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An Intervention into a Secondary School Mathematics Programme

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Abstract: **A pessimistic disposition is taken by many students towards the subject of Mathematics, resulting in unfavorable passes in examinations. The Government of Jamaica, having recognized this academic drawback, sought to train and employ specialist Mathematics teachers, especially in the secondary school system, as it is envisaged that this could possibly garner fruition at the Caribbean Secondary Examination Council (CSEC) level. The objectives of this study were to conduct an action research to effect positive change; build students' capacity in critical thinking in the subject of Mathematics; and obtain favourable passes in the Mathematics CSEC examination among students in Grade 11 at the Donald Quarrie High School. A qualitative approach, with the use of a Tokenism-type community intervention was chosen in carrying out this research. This was because Tokenism allows for democratic-type of participation. Purposive sampling method was used to target a population of 28 individuals: one principal, five teachers and 22 students. In building capacity, a student-centred approach was used. This was reflective of democratic-type pedagogy, Freirian's problem-posing techniques, motivation, Constructivism, and Experiential Learning. The findings from the study which was conducted over the period September to December, 2014, revealed that the intervention programme did not only stimulate students' performance, but their level of mathematical reasoning, critical thinking and problem-solving skills were significantly advanced.**

Keywords: **Mathematics, Critical Thinking, Donald Quarrie High School, Caribbean Secondary Examination Council.**

1. INTRODUCTION

"We avoid the subject because too often we do not understand it. It is too complicated. Whenever we are to work the problem, we become anxious. Mi head literally hurt mi and mi feel sick wen mi fi work de maths dem. Why bother with Mathematics anyways, when most of us won't need it after we graduate? Besides, it is clear that we have a mental block towards the subject".

The aforementioned were the arguments and behavioral language put forward by a selected group of Grade 11 students, with whom we had intervention, as part of an action research project. The research was conducted at the Donald Quarrie High School (DQHS), which operated on a two-shift system. The school has been in existence since 1977, and is situated at Harbour View in the Parish of St. Andrew (The Jamaica Observer, 2014). The school was named after one of Jamaica's distinguished Olympians, Donald Quarrie. What mattered at the DQHS were students' academic and social achievements on a particular set of measures, indicative of its motto: "Excellence through diligence" (The Jamaica Observer, 2014).

It was acknowledged that many students from primary school through graduate school had a mind-set of repugnance towards learning Mathematics, resulting in avoidance of their active participation in the subject (Orton, 2005). Some of the targeted students expressed that they were not good at Mathematics, or that they just did not like it.

Based on the Ministry of Education's plan for educational reform, the performance and achievement of students will continue to be the yardstick by which students and schools in Jamaica are measured (Ministry of Education, 2004). This philosophy is all-encompassing in the "National Shared Vision for Education, which highlighted, full stakeholder participation; equitable and accessible education for all; accountability and transparency and performance at all levels of the system, a globally competitive workforce, and a disciplined, culturally aware and ethical Jamaican citizen" (Ministry of Education, 2004, p.2).

This research followed a specific group of 11Grade students who were scheduled to sit the Caribbean Secondary Examination Council (CSEC) Mathematics at the General level in May/June 2015. These students received their core curriculum for Mathematics in traditional Mathematics classes, and were also given Mathematics remediation by us, the researchers. The students worked in a pull-out group to complete one hundred hours of Mathematics intervention. The first few sessions of the intervention programme were known as the initial placement period. Such intervention was in keeping with the objectives and research questions of the study. The objectives were to

1. Conduct action research to effect positive change.
2. build student's capacity in critical thinking and problem-solving skills in the subject of Mathematics; and
3. Create satisfactory readiness for favourable passes in the Mathematics CSEC examination among students in Grade 11.

Meeting these objectives, rested on answering the two research questions, which were pertinent to the conceptual underpinning of this study. These questions are:

Research Question 1: To what extent has the specially designed Mathematics Programme prepared students to obtain favourable passes in the CSEC Mathematics Examination?

Research Question 2: To what extent was the student's subject matter understanding influenced by reflection and evidence-based data?

Research questions are crucial to any academic study, as they help in the appreciation of the findings and conclusion. Research questions are usually solidified by comprehensive review of the literature, and should be consonant with the objectives of the study. In the case of this research, the two research questions are reflective of intervention, reflection and change.

2. THE PROBLEM

Mathematics is a mandatory scientific subject which is delivered in every school at all levels. It encompasses other academic disciplines, can be identified with most careers, and may be considered the pulse of economic activities, policy and business decision-making.

Over the years, passes in Mathematics for the Caribbean Secondary School Examination (CSEC) have not shown satisfactory performance when compared with other academic disciplines. The Government of Jamaica, having recognized this pitfall sought to employ specialist Mathematics teachers, especially within the secondary school system. Academic fruition of the CSEC Mathematics among students was still not reflected in the Caribbean in the manner intended. In the recent 2012/2013 Statistical Review of the Education Sector, passes in Pure, Applied and Additional Mathematics reported one of the lowest in both CSEC and the Caribbean Advanced Proficiency Examination (CAPE) (Ministry of Education, 2013).

Unsatisfactory performance in CSEC Mathematics was one of the concerns of the Government of Jamaica, which sought to holistically address this issue, among other things, using four approaches; namely: "Governance and Management, Curriculum, Teaching and Learning Support, Stakeholder Participation, Finance" (Ministry of Education, 2004, p. 4). This was intended to be acquiesced to the Education Act (1980), which made provision for equitable access to education in an environment that is conducive to learning; adhere to the national commitment to full-fledged literacy by 2030 (Planning Institute of Jamaica, 2009); and meet the Millennium Development Goal target for gender parity in education by 2015 (Planning Institute of Jamaica, 2009).

3. RELEVANCE OF THE STUDY

We the researchers believed that the study was timely and bore relevance to national development in the context of educational reform, "…to engender skills of problem-solving, creative thinking, critical thinking, and decision-making through cooperative learning" (Ministry of Education and Culture, 2004, p. 4). Our research also met children's educational needs with focus, stability and multi-level fortification (Ministry of Education, n.d.). Through this approach, we ensured access to education, as a charge made by the Education Act, 1980, and hoped that our effort would in some way, contribute to the Government's vision to achieve "World-Class Education and Training" by 2030 (Planning Institute of Jamaica, 2009, p. 69).

The study is also relevant, given: the complex nature of Mathematics; low passing grades obtained by students who sat the CSEC Mathematics in Jamaica; mental block towards Mathematics; the Donald Quarrie High School's leadership, having expressed the desire to lift its reputation for academic success, particularly in the subjects of English Language and Mathematics; the revisitation of the curriculum by the Ministry of Education.

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The main purpose of the study was to obtain academic success in Mathematics among students in Grade 11 at the Donald Quarrie High School; and effect positive behavior change towards the said academic discipline. We believed that their success would better poise them to make socio-economic choices regarding their development, as it relates to further education and the productive sector.

4. LITERATURE REVIEW

This section gives an overview of what denotes action research. It links the views of the various schools of thought, relevant to our study, which purported that our qualitative-type action research rested on the pillars of community intervention, change and reflection.

About Action Research:

Action research is crucial to both teaching and learning. It is geared "…to improve some aspect of the student learning experience. Put more formally, the fundamental purpose of pedagogical action research is to systematically investigate one's own teaching/learning facilitation practice with the dual aim of modifying practice and contributing to theoretical knowledge" (Norton, 2009, pp. xv, xvi).

