AN ASSESSMENT OF THE INTEGRATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS) INTO THE CORE-CURRICULA OF PUBLIC SECONDARY SCHOOLS IN ANTIGUA AND BARBUDA

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Abstract

AN ASSESSMENT OF THE INTEGRATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS) INTO THE CORE-CURRICULA OF PUBLIC SECONDARY SCHOOLS IN ANTIGUA AND BARBUDA

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The education system of Antigua and Barbuda has undergone changes over the years as a result of the introduction of Information and Communication Technologies (ICTs) in public secondary schools to improve teaching and learning. To date, there is lack of evidence to show the level of use and effectiveness. Assessments are necessary to evaluate ICT integration in education in order to effectively plan for similar initiatives. The research sought to determine the extent of ICT integration in the core curricula of schools and the acceptance and use by teachers, students, and educational leaders for instruction in public secondary schools. The research questions focused on the reflection of ICT components in core curricula, the extent to which they are used by teachers and students for teaching and learning and the role of the school environment in the process. The study employed a mixed methods approach to collect data using quantitative and qualitative methods to include questionnaires for teachers and students, interview schedule for educational leaders, observation schedule for classroom practice and document analysis to review the core curricula. The sequential explanatory design was used to guide the process in the collection of the data. The research used Microsoft Excel to manipulate the data using Cronbach Alpha, Pearson's correlation and ANOVA p-value tests to arrive at the findings. The findings from the research were methodologically triangulated and resulted in convergence of the evidence which revealed ICT integration in the core curricula of schools to a moderate extent. It was also revealed that the ICT knowledge of teachers and their confidence

and comfortability increased their use of ICTs for teaching and learning. It was also noted that students' use of ICTs for learning was less than moderate for core subjects although greater use was revealed by teachers. The findings revealed that educational leaders assist in fostering ICT integration at their schools to a moderate extent. It was also noted that many challenges affect the process of ICT integration in schools which revealed the need for consistent evaluation strategies and monitoring for ICT integration processes in schools. The research recommends the use of an updated ICT policy or implementation framework to guide the process to ensure full compliance. It also recommends that the research be conducted with all subjects in public secondary schools and be extended to private secondary schools for greater generalizability of findings. This research has significance for the roles of curriculum developers, educational leaders, teachers and students and for policy makers in Antigua and Barbuda and developing countries who intend to integrate ICTs in their schools or are not aware of the effectiveness of existing ICT programmes in their schools.

Key Terms: curriculum, educational change, hindrances to ICT integration, information and communication technology, ICT integration, ICT pedagogical knowledge, radical constructivism, smart learning environment, technology

Declaration

I declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by reference or acknowledgment, the work presented is entirely my own.

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Dedication

I dedicate this work to God for keeping me focused and my husband and children for their endurance while I spent numerous sleepless nights to complete this research. To God be the Glory.

Acknowledgments

I wish to thank God for granting me the strength and determination to complete the Dissertation amidst the obstacles I faced in my path.

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Special thanks to all for making this research possible so that the findings may be used to make informed decisions about future ICT initiatives in our public schools.

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List of Acronyms

ABIRB	Antigua and Barbuda Institutional Review Board
APUA	Antigua Public Utilities Authority
CARICOM	The Caribbean Community and Common Market
CCAC	Community Computer Access Centre
CCTI	Certificate for Teacher ICT Integration
COL	Commonwealth of Learning
CSME	Caricom Single Market and Economy
DSL	Digital Subscriber Line
EMIS	Education Management Information System
EDPM	Electronic Document Preparation Management
ERIC	Education Resources Information Centre
GATE	Government Assisted Technology Endeavour
ICT	Information and Communication Technology
ICTE-MM-ICT	ICT in School Education Maturity Model
IT	Information Technology
ITU	International Telecommunications Union
LMS	Learning Management System
OECD	Organization for Economic Cooperation and Development
PCK	Pedagogical Content Knowledge
PCTI	Perception of Computers and Technology Instrument
SDG	Sustainable Development Goals
SLE	Smart Learning Environment

TCK	Technological Content Knowledge
TEL	Technology Enhanced Learning
TPACK	Technological Pedagogical Content Knowledge
TPK	Technological Pedagogical Knowledge
UN	United Nations
UNESCO	United Nations Educational Scientific and Cultural Organization

