

Education Professionals' Perceptions of Factors that contribute to Effective Mathematics Teaching and Achievement in Jamaica

Devon Crossfield¹, Paul Andrew Bourne²

¹*Institute for excellence in Leadership and Teacher Development, Church teachers' college: Mandeville*

²*Quality Management and Institutional Research, Northern Caribbean University, Mandeville, Jamaica*

***Corresponding Author:** *Devon Crossfield, Institute for excellence in Leadership and Teacher Development, Church teachers' college, Mandeville*

ABSTRACT

This quantitative survey was designed to identify deficiencies in teacher quality that impede student achievement in CSEC Mathematics in Jamaica. It intended to identify and suggest programs, policies and strategies that should prove effective in diminishing deficiencies identified. It was also planned to identify strategies to improve teacher quality and enhance student achievement as well as to provide a body of literature to guide policy makers. The sample consisted of 120 CSEC Mathematics teachers from both upgraded and traditional high schools of whom 103 completed and returned the questionnaire designed by the researcher. Each questionnaire consisted of 30 items; 29 forced-choices and one free choice. The reliability statistic yielded was 0.744 when subjected to Cronbach Alpha. The response categories were: High (5); Moderate (3), and Low (1). Descriptive and inferential statistics were used to analyze the data. The Statistical Package for the Social Sciences (SPSS) software was used to obtain percentages and frequency values of specific responses. The findings revealed that low socioeconomic status of teachers and students, lack of parental involvement, leadership conditions, scale and replicability, lack of teaching learning resources, poor working conditions, lack of preparation on the part of students, the impact of teacher certification and licensing status, lack of specialization in relation to preparation programs and degrees, coursework, teachers own test scores and limited participation in professional development were major deficiencies that impact teacher quality and student achievement in CSEC Mathematics. It was also found that efforts of the National Transformation Program to promote and emphasize teaching as a viable profession were ineffective. It was recommended that a holistic approach be embarked upon to establish a relevant, high-quality, mathematics education model, to respond to the mathematical needs of students in the Jamaican context, and that teachers be empowered through purposeful professional development to monitor student success, and create a stimulating environment that encourages intellectual engagement of students.

Keywords: *Mathematics, student achievement, teacher quality, Jamaica.*

INTRODUCTION AND BACKGROUND

During 2016, Jamaica celebrates 35 years as a participating territory in the Caribbean Secondary Education Council (CSEC) examinations. Despite impressive achievements and investments of resources in secondary education, the issue of teacher quality and its impact on student achievement remains a challenge in the education system. The dismal performance of students in mathematics as a core subject in the 2012 Caribbean Secondary Education Council (CSEC) examination has triggered renewed concern among senior educators and has fueled much dissatisfaction among stakeholders in the country.

In addition, the Jamaica Ministry of Education requires that practicing teachers in public schools have minimum qualification of a first degree, and those lacking such qualifications are expected to upgrade themselves. Leave requiring absence from the classroom, according to the Ministry of Education, will not be approved except in "special circumstances".

In addition to the obvious teacher quality factors such as qualifications, teacher characteristics, teacher practices and effectiveness, students' underachievement is influenced by inappropriate deployment of teachers in areas for which they lack training.

Education Professionals' Perceptions of Factors that contribute to Effective Mathematics Teaching and Achievement in Jamaica

Though many teachers have upgraded their qualifications, they have not done so in the teaching of mathematics, but are assigned to teach this subject.

STATEMENT OF THE PROBLEM

Policymakers are faced with diverse challenges concerning how to improve the quality and standards of teaching in Jamaica. They face difficult challenges concerning how to educate, recruit, retrain and retain teachers, who can appropriately stimulate improvement in student achievement in mathematics.