Carr and Kemmis (2004) described action research as a composition of reflective enquiry undertaken by participants in social situations in order to improve the rationality of their educational practices, understanding of these practices, and the conditions under which these practices are carried out. Its aim is to bring about change and understanding by analyzing existing practice and identifying components for change. The process is established on the harnessing of evidence on which to make informed decisions. Further, Kember (2002) noted that action research is a series of cycles of planning, acting and reflecting on the action.

Action research also shares a central spiral of action and critical reflection on that action to then inform further reiteration of the spiral. The steps within each spiral may overlap, but they are all present in each spiral (similar to Figure 1). Conceivably, the most valuable characteristic of action research is that the process enhances researchers' professional development through the nurturing of their capability as professional knowledge producers (Kember, 2002).

Figure 1, which emanated from the work of Virginia Commonwealth University (2013), shows the various important stages of action research in both a cyclical and spiral manner, which was applicable to our work.

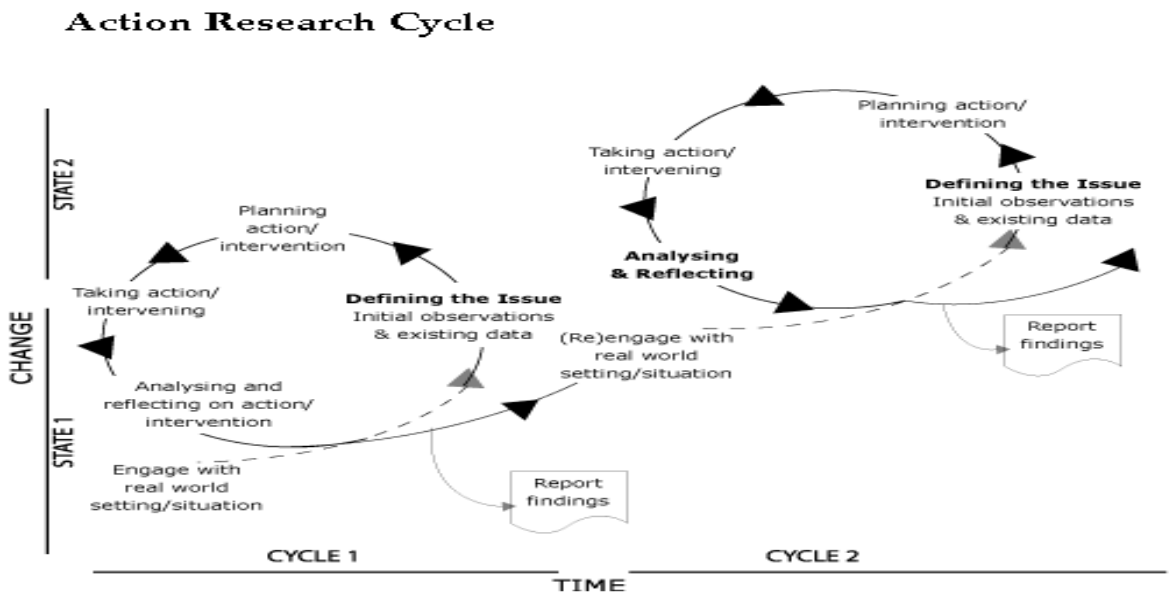

FIGURE 1: VIRGINIA COMMONWEALTH UNIVERSITY ACTION RESEARCH DESIGN

Community Intervention:

In action research, coupled with the Tokenism type of community intervention which we used, Norton (2009) advised that it would be wise if we ask ourselves questions relating to student's attendance, learning, enthusiasm, participation and analytical skills. This was quite fitting with the experience of our Mathematics Programme, whereby although attendance

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ranged from two to twenty-two, learning, enthusiasm and participation were evident. However, the development of the students' analytical skills showed steady progress. This was demonstrated mainly among the boys, who understood the relevant components at the first time of exposure. We then remembered that although the CSEC Mathematics examination passes for boys at the DQHS was not very significant when compared with girls, boys gained higher scores (Caribbean Examination Council, 2014).

The administration of our Aptitude Test also showed passes being more favourable to boys than girls, with less than 50 percent of the students obtained ≥50 percent grade. The literature showed that low passes in Mathematics examination could impact "…children's future education prospects…" (Bleach, 2015, p. 24).

We recalled that in 2011/2012 academic year, the overall report for Jamaica revealed that CSEC Mathematics passes were more farourable to boys than girls, save for when more girls sat the examination (Ministry of Education, 2013). This was not far-fetched from the Caribbean Advanced Proficiency Examinations which showed that 50 percent boys obtained higher passes (grades 1 – 5) when compared with 23.1 percent of their female counterparts (Ministry of Education, 2013). We wondered therefore, whether the favourable passes by boys, when compared with girls were reflective of boys being more kinesthetic and visual-inclined when compared with their female counterpart (Bress, Colley, Ong, Larrabee & Crook, Marcus, Pizzo, Grebb, Ebel, & Cavanaugh, cited in Tatarinceva, 2009).

Motivating the students at every opportunity was with recognition to the fact that learning was "an active, constructive, cognitive and social process by which the learner strategically manages available cognitive, physical, and social resources to create new knowledge by interacting with information in the environment and integrating it with information stored in memory" (Shuell, cited in Kozma, 1994).

Reflection:

The cyclical mechanism under action research, forms part of the reflection, observation and change processes (Kember, 2002). Our action research did not fail to embody reflection, given its propensity to strengthen pedagogy and foster knowledge (Bodman, Taylor & Morris, 2012); and make teaching styles more effective (Kember, 2002), of course, recognizing that "improvements in teaching practice were dependent upon teacher's reflecting on their pedagogy" (Freire, cited in Moriarty, Danaher & Danaher, 2008, p. 433). Reflection also becomes noteworthy when it transcends through critical examination of practice and learning (Moon, 2004; Jasper, 2001; Duffy, 2007).

In the case of our action research, our reflection took the form of journaling, and consideration to student's feedback or discourse which we used to inform our strategies for improvement in both teaching and learning. Gibbs' (1998) model of reflection (Figure 2) is indicative of the way we had engaged reflection at best.