CHAPTER 1: INTRODUCTION

The education system in Antigua and Barbuda has been faced with changes as the country grapples with finding the best strategies and methodologies to improve the performance of students. One such methodology is the introduction of technology resulting in the integration of Information and Communication Technologies (ICTs) in the education system. The term Information and Communication Technologies (ICTs) is used throughout this research to refer to specific devices, tools and technologies used for the purpose of communication and for the management of information to as computers, smartphones, whiteboards, the internet, and software used in education. ICTs have been major additions to the scope of teaching and learning in schools with the intention of improving teaching and learning by embracing and utilizing the emerging technologies instead of the traditional teaching methodology (Livingstone, 2019). For the past few years, initiatives involving ICTs have been introduced into public secondary schools in Antigua and Barbuda with the specific goal of improving student learning. The initiatives have been initiated in public secondary schools regardless of geographical location and are usually realized based on the will of the benefactors and the government. The initiatives were implemented using the whole school approach where each student benefited from the process. Worthy of note is that those ICT initiatives are not related in any way to the Caribbean Secondary Examinations Certificate (CSEC) subject called Information Technology offered in public secondary schools.

Information Technology is a subject offered by the Caribbean Examinations Council (CXC) in the Caribbean Secondary Examination Certificate (CSEC) programme which is an exit exam taken during the last year of secondary schools. The subject involves a coherent view of the significance of information in a socio-economic context. Emphasis is placed on application

of knowledge, problem-solving using the computer, and proficiency in using productivity tools (CSEC Information Technology Syllabus, 2018). Information Technology may be pursued as a subject by a student who wishes to pursue a career requiring further studies in ICT or may be pursued due to the need to be competent in the use of the technology. Secondary schools that offer the subject must have the infrastructure for the students to practice which is mainly in the form of computer laboratories with internet capabilities. Additionally, many students generally use ICTs in schools as productivity tools for researching, writing letters, storing information, and documenting and formatting of information, but their use of ICT as a tool for learning is yet to be determined. While computer competency skills are important to facilitate teaching and learning, the use of ICTs to improve learning brings greater dividends for teachers and students (Kurian & Ramanathan, 2016).

Furthermore, ICTs may also be defined as using technology to manage and process information (Dei 2018; Fu, 2013). ICTs may include electronic computers, computer software to process, convert, store, transmit and retrieve information over the internet and using delivery systems that are electronic such as multimedia projectors, televisions, and radios among others technological devices (Dei, 2018; Fu, 2013). In recent times, schools have shown increased use of technology to keep their students current with technological advancements in the world with the home serving as a complementary avenue for students to continue to engage in computer related learning activities (Kent & Facer, 2004). The use of ICTs is becoming a way of life for students and according to Ishaq et al. (2020), learning is a continuous activity throughout life where students continuously seek knowledge by finding avenues that depart from the traditional sources. Fu (2013) advocates for the use of ICT skills for learning by describing it as an important precursor for learning to take place. This indicates that the integration of ICTs in the

curricula of schools would facilitate learning by expanding access to education and developing novel understanding in various aspects of learning (Dei, 2018; Qaddumi et. al., 2021). This view has implications for the content design and implementation of curricula which is usually fashioned to accommodate the way ICTs should be used in teaching and learning.

Cullingford and Nusrat (2016) championed the cause for more research to be done on ICT integration in schools by claiming that it must be determined if computer use in schools should be based on the teaching of computer competency skills or be presented to students as a way of improving their learning. Fu (2013) on the other hand, sums up the value of using ICTs as a pedagogical tool for teachers and a learning tool for students by describing it as a powerful tool that is integral to educational change and reform. In such a declaration, the curricula should reflect ICT use in every aspect of its development and its execution as classes are conducted.

This research is based on the national philosophy of education in Antigua and Barbuda which embraces the paradigm of learning that sees education and learning shifting from traditional teaching and learning to one that focuses on student-centred and experiential learning, integration of technology and the solving real life problems (Cuyos, 2023). Furthermore, the present learning paradigm is in congruence with the radical constructivist way of learning with adaptability, creativity and critical thinking being preferred over learning by rote. Teaching and learning processes should expose students to the skills that are relevant and current to their studies (Mikre, 2011). This simply means that since students are being prepared to be global citizens, the curricula content design of schools should be replete with ICTs if the students are to be 21st century learners. This view is endorsed by Castro-Sanchez and Aleman (2011) who claim that students who use ICTs for learning perform better and can manipulate information as well as analyse the materials used for learning. The teacher is the facilitator of the learning, and the

students are expected to develop a greater understanding of what is being taught in keeping with the radical constructivist approach advanced by Piaget cited in McDougall et al. (2010). Radical constructivism forms the basis of the integration of ICTs into the core curricula content design of schools since it encourages the students to work independently in making sense of the world around them (McDougall et al., 2010). According to Walsh (2020), citing from the abstract of Von Glasersfeld (1995), radical constructivism is a theory about knowing that uses a pragmatic approach to provide answers to questions relating to reality, language, truth, and the process of understanding in human beings. Further, with the concept of radical constructivism, learners create their own knowledge rather than passively accepting the information given to them.

