?... What I have endured for nineteen years I can endure for another nineteen, and nineteen more if need be" (153). Tambu remarks that "…for most of her life my mother's mind belonging first to her father and then to her husband, had not been hers to make up, she was finding it difficult to come to a decision" (153). Charles Sugnet avers that "Tambu's mother, trapped in the role of Jeremiah's wife…reaches a point of paralysis" (39). Accordingly, she makes no attempt at negotiating her self-worth. She rather resigns to the patriarchal oppression. Further, Ma'Shingayi naively plays the role of an agent of patriarchy. She tries to initiate Tambu into the burden of womanhood and advises her: "…these things are not easy, you have to start learning them early, from an early age. The earlier the better so that it is easy later on…What will help you my child, is to learn to carry your burdens with strength" (16). Katrin Berndt asserts that Ma'Shingayi "is a woman who sticks to the narrow space that was intended for her. She never questions her ways and actions but tries to live according to the Shona customs familiar to her" (94).

N' Deye Touti is an educated young woman with a Muslim background. Having been socialized into believing that an unmarried woman "is a miserable spinster left on the shelf" to use Flora Nwapa's words, (*One is Enough* 37), she proposes marriage to Bakayoko, a married man, saying "je voudrai devenir ta seconde femme…, comme je suis née mulsulmane, ma réligion m' y autorise" (343). (I would like to be your second wife…since I was born a Muslim, my religion permits that).She assures Bakayoko that she will not be jealous of his wife. This means that N'Deye Touti is aware of the plethora of problems associated with polygamy, yet she still wants to stick her neck into it for the obvious reasons, her desire to extricate herself from the stigma of spinsterhood. She derogates self and participates in her subordination. Indeed, N'Deye Touti as Opara asserts "lacks moral purpose" (343).

Ugadiya, Ma'Shingayi and N'Deye Touti being rooted in the values of the patriarchal order "are not polarized between thought and action" (Maduka 76). They choose to passively submit to the oppressive patriarchal structures.

## III. Conclusion

All in all, this study reveals that it would be presumptuous to assert that female characters in African fiction are monolithic in their attitude towards patriarchal oppression in marriage. Arinola, Enitan, Beatrice, Aissatou, and Rama are heroines whose inner forces push the outer forces to give way on their way to self-definition. There is an interaction between the two categories in the spectrum of conformity. The first category consisting of Mumbi, Li and Mam Fatou do not fully disengage themselves from patriarchy. They choose the path of compromise in their participation in the drama of social reformation while the second category consisting of Ugadiya, Ma'Shingayi and N'Deye Touti acquiesce to the dictates of the patriarchal social order; hence their common classification as anti-heroines; though at different degrees.

It is evident from the foregoing that there are convergences in the handling of the theme of this study by the novelists under study. The heroines and the anti-heroines delineated are drawn from works of both male and female Anglophone and Francophone novelists. For instance, the heroines Attah's Arinola and Enitan, and Adichie's Beatrice are drawn from Anglophone female-authored works, while Bâ's Aissatou is an example from a Francophone female-authored work and, Sembène's Rama from a Francophone male-authored work. The large scope of this study cutting across gender, national and linguistic boundaries and also, cutting across rural and urban settings makes possible the assertion of this study that despite the African woman's apparent virtue of passivity and submission, she does not whole-heartedly accept the harsh patriarchal constructs of her society which work against her selfhood; hence her participation in the drama of social reformation. Times are changing and so the woman should not remain the constant factor. The novelists under study have used art to advocate for this change in the society.

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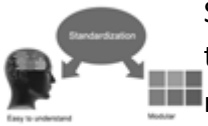


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The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.


The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.


After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

**The following entitlements are applicable to individual Fellows:**


Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

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**The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:**

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- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
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- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

**Note :**

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

# Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

**(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.**

**(II) Choose corresponding Journal.**

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# Preferred Author Guidelines

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Page Size: 8.27" X 11'"

- Left Margin: 0.65
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- Top Margin: 0.75
- Bottom Margin: 0.75
- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, "Abstract" word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

**You can use your own standard format also.**
**Author Guidelines:**

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

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All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

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Complete support for both authors and co-author is provided.

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Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

**5.STRUCTURE AND FORMAT OF MANUSCRIPT**

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

**Papers**: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

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(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

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Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

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A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

*Acknowledgements: Please make these as concise as possible.*

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

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*Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.*

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Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

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www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

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## TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

**1. Choosing the topic:** In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

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**3. Think Like Evaluators:** If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

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**5. Ask your Guides:** If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

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**7. Use right software:** Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

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**16. Use proper verb tense:** Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

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**18. Pick a good study spot:** To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

**19. Know what you know:** Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

**20. Use good quality grammar:** Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

**21. Arrangement of information:** Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

**22. Never start in last minute:** Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

**23. Multitasking in research is not good:** Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

**24. Never copy others' work:** Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

**25. Take proper rest and food:** No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

**26. Go for seminars:** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

**27. Refresh your mind after intervals:** Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

**28. Make colleagues:** Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

**29. Think technically:** Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

**30. Think and then print:** When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

**31. Adding unnecessary information:** Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

**32. Never oversimplify everything:** To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

**33. Report concluded results:** Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

**34. After conclusion:** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

## Informal Guidelines of Research Paper Writing

**Key points to remember:**

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

**Final Points:**

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

**General style:**

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

**Title Page:**

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

**Abstract:**

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

**Introduction:**

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

**Procedures (Methods and Materials):**

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

**Results:**

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

**Discussion:**

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

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- Do not give permission to anyone else to "PROOFREAD" your manuscript.

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- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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| Topics | Grades | | |
|---|---|---|---|
| | **A-B** | **C-D** | **E-F** |
| ***Abstract*** | Clear and concise with appropriate content, Correct format. 200 words or below | Unclear summary and no specific data, Incorrect form<br><br>Above 200 words | No specific data with ambiguous information<br><br>Above 250 words |
| ***Introduction*** | Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited | Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter | Out of place depth and content, hazy format |
| ***Methods and Procedures*** | Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads | Difficult to comprehend with embarrassed text, too much explanation but completed | Incorrect and unorganized structure with hazy meaning |
| ***Result*** | Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake | Complete and embarrassed text, difficult to comprehend | Irregular format with wrong facts and figures |
| ***Discussion*** | Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited | Wordy, unclear conclusion, spurious | Conclusion is not cited, unorganized, difficult to comprehend |
| ***References*** | Complete and correct format, well organized | Beside the point, Incomplete | Wrong format and structuring |

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