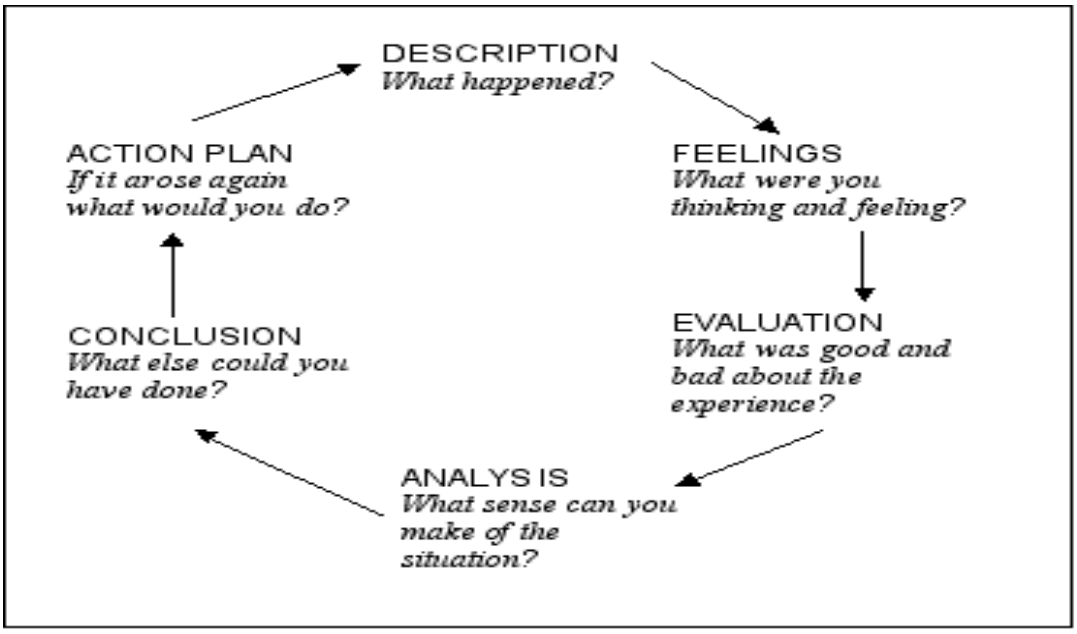

FIGURE 2. GIBBS' MODEL OF REFLECTION

The foregoing stands to reason why action research could influence empowerment, and contribute to "…generating solutions to practical problems" (Koshy, Koshy & Waterman, 2011, p. 2); change a teacher's role, needs, enable flexibility, resources, teaching and learning strategies, values, and action learning (Kember, 2002). McGill & Beaty (cited in Kember, 2002), in describing action learning, noted that it is "a continuous process of learning and reflection, supported by colleagues, with an intention of getting things done.

Through action learning, individuals learn with and from each other by working on real problems and reflecting on their own experiences" (p. 86). The true essence was that the whole remit of action research "involves people and social situations that have the ultimate aim of changing an existing situation for the better" (Meyer, cited in Koshy, Koshy & Waterman, 2011, p.). This was evidenced in our action research and community intervention involving the Principal, teachers and students of the DQHS.

5. METHODOLOGY

This methodology comprised qualitative method and action research. The former looked at the primary and secondary information obtained, while the latter, intervention. This section also articulates the justification for, and strength of the Methodology, research design with a view to primary information and intervention, the Principal, the teachers and the students. It also looked at Secondary Information, the Sample, Data Collection Procedure, Data Analysis and Techniques, Limitations, Positionality, and Ethical Consideration.

Justification for and Strength of the Methodology:

Action research was embarked upon for this study because of its propensity to effect reflection and change. In an effort to strengthen the overall discourse, purposive sampling method was used and this was found to be prudent, as it had loan itself to ease of contact and connection with the teacher-student community. In other words, this methodological approach enabled the capturing of evidence-based information from the students, the teacher and the literature. Our conversations created opportunity for novel insights. Students were also able to learn the same topics twice – once in their regular classes and the other, during the delivery of our Mathematics Programme. This enabled reinforcement of the 12 components taught. It also allowed for detection of the various spiral and cyclical changes which occurred because of this research. Scope for further research was also noted.

Research Design:

A qualitative approach was found to be useful to effect this research because it did not limit the respondents' views from which theories can be developed (Creswell, 2012). It provided details regarding the respondents' personalities, needs, behavior, wishes, inter alia (Madrigal & McClain, 2012). This qualitative research also accommodated reflection and observation.

Data were collected using Primary (including intervention) and secondary methods because these had the propensity to create avenues for responding to the research problem (Creswell, 2012; Babbie, 2001), and the research questions, as well as meet the objectives of the study.

Primary Information and Intervention:

Primary information was gleaned from dialoguing with the Principal and teachers, as well as, classroom intervention with the Grade 11 students at the Donald Quarrie High School where we taught Mathematics in preparation for the CSEC examination. Our intervention initiation started off with our investigation of the school's history, profile, and vision, followed by identifying the various triggers relating to the teacher-student community, then an establishment of relationship and trust. We realized that these tools would likely make our intervention viable. The details are indicated below:

The Principal:

Our first discourse with the Principal was via telephone. He welcomed us to a meeting to discuss our action research. In introducing ourselves, we also brought to his attention, our Intervention Plan and informed him of the objectives, purpose and significance of our research, and the anticipated outcome. He expressed that the school was assessed exclusively by Ministry of Education on quantitative measures of students' outcome - that is, test scores and adequate yearly progress. The Principal added that our objectives for the CSEC Mathematics preparation was not far-fetched from his vision for the school, hence his immediate buy-in and approval regarding our research. He welcomed our Intervention Plan, and our willingness to contribute to the positive development of the school through our Mathematics Programme.

During our interaction with the Principal, we realized that the Dewey model was at work, in that our kind of intervention, was built into the school's pedagogy… "for candidates to gain the awareness, knowledge and competencies….engender a progressive educational movement that is built on the principle and practice of active and constructive participation in community life" (Dewey, cited in Solomon & Levine-Rasky (2003, p. 130) – in other words, a kind of "service learning" purported by Hones, cited in Solomon & Levine-Rasky (2003).

During our conversation, we learned some things about the culture and politics of the student and the academic community of the school. This was because participation, choice, trust and relationship were established, as four effective community intervention tools, and the foundation on which we would proceed with our research. These tools enabled further discourse with other key members of the academic community.

The Teachers:

The Principal later introduced us to the Head of the Mathematics Department and four other key teachers whom we sensitized about our purpose and objectives. Their response was a clear demonstration of intellectual excitement, as they made the necessary arrangements to facilitate us. Such arrangements included the assignment of 30 students, available classroom, and mutually agreed days and time. Our Mathematics Programme was executed on Wednesdays and Fridays during the hours of 11:00 a.m. to 12:00 noon.

We introduced the academic team to the objectives and purpose of our action research. In strengthening our arguments surrounding our work, we provided them with an article, which noted three key phases of teaching, in relation to action research. These phases were Planning, Instruction, and Evaluation, denoting action, the gathering of information, and the analysis of information, being presented in a "cyclical, repetitive process of inquiry that guides teacher preparation and instruction" (Action Research in Teaching and Learning, n.d., p. 1). We also informed them that our community intervention Tokenism-type approach would have encouraged full participation of both teachers and students, and the free expression of opinions. In addition, we also sought to identify the triggers – that is, what would have interested the teachers to support us in the effective delivery of our Mathematics Programme. Where there were instance of discouragement, as a limitation, we employed the placation intervention strategy to cushion such negative aura so as not to be distracted from our mission of enabling student's success.

The Students:

Our intervention programme was conducted over the period October 1 to December 3, 2014. At every class we had a register where we recorded the student's names. We kept a journal of happenings at each class. This resulted in us revisiting our approaches from time to time. In essence, we revisited our academic delivery, motivational communication, and students' responses. We treated the latter as evidenced-based, because it had helped to inform the kind of strategies most suitable to be employed for improvement in problem-solving.

Evidenced-based data were also with respect to the statistical CSEC outcome indicated by the Caribbean Examination Council. Coupled with taking such evidence into consideration, we also we sought to identify the triggers – that is, what would likely interest the students to have wanted to participate in our Mathematics Programme, especially where some of them demonstrated a mental block towards the subject. Here we chose to use Tokenism as the Community Intervention approach for this research because this process enabled the participants to share their opinions freely, and was fitting with our student-centred approach. Based on "Arnstein's ladder and levels of participation", Tokenism involves Placation, Consultation, and Informing (Rabinowitz, n.d.). These methods spanned the degrees of Citizen Participation and Tokenism. This brings to mind, the World Bank's Alternative Hierarchies of Participation, particularly empowerment, collaboration, shared decisions, and consultation (Barry, 1999), which were used in our interaction with both the students and academic team.