Purposes of the Paper

- To ascertain educational professionals' perceptions of factors that contribute to effective math teaching and achievement in Jamaica.
- To stress the importance of teacher training with specialization in mathematics and sustained, purposeful, job related professional development as a means of improving achievement in CSEC Mathematics.
- To identify and suggest programs, policies and strategies that should prove effective in diminishing the teacher-related training or other factors that inhibit student achievement in CSEC Mathematics in Jamaica.
- To produce a body of literature and findings that can be recommended to teacher training institutions and principals for creating contexts that influence effective teaching/learning of CSEC Mathematics in schools.

Limitations of the Study

- The study represents a small sample; therefore, generalizations should be approached cautiously.
- The study did not measure many personal characteristics important for teacher effectiveness. Philosophical views, emotions, traditions, culture and educational structure may be directly related to teacher effectiveness.

Significance of the Study

The significance of this issue is that it was planned to identify and highlight deficiencies in teacher quality that undermine student underachievement in CSEC Mathematics in Jamaica, and to provide findings that identify

programs, policies and strategies that are effective in diminishing teacher quality that are deleterious to students' achievement in CSEC Mathematics. Principals could be guided by the findings, to create contexts which influence effective teaching and learning in their schools. Thus, the study would be beneficial to the entire educational system.

Previous studies have not dealt adequately with the matter. Thus, this study was designed to identify and suggest programs, policies and strategies that may be effective in eliminating deficiencies in teacher quality that contribute to student underachievement in CSEC Mathematics in Jamaica. In his work, Teachers' qualifications and their impact on student achievement, Zuzovsky (2003) used data collected as part of the trends in International mathematics and science to validate the already existing assumptions regarding the impact of teacher quality on student achievement. Richardson (2008) found a significant relationship between teacher quality and academic performance of middle school students. Buddin and Zamarow (2009) showed that teacher quality is an important determinant of students' achievement, but showed no direct connection between the traditionally assured measures of teacher effectiveness and student achievement over time.

RESEARCH DESIGN AND PERSPECTIVES

This survey approach is said to examine our perception of daily activities and how we make sense of everyday activities, in order to ensure that our behaviors are socially acceptable. The survey method was considered suitable for this research, for the issue of improved teacher qualification and student underachievement have been perennial challenges to the education system in Jamaica and elsewhere.

Elements of quantitative research were used in this descriptive study to "gather data that describe naturally occurring phenomena". Organizing, tabulating, depicting and describing data on the characteristics of the population or phenomenon being studied were included. Charts and tables were used to aid the readers' understanding of the distribution of the data (Glass & Hopkins, 1984). Quantitative research involves more than the use of numerical data (Griffith, 2012). It entails collection and analysis of data to describe, explain, predict, or control phenomena of interest.

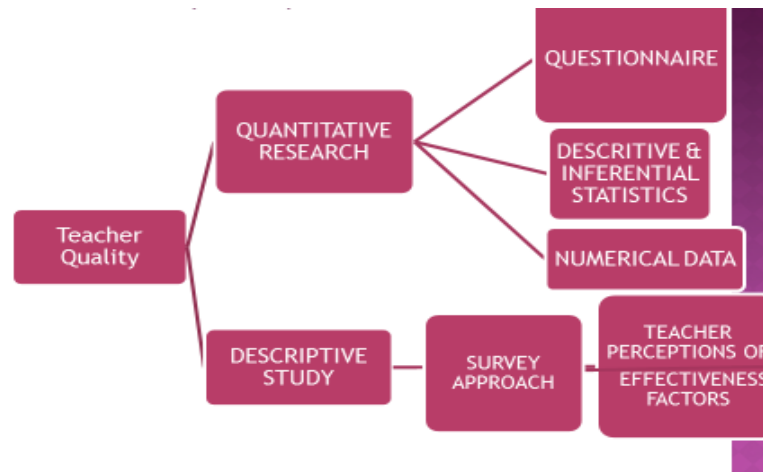


Figure1. Concept map showing research design

INSTRUMENTATION

Of the 200 participants, 103 completed and returned the 30-item questionnaire, which was constructed by the researcher and achieved a reliability statistic of 0.743. The response categories were High 5-4; Moderate; 3-2 and Low 1-0.