Many researchers are of the view that technology is an integral part of every aspect of life, and schools must respond by ensuring that there is a paradigm shift from teacher-centred to student-centred teaching. Radical constructivism is the approach where students work independently using ICTs to construct knowledge and be responsible for their own learning (McDougall et al., 2010). The radical constructivist approach causes students to focus on higher level concepts (McMahon, 2009) and creates a link between the acquisition of skills to encourage critical thinking and the use of ICTs. This suggests that in addition to the fusion of ICTs into the curricula content design, teachers must be pedagogically trained and possess the ICT competencies necessary to make learning effective. Gagne (1965) is of the view that teachers are responsible for creating the environment for learning to take place and this has implications for the preparation of novice teachers in their training especially in the use of the emerging technologies. ICTs also provide the option of multiple technologies for use by teachers in the classroom to assist the students with a resource rich environment with the goal of producing citizens that are rich in ICT knowledge (Mikre, 2011).

Lowther et al. (2008) alluded to autonomy, capability and creativity as critical characteristics that must be present for effective teaching and learning using ICTs. Autonomy is envisioned as two-fold: firstly, with the students taking control of their own learning and secondly with teachers being given the opportunity to create material for the course content. Further, Lowther et al. (2008) view ICTs as improving the capabilities of students to apply and transfer knowledge with efficiency and effectiveness when learning, while at the same time using the creativity to optimized self-potentiality.

Being aware that the state of Antigua and Barbuda has been the recipient of several ICT initiatives in public secondary schools for many years with the intention of improving teaching and learning, the country sought to regulate the process by creating a policy document. In 2003, the Ministry of Education introduced an Information and Communications Technology Policies and Strategies document formulated specifically for Antigua and Barbuda from a generic document created with the collaboration of small island states in the Caribbean to guide ICT implementation processes and improve teaching, learning and administrative processes in the education system in the country (ICT Policies and Strategies for Implementation in Antigua and Barbuda, 2003). The policy document referred to strategies that should be implemented to guide the use of ICTs in schools which includes strategies that were geared towards research and evaluation of the impact of ICTs in education. A preliminary review of the Ministry of Education ICT files indicates that there is lack of documentary evidence of any assessments or evaluations that were conducted in education to determine the effectiveness of the ICT initiatives that were introduced in schools (Ministry of Education: Antigua and Barbuda ICT Files, 2000 - 2018). The thrust of this study, therefore, is to determine the effects that ICT integration into the core curricula content has had on public secondary education in Antigua and Barbuda.

Statement of the Problem

Antigua and Barbuda is a twin-island state with 13 public secondary schools spread across the urban, sub-urban and rural areas of the islands and is desirous of integrating ICTs into the curricula of those schools. Over the years, attempts have been made to integrate ICTs into the core curricula content of public schools in Antigua and Barbuda to improve the learning performance of students as advocated by Ibrahim et al. (2022). The problem is that there is lack of evidence to show that ICT integration initiatives in the core curricula of public secondary schools in Antigua and Barbuda have been effective and there is also lack of evidence to demonstrate that evaluations have been conducted to determine their effectiveness in relation to the way teachers teach and the way students learn.

The ICT initiatives which included android tablets, laptops, electronic textbooks have resulted in administrators, teachers and students at public secondary schools being encouraged to use devices in the teaching and learning processes. The penultimate initiative introduced in 2016 was the replacement of hardcopy textbooks with e-textbooks consisting of the digitized content of textbooks for twenty subject areas placed on an interactive platform for use by teachers and students. The government was of the view that the initiative would encourage the students to be motivated to learn and work independently and would make the task of teaching easier for teachers. Additionally, it was thought that having the textbooks on one device would be more acceptable by the students since they were not required to contend with the weight of several textbooks at any given time on their way to and from school.