We started the class with the basic time-table, and found that only two out of a class complement of eight, who attended class that day, knew up to their six-times; the others did not know beyond their two-times. Prior to getting into the Mathematics problems, we started the students with a motivational talk, and linked their expressed career interests with elements of Mathematics, particularly the 12 syllabus-related components. This gave us a sense of their feelings towards the subject of Mathematics, their level of confidence in succeeding in the CSEC examination, and their attitude towards self-actualisation.

The majority of the students expressed the desire to become professionals: members of the Jamaica Defence Force and the Jamaica Constabulary Force, Clinician, Musician, Entrepreneur, Accountant, Nurse, professional athlete. Nevertheless, we

advised them of the CSEC subjects that would be required for them to begin their journeys to achieving their careers and that successful passes in Mathematics and English were compulsory.

At the beginning of every class, we had the students communicate to us, their understanding of the topic in question. For example, on the first day, we introduced Theorem. Some were able to communicate their understanding of this component. Although they were eager to learn, their understanding of the topics was not consistent with the true meaning. Each student was asked to inform us of the particular area which they did not understand, and justify such misunderstanding before we took them further through the various Mathematics components.

The class also started with us reiterating that which was done in the previous week. We also insisted on them learning the time-table; as this had made problem-solving easier. We also taught the BOMDAS principle, which meant that whatever is contained in the Bracket should be simplified first, followed by that which was raised to a power (depicting the O), then Multiply, Divide, Add, and then Subtract. This was referred to the order of Mathematical operation.

Another strategy which we had employed was to have the students work the problems from the answer upwards in order to determine whether the answer was indeed accurate. This was one of the yardsticks we used to determine their readiness for the CSEC examination.

Secondary Information:

On the point of secondary information, this was obtained by exploring materials that were pertinent to this research. These materials were extracted from journals, books, statistical reports, national reports, legislation, newspaper articles, policy documents, websites, and the Mathematics Curriculum. Further details are noted in the literature review.

Sample:

Purposive sampling was used to target the population studied – that is, the six key members of the academic community and 22 out of 30 selected students. The former comprised the Principal and five teachers, one of whom was the head of the Mathematics Department; while the latter, Grade 11 Mathematics students.

Protocol dictated that permission be obtained from the Principal before anyone else could be targeted. Some scholars would say that we made this decision based on our knowledge and experience relating to the sample (Gay & Airasian, 2000; Babbie, 2001). Besides, purposive sampling is quite fitting with qualitative research (Gay & Airasian, 2000) and action research; the latter having the tendency to "…draw on the qualitative methods and multiple perspectives of educational ethnography" (Zeni, 1998, p. 10).

Data Collection Procedure:

The data collection process took place over the period, September 15 to December 3, 2014 involving the teacher-student community of the DQHS. The initial contact with the Principal was on September 15, while our Mathematics Programme with the students ended on December 3, 2014.

After our discourse with the academic authorities, the decision was that the students would be identified according to their grades and shift. We were allowed to administer our Programme to a selected number of Grade 11 students from the afternoon shift. These students were selected based on the results of the aptitude test, which was prepared by us and delivered by the various Mathematics teachers of the Grade 11 classes. The school considered these students to be the ones who needed improvement. Less than 50 percent of the students were successful in the aptitude test. The teachers informed the selected students to report to school one hour earlier than their scheduled shift, so that they could participate in our Programme.

Our first interaction with the students was on October 1, 2014. Not everyone from the selected 30 were present, but instead 14. After the introductory and motivational sessions, we engaged them in highlighting the Mathematical areas that posed a challenge to them. These areas were consonant with some of the unanswered questions and incorrect answers on their aptitude test. We also provided the students with hard and electronic copies of the CSEC Syllabus, as well as study tips, and tips to passing an examination. Throughout the period, we used email to furnish students with Mathematics problem-solving tips, and motivational statements.

The Mathematics components covered, by virtue of the Syllabus, were Theorem, Arithmetic (Computative Law, Associative Law, Distributive Law), Computation, Algebra (Simple Equation, Linear Equation, Simultaneous Equation), Currencies, Factorization, Mensuration, Ratio and proportion, Percentage, Sets, Graphs, Geometry. The extent to which the students had grasped these components, are noted in the results of this research.

Data Analysis and Techniques:

Qualitative analysis can be crucial, as it does not carry a scientific rigor like the quantitative method, which has the propensity for making predictions. Nevertheless, qualitative analysis is seen by some schools of thought as an art, a science and a dance (Miller & Crabtree, cited in Schutt, 2011). Simply put, the authors explained that

"When the researcher reads the text literally, she is focused on its literal content and form, so the text 'leads' the dance. When the researcher reads the text reflexively, she focuses on how her own orientation shapes her interpretations and focus. Now, the researcher leads the dance. When the researcher reads the text interpretively, she tries to construct her own interpretation of what the text means" (p.324).

For the purpose of this research, data were analyzed using reflection throughout. We kept a journal, as part of the experiential learning process. This had helped us to revisit our teaching techniques and research approaches, and at the same time, improve communication, thinking, learning and our styles of delivery. For example, where students were taught 12 Mathematical components from the syllabus (indicated under Data Collection Approach), our reflection of their responses was akin to the analysis and findings, which depicted changes. Further details are noted in the results. We ascertained whether the problem-posing technique, experiential learning, motivation and Constructivism methods, as well as gender balancing were useful in the delivery of Mathematics. We also observed the conditions under which students were taught and whether such were conducive to learning, despite our consistent application of a demographic-type pedagogy.

We analyzed the aptitude and subsequent assessments to determine the impact that the intervention programme had on the students' Mathematical skills. As suggested by Sangwin (2003) multiple methods of assessment were used to construct student profiles from which data were compared in order to appraise students' progress. We also gleaned from the students, their perspectives about the Programme, their understandings of that which was taught, and what were the issues that positively and negatively impacted their learning.

Limitations:

Our intention to cover at least 50 percent of the syllabus by December 2014, did not materialize because of the holidays which fell in between. Although these were factored into our Intervention Plan, the students having not always been compliant with their homework resulted in us achieving approximately 40 percent coverage. The effort to administer a post-test before the Christmas holiday, to determine the student's readiness for the CSEC Mathematics was futile because when we arrived, the students were in their regular classes, sitting their regular end-of-term examination; and so, our intention to explore greater detail and analysis of the 12 Mathematical components was compounded by the time allotted to conduct this action research.

A negative externality was where some students expressed fear of their parents in relation to seeking help with their school work. This was because some parents exuded antagonism, hence the absence of homework support.

In reference to classes under our special Mathematics Programme, we were concerned about the distractions whereby student prefects would sometimes excuse themselves from the class to carry out duties. Most times the class ended without their return.

Discouragement by a key member of the academic community was also a limitation. We were constantly reminded that our efforts were futile and that the school authority was wasting its time on the students. We wondered whether such negative vibes was otherwise evident, possibly resulted in the fluctuation of attendance.

Positionality:

The Principal and Teachers:

In our discourse with the Principal and teachers, we took what we deemed to be an insider approach, given our professional capacities – being educators and administrators. We assumed that they saw us in a similar manner, because they constantly referred to us as Captain and 'doc' respectively. They communicated to us with an aura of respect.