Population, Sample, and Sampling

The population from which the sample was selected from consists of about 234 secondary schools inclusive of 190 public and 44 private schools. Each school has an average student population of about 1200 and a staff of about 49, including one principal, two Vice Principals and two Guidance Counselors. The economy of the communities from which the participants were chosen is based on farming. Gay, Mills and Airasian (2011) state that the larger group from which a sample is chosen or from “which the researcher would like to generalize the results of the study” is called the population (Cited by Griffith, 2012). Thus, the sample for this study was selected from the population described above.

A sample is the sum total of items, individuals or events chosen from a population for a study. It represents the larger population from which they were selected (Airasian, et al. 2011). In this quota sample, 200 teachers were selected from eight secondary schools whose names were written on cards, placed in a bag and selected by shaking the bag and picking the names at random, then labeled A, B, C, D, etcetera for anonymity.

Stratified random sampling was used to select the study participants in order to reflect the population. Thus, teachers were linked

exclusively to the class or group of students that they taught.

Data Analysis

The data was analyzed using descriptive statistics to identify the most important teacher quality factors as perceived by teachers and inferential statistics in the form of Chi-Square was used to ascertain differences in perceptions among major demographic groups on teacher effectiveness factors.

PRESENTATION, INTERPRETATION AND DISCUSSION OF RESULTS

Research Question # 1 Asked

“What teacher quality factors do educators perceive to be influencing student academic achievement in CSEC mathematics in Jamaica?” The response categories with weightings were as follows: High (5); Moderate (3); Low (1). Figure 2 below show the findings.

The findings unearth numerous teacher qualification factors believe to contribute to students achievement in CSEC mathematics in Jamaica (figure 2 below). These include teacher certification and licensing status; pre-service programs and experience; teachers’ product and test grades; participation in professional development activities, adequate professional training and degree in mathematics; and two-year induction program who will be regularly evaluated. Also, adequate, high quality professional development; teachers’ readiness to teach the content, participation in professional development activities focusing on content knowledge; professional development activities intended to improve the quality of delivery of Mathematics concepts and raising the minimum qualification requirements of teachers

Education Professionals' Perceptions of Factors that contribute to Effective Mathematics Teaching and Achievement in Jamaica

constituted were major factors found to influence students' academic performance in CSEC mathematics. In addition, access to pre-service teacher education for all teachers; access to ongoing professional development; a comprehensive registration and licensing scheme, and preparation of educational innovators to generate ideas and suggestions regarding teaching were factors found to be effective in improving students' academic achievement.

The findings of this research are supported by the literature. Mathematics is a subject in which teachers' academic qualifications in areas such

as coursework, degree attainment, preparation programs, and certification have a direct impact on teacher quality (Goe, 2007; Rice, 2003). These factors influence the teaching ability of teachers, and student performance. Carr (2006) found that teacher "highly qualified" status contributed to student achievement in all subject, while Darling-Hammond (2000); Darling-Hammond et al. (2005) found that teacher certification impacted student achievement. National Board Certified Teachers were found to have marginally improved high school students' mathematics achievement (Cavalluzzo, 2004).