Our professionalism was displayed through our persona, well-dressed attire, good command of the English Language, and our stated purpose of business. In addition, we had researched the background of the school and gained some knowledge of its operation in order to position ourselves for good dialoguing with the team. The literature considered this approach to

be better than if we had taken an outsider method, because the former would likely help us as researchers to "…gain access to privileged or more balanced viewpoints" (Abu-Lughod, Hill-Collins, Archibald & Crnkovich, cited in Mullings, 1999, p. 4). It also enabled us to receive an unexpected warm reception, whereby gratitude and delight were expressed regarding our voluntary purpose of business. They also gave suggestions on strategies which were useful in academic delivery, and at the same time, provided easement in dealing with the students.

The Students:

Upon meeting the students, we were introduced by one of the Mathematics teachers, whom we had met earlier. Afterwards, one of the first things that we did was to remove the titles from our names, thus adding some ease to how the students would relate to us. It was obvious that they were not comfortable with this, as they continued to address us as Sir and Miss, demonstrating highly respectful demeanor. By virtue of one of us being a man and the other a woman, we believed that the former was seen more in an authoritative capacity, especially because he was dressed in his military attire. Two of the students expressed their desire of making the military a career choice. The woman researcher was well-dressed in her office suit, and the students would look at her, with seeming admiration, from her hair to her feet. On some days, some of the girls and boys whispered to her quietly, "you look nice miss".

The thing with authority is that it is a "social position" (Laupa, cited in Edlund, 2008); for example, children tend to judge authorative figures based on perceived social position, and directive given by that figure (Laupa, 1991). Authority is also "…derived from a person's ability to sense the ultimate good…" (Plato, cited in Vanderstaay, Faxon, Meischen, Kolesnikov & Ruppel, 2009, p. W263). It is legitimized by the agreement of those it controls" (Weber, cited in Vanderstaay et al, 2009, p. W263).

We recognized that given the vast difference in age and our disposition as professionals, we could not have taken an insider approach. We told them that we would be learning from each other. They claimed that while they understood that they would be learning from us, they could not fathom how we could learn from them, as we were the experts. This led to further explanation that teaching and learning was not one-sided, otherwise it would not have been effective.

We treated each child as being capable of solving Mathematics problems, and deemed them worthy of a successful grade in the CSEC Examination. It was important to us that every child effectively grasped the materials and show evidence of efficient learning. This was one of the ways in which we upheld education as a right to every child. Besides, "education is known to hold the key to the economic, political, sociological and human resources development and well-being of any society… preparing the individual for life in the community and reforming the society for relevance, adequacy and competitiveness in the world" (Ogunkola, 2013, p. 97).

As part of the secondary information for our research, we explored the CSEC syllabus and then shared same with them via hard and soft copies – having highlighted the key areas that would be covered. We also gave them motivational talks and quotes and engaged them briefly into discussing their career ambitions. We tied some of their desired careers with the importance of becoming successful in Mathematics. For example, we explained that the knowledge of Mathematics would likely provide access to engineering, medicine, the army, entrepreneur, teaching and other career paths.

Ethical Consideration:

The first points of ethical consideration that we noted were impartiality, truth and relevance, starting from our engagement for buy-in and trust through the execution of the consent form. Ethics gurus such as McBridge & Schostak (n.d.) refer to this as the negotiation of accounts, which abided under the ambit of respect for all participants by ensuring anonymity, freedom of expression, human rights, and confidentiality. Of importance too, were the awareness of the risks and benefits of the research, the absence of coercion, the researcher's objectivity, and the protection of the data during and after the research (Zeni, 1998). All the players in this research were cognizant of all the ethical arrangements.

An information sheet for informed consent was designed to create an understanding of our study and what would have been required to effectively support the action research process. This information sheet delineated the purpose, the involvement of the research, reason for participation, volunteerism, confidentiality, status of information provided, status of the results, and the possible advantages and disadvantages of taking part in the research. This was accompanied by a consent form, which was executed by the Principal and the teachers, in order to garner full support and permission in delivering our CSEC Mathematics Programme to the 30 students who were assigned to us by the academic authorities.

This form made provision for opting out, should the parties refrain from granting support. The forms were executed by the Principal and teachers over a one-week period and returned to us in a timely manner.

6. RESULTS

The Principal and Teachers:

The positive responses from the academic community began with their support of our intervention via their execution of the consent form. The Principal expressed concern about the unfavourable passes in the CSEC Mathematics, and welcomed our opportunity for improvement. They expressed having observed some level of improvement in the student's academic performance, in the subject of Mathematics, particularly some of the components which we had taught.

The teachers reported that the students demonstrated improvement only when a student-centred participatory approach was employed. However, when students were asked to solve a Mathematics problem on the board, they appeared to have a phobia for solving the problems, as they reiterated fear of making errors.

The academic community, which welcomed us with excitement, noted that our intervention would have helped to reinforce that which they had already taught, or cover areas that were not yet taught, thus made the CSEC preparation much easier, a change process which they envisioned, having noted the depth and seriousness of our Intervention Plan.

Coupled with the learning strategies which we had employed, further support from the academic team was in the form of suggesting the use of quizzes, self-study and consistent homework, as this was considered some of the right ways to achieve success.

The Students:

Critical thinking and problem-solving skills were achieved over the intervention period, followed by initial statements such as "Mi head literally hurt mi and mi feel sick wen mi fi work de maths dem". The students continued to express that they usually try to avoid the subject because too often they did not understand it. "It is too complicated". Whenever we tried to work the problem, they would become anxious. As a result, they said that they often wondered about the reason for this subject when they did not think that they would need it after graduation. They also expressed having a mental block towards the subject. Some were not sure whether they could be successful in their CSEC examination, claiming to not be good at the subject and that they did not like it.

Having started out with the basic time-table, coupled with motivational talks, then into the core of business relating to the Mathematics components, helped in the students obtaining a positive attitude towards the subject. Later, students began to demonstrate focus. There was less chewing on their straws and less fidgeting. Sometimes they stood up suddenly with excitement, when they finally understood a problem, especially when we solved the Mathematics problem in a reverse orientation - from the bottom-up, to determine precise accuracy. Statements such as "Yes! mi seet now, mi get it now man". Yes, a so mi did tink mi fi dweet"; "yes, so mi did right de way mi did a work it". There were others who sat still, but rented the air with a loud sigh of relief.

We continued to link Mathematics to real life scenarios, particularly, with their expressed desired career paths: Members of the Jamaica Defence Force and the Jamaica Constabulary Force, Clinician, Musician, Entrepreneur, Accountant, Nurse, professional athlete. We advised them of the CSEC subjects that would be required for them to begin their journeys to achieving these careers and that successful passes in Mathematics and English were compulsory. Even those with mental blocks towards Mathematics began paying keen attention.

As we continued with the classes on Wednesdays and Fridays of each week, we noticed fluctuation in student's attendance, plus new faces almost every time. Of course there were those who were consistent, but the most we have ever had present was 22, and the least being two. It meant therefore that at no given time did all the 30 students who were assigned to our Programme, showed up all at once.

The students claimed that they were grateful for having learned one topic twice – one from their regular classes and the other from our Programme. They all claimed to have understood the components better from our Programme because we took the time to reiterate the sums. We noticed significant improvement when compared with the results of the Aptitude Test that was administered prior to the start of our Programme.

Earlier, a lack of confidence in student Mathematical ability was demonstrated by their responses given such as "I don't know", or "that's too hard" as oppose to attempting to offer an answer. This was the reason why we employed oral tests,

oblivious to the students. They were quite responsive and did not know that they were being tested. This made them much more relaxed than if they were given a structured examination.