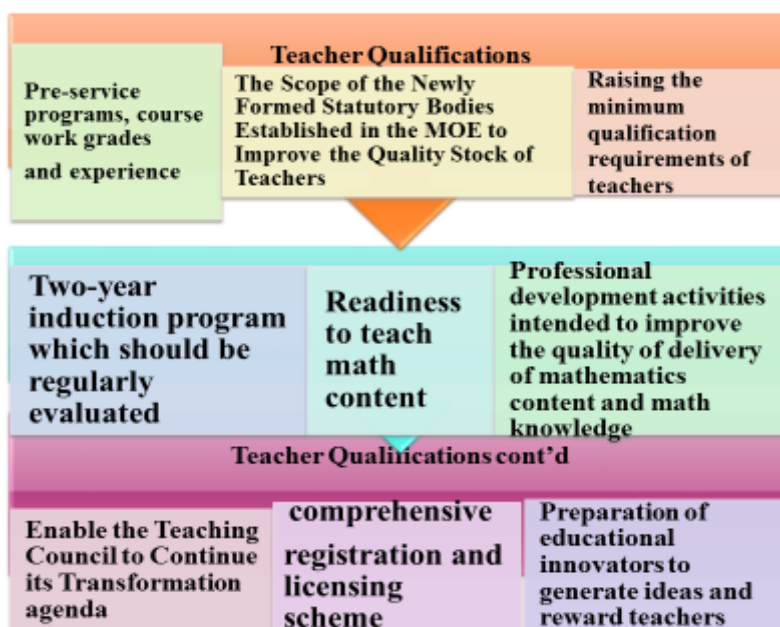


Figure2. Concept map showing perceived teacher qualification factors contributing to students' achievement in mathematics

The other teacher quality factors found to influence students' academic achievement in mathematics are called teacher characteristics (see figure 3). The findings indicate that inclusion of teachers in the decision making process in selecting skills and resources needed for the development of their competencies, inclusion of students in the decision making process in selecting skills and resources needed for the development of their competencies, and the extent to which teachers encourage and cultivate innate student talents and inclination are key teacher quality factors that influence students' academic achievement. In addition, socioeconomic status of teachers and the provision of appropriate support and working conditions in the school that teachers need to develop their competencies were found to be teacher quality factors influencing students' academic achievement.

These findings are corroborated by the literature. Teacher sharing of information, vision, and trust, have found to positively impact observed instructional quality in mathematics (Leana & Pil, 2006). Similarly, Kannapel & Clements (2005) found that collaborative decision making differentiated high- from low-performing elementary schools. Rowan et al. (1997) found that schools with shared decision making and common planning periods were positively associated with high school students' mathematics achievement. Including students in the decision making process can be viewed as high expectations from teachers. Teachers' high expectations for students are found to be associated with higher middle school mathematics achievement (Frome et al., 2005).

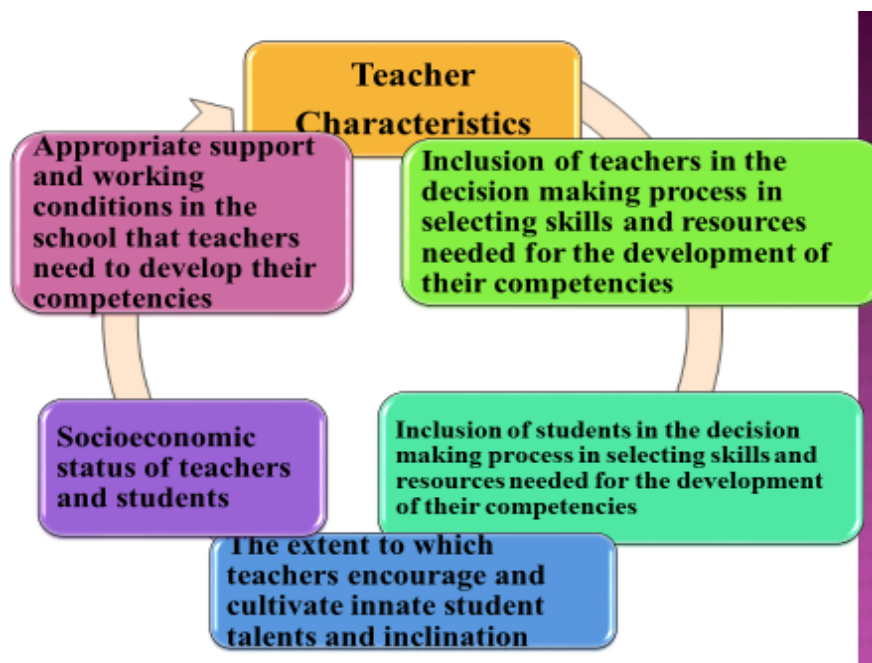


Figure3. Concept map showing perceived teacher characteristics as factors contributing to students' achievement in mathematics

Teacher practices were another set of teacher quality factors found to influence students' academic achievement in CSEC mathematics (see figure 4). The teacher quality factors found to influence students' academic achievement through this lens are; tendency of teachers to organize evaluations of their programs by students; the viability of teaching as a profession; fostering of a culture of applying the curriculum and improve student learning outcomes by implementing a pay by performance-based system; rigorous performance management system for teachers; continuing opportunities to use emerging new methods, forms of assessment, and technologies, and provision of teaching assistants to enable teachers to focus on higher level professional tasks. Also, the deployment of teachers to match the needs of all stakeholders; scale and replicability; undervaluing and neglecting of proper reading and writing; a system of inclusivity and accountability, and programs centered on the improvement of school leadership were factors found to influence students' academic achievement in mathematics.

The findings pertaining to these factors are timely as educators today are grappling to find answers to these issues in the classroom. The literature reviewed showed that alignment of instructional content with assessments, cognitive engagement or challenge, interactive practices, quality of assignments, practices aligned with framework for teaching, practices aligned with reform standards, mathematics framework and

principal assessments of teacher practice have been found improve students' mathematics growth (Rowan et al., 2002; Kyriakides, 2005; Marcoulides et al., 2005). Thus, the above teacher quality factors contribute to student achievement in the Caribbean Secondary Education Council (CSEC) Mathematics examinations in Jamaica.

Research Question # 2 Asked

"Is there a perceived relationship between teacher effectiveness factors and students' achievement among the demographic groups: Tenure, teaching experience, age group, qualifications, position held and major area of study?" Thus, Ho: There is no perceived relationship between teacher effectiveness factors and students' achievement among the demographic groups: tenure, teaching experience, age group, qualifications, position held and major area of study. Chi-squared statistics was calculated to test this hypothesis.

The teacher effectiveness factors subjected to the chi-squared test included improved matriculation to university', reduced economic inequities, gender inequities, geographic inequities, improved input-output ratios, students attaining the specified proficiency standards, student's satisfaction with instruction they are receiving, dropout rate of students, providing the learner with skills to function in the job, sustainable achievement of students, and providing a broad-based approach to learning.

Education Professionals' Perceptions of Factors that contribute to Effective Mathematics Teaching and Achievement in Jamaica



Figure 4. Concept map showing perceived teacher practices factors contributing to students' achievement in mathematics

Appendices A-E show highly significance values, $p(0.00) < \alpha(0.05)$, indicating all participants from the different demographic groups perceived that the selected effectiveness factors have a significant effect on student achievement in CSEC mathematics. However,

there is insufficient evidence to support this as 66.7% of some cells from the output data had expected frequencies less than 5, which means one of the assumptions of chi-square was violated. This means that generalization must be approached with caution.

Teacher effectiveness factors	Chi-square statistics
Improved matriculation to university	$X^2(1) = 37.85, p < .001.$
Reduced economic inequities	$X^2(1) = 34.45, p < .001.$
Gender inequities	$X^2(1) = 44.15, p < .001.$
Geographic inequities	$X^2(1) = 42.25, p < .001.$
Improved input-output ratios	$X^2(1) = 28.09, p < .001.$
Students attaining the specified proficiency standards	$X^2(1) = 29.64, p < .001.$
Student's satisfaction with instruction they are receiving	$X^2(1) = 38.81, p < .001.$
Dropout rate of students	$X^2(1) = 38.10, p < .001.$
Providing the learner with skills to function in the job	$X^2(1) = 52.20, p < .001.$
Providing a broad-based approach to learning	$X^2(1) = 24.80, p < .001.$
Sustainable achievement of students	$X^2(1) = 49.09, p < .001.$

Appendix A. Table showing relationship between # of years in current position and selected teacher effectiveness factors.