Observations made during the oral assessment revealed information about how students answered questions, hence the application of our techniques: Motivation, problem-posing, constructivism, student-centredness, inter alia. It was imperative to note also that their response to a student-centredness was not at first welcoming, as it was a deviation from their culture of a chalk and talk or teacher-centredness. Despite, however, we gently pushed the student-centred approach, having recognized that it has been scientifically proven "to foster a deep approach to learning" (Kember, 2002, p. 93).

The students' feedback to this approach was welcoming when we asked whether they would have liked us to do anything differently. Their remarks were positive, and they were happy that their participation in our Programme did not attract any monetary fee. They also considered our techniques to be rewarding as it was helping them to grasp the relevant Mathematical concepts. These were some of the changes, including improvement in knowledge of their time-table that emanated from our action research resulting in the following responses to the 12 Mathematics components:

Theorem:

Theorem was introduced to the students as the foundation to navigate the various topic competently. The students did not know the definition of Theorem; neither the principles governing same. However, after two in-depth classes, accompanied with assignments, and lessons sent to them via email outside of the class sessions, the students demonstrated a better understanding of the subject.

Arithmetic (Computative Law, Associative Law, Distributive Law):

Not all the students were au fait with the principles governing arithmetic. Having employed the BOMDAS strategy provided easement in their grasp of the concept.

Computation:

Having worked an example, using a student-centred approach with a mix of chalk and talk, the concept was grasped readily. In the regular teacher's report (post-intervention), it was communicated to us that sometimes the students would confuse aspects of the problems.

Algebra (Simple Equation, Linear Equation, Simultaneous Equation):

Initially, this component posed difficulty because of its natural complexity to a beginner. The students had difficulty in using the substitution method to solve Simultaneous Equation. After numerous drills, self-study and extra tutoring, we were satisfied with their reasonable understanding in the end. The students were then more able to use the elimination method of solving Simultaneous Equation effectively. At one point during the lecture, one student echoed, "Mi get it now sah, mi get it". This was interpreted to mean that the problem was now clearly understood.

Currencies:

The whole matter of conversion of currencies was challenging to the students. We practiced past papers and gave assignments. Some did not complete the assignment because they did not understand fully what to do. However, we worked the problems in class, using real life experiences.

Factorization:

This did not pose any challenge, as the students understood the basic principles governing this component prior to our teaching. However, the post-report from the teachers was that the students did not demonstrate confidence in working this problem, especially when it comes to solving the linear equation.

Mensuration:

Having employed the experiential learning strategy, the students were able to demonstrate satisfactory grasp of this component.

Ratio and Proportion:

The students did not have much challenge with this component. They were excited about the topic and understood aspects of it prior to our teaching. However, they claimed to have learned much more.

Percentage:

The students understood well, this component, and as a result, we proceeded to solving problems relating to Sets.

Sets:

Here the students paid very close attention to the definition and the basic workings of the component. They grasped the concept quickly.

Graphs:

Some of the students struggled with this component, which led us to reiterate every steps until we were satisfied that they were able to work the problems on their own. The teachers reported that they had not done any assessment of the students in this area, hence was not able to deliver a post-report.

Geometry:

We taught basic Geometry, whereby we introduced the theorems, which the students had graped easily. The ease at which they worked these problems, coupled with their exuding confidence was remarkable.

7. DISCUSSION

The students' expression of fear for Mathematics problem, was not surprising to us, as research has shown that "Mathematics is often experienced as an intensely emotional subject (Bibby, 2002, p. 705). Regardless, however, the foregoing showed an appreciation of positive change against time over the research period. Such change is in keeping with Evans' (2001) perspective that "schools directly affect their life changes and serve to allocate persons to various roles and positions in society" (p. 22), depicting what Goodson & Sikes (2001) refer to as the social script of one's life manifesting over time. In other words, the movement from limited understanding of the Mathematical concepts to the employment of strategies for better understanding, to the grasping of knowledge, resulting in the achievement of critical thinking and problem-solving skills, embrace both a spiral and cyclical process in action research.

Suggestions by the teachers to use quizzes, self-study and homework as the right ways to achieve academic success, were deemed to be useful strategies. This brought to mind Aristotle's view point that if we endeavour to do things in the right way, with the right people, under the right circumstances, at the right time, for the right cause, then this could be tantamount to virtue (Aristotle, cited in Bleach, 2015). In the case of this research, such virtue would be in reference to the achievement of critical thinking and problem-solving skills among the selected Grade 11 Mathematics students at the Donald Quarrie High School, resulting in favourable passes of the Mathematics CSEC examination.

This kind of collaboration between us and the teachers would be what McNiff & Whitehead (cited in Bleach, 2015) envisioned as improving educational practices, especially having used Bleach's (2015) recommendation of research and capacity building and practice throughout the process of ensuring critical thinking and problem-solving skills.

The foregoing can attest to the fact that students were advanced from their existing levels of Mathematical understanding to a higher level, through scaffolded lessons. A selection of Mathematical exercises allowed for cyclical practice of the elements of Mathematical concepts, in terms of operations: bracket, power, multiplication division, addition and subtraction. Cyclical and spiral practices to assist students develop their working memory was promoted by Cleary and Zimmerman (2004) and Virginia Commonwealth University (2013) respectively (Figure 1), as an imperative characteristic of learning support programmes.

This scheme of teaching had an encouraging effect on student success with the students demonstrating advanced levels of Mathematical understanding at the conclusion of the Programme. It meant therefore that in the end they were able to apply Mathematics to a real world situation. Our reflection and observation of their learning attitudes resulted in our application of strategies that were also informed by secondary sources. It stands to reason why (according to Prescod, 2014, & Aston, 2009) students are likely to improve in their skills, awareness and responsibility when a teacher, through reflection and evaluation, applies instructions that are consonant with the relevant needs. Scholars such as Gibbs (1998), Jasper (2001), and Moon (2004) considered reflection as a powerful learning tool and one that contributes to better academic delivery and sustainable development.

We also retreated to planning and intervention where anomalies were noted in our Limitations, indicated earlier. As a point of Mathematical development, we engaged students according to what Vygotsky (1978) would describe as their Zone of Proximal Development, with a view to students' application of what they were taught, with and without help. In the case of this research, we looked at how the students went about solving the Mathematics problems, and where there were anomalies, we scaffolded them into a more favourable direction that enhanced their understanding and problem-solving

skills. Our methods of direction were unique to each student, and indicative of their learning styles and capabilities. We had also re-organized, analysed and implemented similar to the process indicated in Figure 1.

Of importance to note was that the students' improvement may also be as a result of the styles which we had used. Consonant with the responses to the research questions, these styles entailed:

(i) Problem-Posing Techniques, a term used by Freire (1972), to mean a more liberated and dynamic way of learning. In essence, we did not treat the students as novices, but helped them to critically analyse the Mathematical problems.

(ii) Motivation Techniques – here we gave study tips, verbally and electronically. The students responded positively. One boy remarked, in response to a sum, "Sir, I'm getting it now. I am going to start doing my homework". He honoured his promise for the remaining classes.

(iii) Constructivism and Experiential Learning, whereby we tied adolescent-type scenarios to a sum that they might deem to be unclear. In instances where only one student out of the class expressed a lack of understanding despite the explanations, we never proceeded until that student fully understood the problem.