Teacher effectiveness factors	Chi-Squared Statistics
Improved matriculation to university	$X^2(1) = 82.56, p < .001$
Reduced economic inequities	$X^2(1) = 70.06, p < .001$
Gender inequities	$X^2(1) = 62.84, p < .001$
Geographic inequities	$X^2(1) = 65.92, p < .001$
Improved input-output ratios	$X^2(1) = 78.70, p < .001$
Students attaining the specified proficiency standards	$X^2(1) = 83.08, p < .001$
Student's satisfaction with instruction they are receiving	$X^2(1) = 81.55, p < .001$
Dropout rate of students	$X^2(1) = 59.89, p < .001$
Providing the learner with skills to function in the job	$X^2(1) = 57.73, p < .001$
Providing a broad-based approach to learning	$X^2(1) = 60.00, p < .001$
Sustainable achievement of students	$X^2(1) = 64.43, p < .001$

Appendix B. Table showing relationship between highest level of qualification of participants and selected teacher effectiveness factors.

Education Professionals' Perceptions of Factors that contribute to Effective Mathematics Teaching and Achievement in Jamaica

Teacher effectiveness factors	Chi-Squared Statistics
Improved matriculation to university	$X^2 (1) = 77.49, p < .001$
Reduced economic inequities	$X^2 (1) = 51.85, p < .001$
Gender inequities	$X^2 (1) = 46.17, p < .001$
Geographic inequities	$X^2 (1) = 53.58, p < .001$
Improved input-output ratios	$X^2 (1) = 44.59, p < .001$
Students attaining the specified proficiency standards	$X^2 (1) = 68.96, p < .001$
Student's satisfaction with instruction they are receiving	$X^2 (1) = 75.38, p < .001$
Dropout rate of students	$X^2 (1) = 64.42, p < .001$
Providing the learner with skills to function in the job	$X^2 (1) = 74.55, p < .001$
Providing a broad-based approach to learning	$X^2 (1) = 73.21, p < .001$
Sustainable achievement of students	$X^2 (1) = 74.32, p < .001$

Appendix C. Table showing relationship between age group of participants and selected teacher effectiveness factors.

Teacher effectiveness factors	Chi-Squared Statistics
Improved matriculation to university	$X^2 (1) = 61.70, p < .001$
Reduced economic inequities	$X^2 (1) = 62.95, p < .001$
Gender inequities	$X^2 (1) = 57.95, p < .001$
Geographic inequities	$X^2 (1) = 55.21, p < .001$
Improved input-output ratios	$X^2 (1) = 44.88, p < .001$
Students attaining the specified proficiency standards	$X^2 (1) = 50.63, p < .001$
Student's satisfaction with instruction they are receiving	$X^2 (1) = 66.98, p < .001$
Dropout rate of students	$X^2 (1) = 52.30, p < .001$
Providing the learner with skills to function in the job	$X^2 (1) = 81.25, p < .001$
Providing a broad-based approach to learning	$X^2 (1) = 88.50, p < .001$
Sustainable achievement of students	$X^2 (1) = 77.22, p < .001$

Appendix D. Table showing relationship between major area of study and selected teacher effectiveness factors

Teacher effectiveness factors	Chi-Square Statistics
Improved matriculation to university	$X^2 (1) = 63.38, p < .001$
Reduced economic inequities	$X^2 (1) = 81.21, p < .001$
Gender inequities	$X^2 (1) = 74.47, p < .001$
Geographic inequities	$X^2 (1) = 77.39, p < .001$
Improved input-output ratios	$X^2 (1) = 60.00, p < .001$
Students attaining the specified proficiency standards	$X^2 (1) = 62.57, p < .001$
Student's satisfaction with instruction they are receiving	$X^2 (1) = 69.30, p < .001$
Dropout rate of students	$X^2 (1) = 68.09, p < .001$
Providing the learner with skills to function in the job	$X^2 (1) = 65.23, p < .001$
Providing a broad-based approach to learning	$X^2 (1) = 71.85, p < .001$
Sustainable achievement of students	$X^2 (1) = 65.37, p < .001$
Relevance of competencies derived from course to job market	$X^2 (1) = 73.99, p < .001$