(iv) Student-centred approach, in the sense that we did not create an autocratic-type of delivery, but rather a democratic one, similar to what Freire would describe as a dialogical pedagogy (cited Moriarty, Danaher & Danaher, 2008).

(v) the use of motivation techniques for the students was very crucial to learning, as it was found that some of the students had a mental block towards Mathematics. This reminded us of the scholarly work of Huitt (2011), which argued that

> "in a teaching/learning environment, it is important to assist the learner to develop a self-attribution explanation of effort (internal, control). If the person has an attribution of ability (internal, no control) as soon as the individual experiences some difficulties in the learning process, he or she will decrease appropriate learning behavior (e.g., I'm not good at this)".

Teacher's support was another reason for the student's advancement during the cyclical and spiral action research processes. One of the Mathematics teachers sat in a few of the classes, and having recognized that not all the students were at the same academic level, made suggestions in keeping with the CSEC syllabus, and supported our strategies for critical thinking.

What we observed was that those who understood most of the Mathematics problems at the first time of exposure were mainly boys. Here we wondered whether this was a clear demonstration of masculinity in a learning environment, rendering girls to appear less knowledgeable; or perhaps the application of our Constructivist, problem-posing and Motivational methods were more akin to the learning styles of the boys when compared to their female counterparts. Regardless, however, we thought it prudent to apply a gender-balanced approach by allowing both boys and girls to approach the whiteboard and physically demonstrated knowledge of the problems. Like Tatarineceva (2009), this made us realise that gender influenced learning, cognitive performance, and psychological response.

8. ACTUAL OUTCOME

In the case of this research, five changes took place in both a cyclical and spiral manner, as indicated in the results. Some of these change outcomes were seen where the students demonstrated a better understanding of the 12 components taught, when compared with the results of the aptitude test. This could have been as a result of the teacher-student ratio of 2:22, when compared to their daily exposure of a 1:40 on average.

Another assumption could be that the extra time allotted to the students outside of the regular teaching-learning hours may have contributed to such change. The reduction of Mathematics teaching load for the teachers was also a solution which emanated from our research. This goes to show that action research can actually create solutions to real problems, as indicated by Meyers' (cited in Koshy, Koshy, & Waterman (2011).

The third outcome was that the students' critical thinking and problem-solving skills were enhanced, beginning with the improvement in the time-tables. The realisation of such skill could have been as a result of our moving away from their culture of an exclusive chalk and talk to a mix of technology, constant motivational talks and study tips, imploring them, in an adolescent-friendly manner, noting the importance of punctuality and commitment to completing assignments, flexibility, chalk and talk, and student-centredness in our delivery, as part of a hidden curriculum process.

The fourth outcome also resonated well with Marxists such as Bowles and Grantis (cited in Pearson Education, 2005) perspectives of the hidden curriculum, whereby we had encouraged order, values and quality. Another outcome was the acquisition of new knowledge by the students and the researchers. While the students obtained knowledge from what we had taught, we observed and learned the various behavioural patterns: increase in retention span, increase in confidence, and enthusiasm.

We anticipated that the foregoing outcomes have provided scope for continued learning that would result in favourable passes in the general proficiency of the CSEC Mathematics Examination in June, 2015; further enhancement of critical thinking, analytical and problem-solving skills; the development of the students' social skills; and an establishment of social cohesion.

9. CONCLUSION

This conclusion forms the responses to the two research questions indicated below:

Research Question 1: To what extent has the specially designed Mathematics Programme prepared students to obtain favourable passes in the CSEC Mathematics Examination?

The specialized Mathematics Programme achieved approximately 40 percent coverage of the CSEC syllabus, and resulted in improvement of the students' critical thinking and problem-solving skills. The 12 Mathematics lessons taught, emanated from the syllabus and were matched and modeled to their existing Zone of Proximal Development (ZPD). The students demonstrated better understanding of the relevant Mathematical concepts. Such improvement was evidenced in the oral tests and post-report from the teachers. Their capacity to reason and solve Mathematical problems was still being developed and should continue to advance as they accrue more knowledge in the problem-solving process. Results of the intervention programme were positive as the students achieved an expected level of growth in their Mathematical understanding within the short time period of this research. This is consonant with meeting objective numbers two and three.

Research Question 2: To what extent was the student's subject matter understanding influenced by reflection and evidence-based data?

Reflection from journaling and evidenced-based data from the student-teachers' responses and the Caribbean Examination Council's statistics, had helped us to apply strategies that were considered prudent for improvement. Some of these strategies were the linking of Mathematics to real life scenarios, reiteration of the Mathematical concepts, motivational talks, Constructivism, the application of student-centredness, etcetera.

These strategies emanated positive behavior – a shift from a pessimistic disposition and fear of Mathematics, towards confidence and improved knowledge-base. This is in keeping with the achievement of objective numbers one and two of this study.

10. RECOMMENDATIONS

The following are the recommendations of the research:

Division of the classes to a reasonable size teacher-student ratio would be helpful in the school's preparation for the CSEC examination. In doing so, the teachers should also engage more in a student-centred approach – a paradigm shift from their culture of a teacher-centred regime, which based on the results of this study, negatively impacted students' confidence in Mathematics.

Mentoring and motivational sessions, as a form of hidden curriculum, would also be useful in keeping the students consistently on track with their studies and to maintain their achieved critical thinking and problem-solving skills. This could be channeled through the Parent Teachers' consultations, and staff meetings, bearing a message which depicts the importance of education and the right to its opportunity by every child.

The focal point of Mathematics lessons should be customized around the students' Zone of Proximal Development (ZPD), parallel with the CSEC curriculum. Coupled with this, there should be comprehensible teaching of Mathematical concepts with instant feedback which should be followed by activities that incorporate multisensory activities.

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REFERENCES

[1] Action Research in Teaching and Learning (n.d.). Retrieved from http://www.sagepub.com/upm-data/26946_Stringer_Sample_Ch_1.pdf

[2] Aston, S. (2009). How to Contribute to Student Teachers' Critical Development: A Higher Education Practitioner's Personal Account of a Move Towards a More Critical and Emancipatory Pedagogy Through Design and Technology. Educational Journal of Living Theories, 2(2), 172-214.

[3] Babbie, E. (2001). The Practice of Social Research. 9th edition. Australia: Wadsworth.

[4] Barry, M. (1999). Empowerment through Participation: The relevance of Theories of Participation to Social Work. (13-37): In Empowerment Practice in Social Work: Wells,L., Shera, W., (1999) Canadian Scholars' Press Inc.Toronto Canada

[5] Bibby, Tamara (2002). Shame: An Emotional Response to Doing Mathematics as an Adult and a Teacher. British Educational Research Journal, 28(5), 705-721.

[6] Bleach, J. (2015). Improving Numeracy Outcomes for Children through Community Action Research. Educational Action Research, 23(1), 22-35.

[7] Bodman, S., Taylor, S., & Morris, H. (2012). Politics, Policy and Professional Identity. English Teaching: Practice and Critique, 11 (3), 14-25.

[8] Caribbean Examination Council (2014). Caribbean Examination Council Headquarters Grade Summary Centre Statistics Report 2014 June Administration. Barbados: Caribbean Examination Council.

[9] Carr, W., & Kemmis, S. (2004). Becoming Critical: education knowledge and action research. London: Routledge.

[10] Cleary, T. J., & Zimmerman, B. J. (2004). Self-regulation empowerment program: A school-based program to enhance self-regulated and self-motivated cycles of student learning. Psychology in the Schools, 41(5), 537-550.