Appendix E. Table showing relationship between participant's tenure and selected teacher effectiveness factors

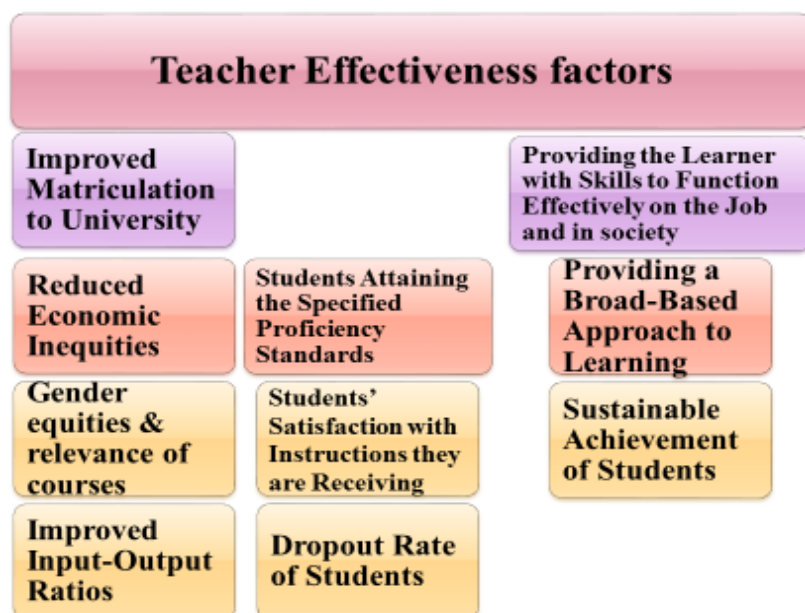


Figure 5. Concept map showing perceived teacher effectiveness as factors contributing to students' achievement in mathematics

Research Question # 3 Asked

“Is there a relationship between gender and selected teacher effectiveness factors?” Thus, Ho 1: There is no difference in the views of male and female educators on the perceived factors influencing students' academic achievement in CSEC mathematics in Jamaica. The variables were subjected to chi-squared statistics.

The results revealed that $\chi^2(1) = (38.37-75.80)$, $p < .001$, indicating that male and female teachers have different views on the teacher effectiveness factors that contribute to student achievement on the CSEC mathematics in Jamaica. This was also supported by the degree to which the observed counts and the expected counts in each cells differed in the output data.

Majority of the males (41.7%) rated High, the likelihood of their students gaining improved matriculation to university, while majority of the females (46.6%) rated it Moderate.

All 24 participants who rated reduced economic equities, High, were males, and of the 60 participants who rated it moderate, 36 (60%) were females. All 17 who rated gender equities High, were males, while of the 64 who rated it Moderate, 51.6% were females. All 18 participants who rated geographic equities High, were males. Of the 58 who rated it Moderate, 30 or 51% were males. All 25 (100%) who rated improved input-output ratios High, were males. Of the 70 who rated it moderate, 47 (67.1%) were females. All 37 participants who indicated

that their students attained the specified proficiency standards were males. However, of the 60 who rated it moderate, 49 (81.7%) were females. All 40 participants who indicated High, student's satisfaction with instruction they are receiving were males and 45 (84.9%) of the 53 participants who rated it Moderate were females.