[11] Creswell, J.W. (2012). Educational Research Planning, Conducting and Evaluating Quantitative and Qualitative Research (4th ed). Massachusetts: Pearson Education, Inc.

[12] Duffy, A. (2007). A concept analysis of reflective practice: Determining its value to nurses. British Journal of Nursing, 16(22), 1400-1407

[13] Edlund, S. (2008). Observations of Children's Responses to Different Types of Adult Authority Figures. Retrieved from http://digitalcommons.ric.edu/cgi/viewcontent.cgi?article=1008&context=honors_projects

[14] Evans, H. (2001). Inside Jamaican Schools. Retrieved from http://books.google.com.jm/books?hl=en&lr=&id=AVGJwWZVb2sC&oi=fnd&pg=PR8&dq= Inside+Jamaican+Schools+by+H.+Evans&ots=3yP3QFLyw&sig=ZNoj0mK0TUhcUKYG6ph8hvzx1HA&redir_esc=y#v=onepage&q=Inside%20Jamaican%20Schools%20by%20H.%20Evans&f=false

[15] Freire, P. (1972). Pedagogy of the Oppressed. United Kingdom: Penguin.

[16] Gay, L. R. & Airasian, P. (2000). Educational Research. Competencies for Analysis and Application. 6th Edition. New Jersey: Prentice Hall.

[17] Gibbs, G. (1988). Learning by Doing: A guide to Teaching and Learning Methods. Oxford: Oxford Polytechnic.

[18] Goodson, I. F. & Sikes, P. (2001). Life History Research in Educational Settings: Learning from Lives. Birmingham: Open University Press.

[19] Huitt, W. (2011). Motivation to learn: An overview. Retrieved from http://www.edpsycinteractive.org/topics/motivation/motivate.html

[20] Jasper, M. (2001). The Role of the Nurse Manager in Ensuring Competence. The Use of Portfolios and Reflective Writing. Journal of Nursing Management, 9, 249-251.

[21] Kember, D. (2002). Long-term outcomes of educational action research projects. Educational Action Research, 10(1), 83-104.

[22] Koshy, E., Koshy, V., & Waterman, H. (2011). Action Research in Healthcare. India: SAGE Publication Ltd.

[23] Kozma, R. B. (1994). The Influence of Media on Learning: the Debate Continues. Retrieved Fromhttp://www.ala.org/aasl/aaslpubsandjournals/slmrb/editorschoiceb/infopower/selctkozmahtm.

[24] Laupa, M. (1991). Children's Reasoning About Three Authority Attributes: Adult Status, Knowledge, and Social Position. Developmental Psychology, 2, 321-329.

[25] Madrigal, D. & McClain, B. (2012). Strengths and Weaknesses of Quantitative and Qualitative Research. Retrieved from http://www.uxmatters.com/mt/archives/2012/09/strengths-and-weaknesses-of-quantitative-and-qualitative-research.php

[26] McBride, P. K. (2014). Mathematical Problem Solving. Elsevier.

[27] McBridge, R. & Schostak, J. (n.d.). Researching Action and Change. Retrieved from http://www.enquiry learning.net/ELU/Issues/Research/Res1Ch3.html

[28] Ministry of Education (n.d.). Curricula. Lower Secondary. Retrieved from http://www.moe.gov.jm/sites/default/files/lower3nd-mathematics.pdf.

[29] Ministry of Education (2004). The Task Force on Educational Reform Jamaica. A Transformed Education System. Retrieved from http://www.stcoll.edu.jm/Education/PDF%5CIssues%20and%20Perspectives%5Ceducationtaskforce.pdf.

[30] Ministry of Education (2013). Annual Statistical Review of the Education Sector. Education Statistics 2011-2012. Kingston: Ministry of Education.

[31] Ministry of Education, Youth and Culture (2004). The Development of Education. National Report of Jamaica. Kingston: Ministry of Education, Youth and Culture.

[32] Moon, J. A. (2004). A Handbook of Reflective and Experiential Learning: Theory and Practice. OX: Routledge Falmer.

[33] Moriarty, B., Danaher, P.A., & Danaher, G. (2008). Freire and dialogical pedagogy: a means for interrogating opportunities and challenges in Australian postgraduate supervision. International Journal of Lifelong Education, 27(4), 431-442.

[34] Mullings, B. (1999). Insider or Outsider, Both or Neither: Some Dilemmas of Interviewing in a Cross-Cultural Setting. Geoforum, 30, 337-350.

[35] Norton, L. S. (2009). Action Research in Teaching and Learning. A Practical Guide to Conducting Pedagogical Research in Universities. London: Routledge.

[36] Ogunkola, B. (2013). Improving Science, Technology and Mathematics Students'Achievement: Imperatives for Teacher Preparation in the Caribbean Colleges and Universities. Academic Journal of Interdisciplinary Studies, 2(1), 97-108.

[37] Orton, A. (2005). Patterns in the Teaching and Learning of Mathematics. London: Continuum.Pearson Education (2005). Hidden Curriculum. Retrieved from http://wps.pearsoned.co.uk/ema_uk_he_ plummer_sociology_ 3/40/1032/2647735.cw /content/index.html

[38] Planning Institute of Jamaica (2009). Vision 2030 Jamaica. National Development Plan. Kingston: Planning Institute of Jamaica.

[39] Prescod, G. (2014). Notes from a Lecture on Critical Consciousness, Pedagogy and Curriculum. International University of the Caribbean.

[40] Rabinowitz, P. (n.d.). Arnstein's Ladder and Levels of Participation. Retrieved from http://ctb.ku.edu/en/table-of-contents/assessment/promotion-strategies/social-planning-policy-change/tools

[41] Sangwin, C. J. (2003). Assessing higher mathematical skills using computer algebra marking through AIM. In Proceedings of the Engineering Mathematics and Applications Conference (EMAC03, Sydney, Australia) (pp. 229-234).

[42] Schutt, R. K. (2011). Investigating the Social World: The Process and Practice of Research (Chapter 10). Retrieved from http://www.sagepub.com/upm-data/43454_10.pdf

[43] Solomon, P., & Levine-Rasky, C. (2003). Teaching for Equity and Diversity: Research to Practice. Toronto: Canadian Scholars' Press.

[44] Tatarinceva, A. (2009). Influence of the Gender Factor on a Student's Learning Style and Achievements in Language Learning. Retrieved from http://www.tsi.Lv/Research/Conference/MIP_2009/12.pdf.

[45] The Education Act. L.N. 67/1982.

[46] The Jamaica Observer (2014, May 6). Teenage Donald Quarrie High School. The Jamaica Observer. Retrieved from http://www.jamaicaobserver.com/teenage/Donald-Quarrie-High-School.

[47] Vanderstaay, S. L., Faxon, B. A., Meischen, J. E., Kolesnikov, K. T. & Ruppel, A. D. (2009). Close to the Heart: Teacher Authority in a Classroom Community, College Composition and Communication, 61(2),W262-W280.

[48] Virginia Commonwealth University (2013). What is Action Research. Retrieved from http://www.merc.soe.vcu.edu/action-research/what-is-it/

[49] Vygotsky, L. S. (1978). Mind in Society: The Development of Higher Psychological Processes. Massachuttes: Harvard University Press.

[50] Zeni, J. (1998). A Guide to Ethical Issues and Action Research. Educational Action Research, 6(1), 9-19.