Of the 53 participants who rated the dropout rate of students Moderate, 35 or 66% were males. All the participants who rated it High, were males. Of the 56 who rated 'Providing the learner with skills to function in the job' High, 48(85.7%) were males. All 40 of the participants who rated it Moderate were females. Providing a broad-based approach to learning was rated High by 51 participants, 48(94.1%) males and 3 (5.9%) females. Sustainable achievement of students was rated High, by 51 participants, 48(94.1%) males and 3 (5.9%) females.

All 21 (43.8%) who rated relevance of competencies derived from course to job market High, were males. Of the 66 that rated it Moderate, 27(40.9%) were males and 39(59.1%) were females. All 16 participants who rated it Low, were females.

In a less recent study gender was not found to be associated with differential student achievement in mathematics (Ehrenberg, Goldhaber, & Brewer, 1995). The current literature base does not support inferences about relationships between teacher effectiveness as determined by value-added scores.

Teacher effectiveness factors	Chi-Squared Statistics
Improved matriculation to university	$\chi^2 (1) = 73.14, p < .001$
Reduced economic inequities	$\chi^2 (1) = 43.71, p < .001$
Gender equities	$\chi^2 (1) = 38.37, p < .001$
Geographic equities	$\chi^2 (1) = 44.34, p < .001$
Improved input-output ratios	$\chi^2 (1) = 38.44, p < .001$
Students attaining the specified proficiency standards	$\chi^2 (1) = 60.12, p < .001$
Student's satisfaction with instruction they are receiving	$\chi^2 (1) = 65.30, p < .001$
Dropout rate of students	$\chi^2 (1) = 52.44, p < .001$
Providing the learner with skills to function in the job	$\chi^2 (1) = 63.50, p < .001$
Providing a broad-based approach to learning	$\chi^2 (1) = 73.40, p < .001$
Sustainable achievement of students	$\chi^2 (1) = 75.80, p < .001$
Relevance of course competencies to job market	$\chi^2 (1) = 61.69, p < .001$

Figure 6. Table showing relationship between gender and selected teacher effectiveness factors

IMPLICATIONS

- The existing and evolving challenges that impede and inhibit the quality of teachers to deliver CSEC Mathematics are difficult to address, and it seems complex to keep mathematics teaching at required levels.
- Lack of participation in decision making is key a factor affecting teacher quality.
- There need exists for first class pre-service and induction experiences for teachers inclusive of improved University-School partnerships.
- An urgent need exists for ongoing upgrading of the overall skills set of teachers. The absence of a framework for evaluation and instructional supervision has resulted in below par student achievement and the "professional isolation of many teachers".
- Despite initiatives being implemented and pursued under the Transformation Program are on the right path, they are at a snail's pace, and are inhibited by archaic structure of the secondary system, nonexistence of standards and an enabling accountability framework, lack of articulation and teachers' capacity to stimulate the learning of mathematical concepts and skills.
- There is need for curriculum transfer and alignment between critical levels of the education system to enable students to consolidate prior learning experiences demanded at the secondary level.

RECOMMENDATIONS

- Provide meaningful and useful job-related and job-embedded sustained professional

development activities as well as incentives to teachers for innovations.

- Teachers endorsed quality assurance; this is an avenue to implementing strategies to improve the quality of teaching and learning.
- Embark on an aggressive program to develop stakeholder partnerships aimed at encouraging parents to participate more in their children's education.
- Build a data-base to track best practices, student achievements and teacher effectiveness to help establish relevant, educational models for best practice, as well as information on students who achieved in mathematics.
- Respective statutory bodies in the Ministry of Education should focus better on implementing the programs which fall under their purview, so as to help in developing quality teachers for the system.
- Prepare children prior to secondary education to deal with mathematical problems, theoretically and practically so that they enter secondary school fully prepared.

RECOMMENDATION FOR FURTHER

- It is highly recommended that further research be conducted with similar variables and a larger sample size to get comprehensive data on factors contributing to deficiencies in teacher quality so as to improve generalizations of findings.
- The instrument used in this study could be used in other secondary schools in Jamaica to replicate this study to determine if there are differences from the findings of this study.

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