To accurately determine the level of ICT integration and its effectiveness in public secondary schools, it is necessary for the integration processes in schools to be assessed. The quality of curricula design is usually one avenue to examine for the level of ICT integration and

this is usually assessed by examining the aim, goal and objectives of a programme, the resources required, the programme evaluation and the administration of the curricula (MacCarrick et al., 2010). This indicates that the content of curricula must be current, relevant, meet specific goals, and should have consistent evaluations to determine the practicability and usefulness of the programme. Rehan et al. (2019) purport that curricula evaluations may be done using the reviewers' approach which requires the examination of curricula against specific standards and evidence of what happens in practice. This suggests that if a country wants students to use ICT to learn, the changes must be reflected to some extent in the curricula and practice. On the other hand, curricula may be assessed using the interpreter's approach which explores why the standards set for the curricula are not adhered to (Rehan et al., 2019). Additionally, the interpreters will study the related variables to determine the reasons for the state of the curricula.

The study focused on the state of the core curricula content in Antigua and Barbuda considering the many attempts at integrating ICTs in education, and sought to determine the pedagogical use by teachers and the use by students to learn. It is noted that curriculum is a major focus of any ICT integration programme in schools, and it should be responsive to the needs of all learners (UNESCO, 2017). The curricula implemented in schools should reflect the intended curricula which may be transformed by the varied classroom interactions that are used for instruction (UNESCO, 2017). The UNESCO document further indicates that curricula may refer to what societies see as important teaching and learning which are sometimes referred to as the intended curricula since they are usually in the form of written documents. Once implemented in the classroom, however, they are referred to as implemented curricula. The quality of the core curricula as well as its viability in encouraging students to learn would need to be assessed to get a comprehensive picture of the ICT readiness components that are presently in

use in public secondary schools (Rehan et al., 2019). Similar in views to other researchers in the study of curricula, Rehan et al. (2019) purports that curricula are dynamic and should reflect curricula-related changes in the teaching and learning processes. Bearing in mind the number of ICT initiatives introduced in the education system of Antigua and Barbuda at the secondary level, it is believed that the taught core curricula should reflect changes in ICT design and use and would be a critical avenue to examine for effective attempts at change (UNESCO, 2017).

As the individual in charge of the Curriculum Development Unit in Antigua and Barbuda, the researcher sought to conduct the study to assess the status of ICT integration into core curricula content design in public secondary schools to find out if schools were embracing the emerging pedagogy as the new way of teaching and learning. Although the performance of students may be affected by a multiplicity of factors, the 29.5 and 23.7 percent passes in Mathematics nationally for the Caribbean Secondary Examinations Certificate (CSEC) for the years 2021 and 2022 respectively are causes for concern (Ministry of Education CSEC Statistics, 2022). The national passes for English for the same years were 71.2 and 67.4 percent which were slightly above average performance nationally. Social Studies, on the other hand, reflected 63.2 and 60.4 percent passes for the same period which showed a decline in passes from the previous year. The findings of this research enabled the researcher to determine if teachers of the core subjects used ICTs for teaching and if students are encouraged to use them for learning. If ICT integration initiatives are to be encouraged, they must be guided by data derived from past initiatives else countries may face the consequences of poorly implemented processes (Cetin & Solmaz, 2017). Since all ICT initiatives in Antigua and Barbuda to date have been with secondary schools, the researcher focused on that level of the education system for the research.

The research examined the core curricula content design to establish the extent of integration, the roles of teachers, students, and educational leaders (principals of schools), and the infrastructural and environmental factors that may have influenced the implementation process. The information gleaned from the research provided pertinent data relating to ICT integration in core curricula in public secondary schools in Antigua and Barbuda which may be used to guide the process in all subject areas. The findings of the research would also be relevant to other small developing states in the Caribbean region and beyond since it is the goal of most territories in the region to improve the performance of students through the infusion of ICT in the curricula content of schools. Additionally, the research will add to existing data relating to the challenges of ICT integration encountered by students, teachers and educational leaders and provide information to mitigate the challenges in the integration process in Antigua and Barbuda and will ultimately provide guidance for developing countries. The findings of the research will add to existing literature and provide a framework for further ICT integration initiatives in schools in Antigua and Barbuda, the region and beyond.

Purpose of the Study, Research Aims, and Objectives

Antigua and Barbuda have been the recipient of several ICT initiatives in public secondary schools over the years and to date, there is lack of evidence to show that the initiatives have been effective and that evaluations have been conducted to show the use and effectiveness of the initiatives. The purpose of this mixed method study was to assess the Integration of Information and Communication Technologies (ICTs) into the core curricula of public secondary schools in Antigua and Barbuda to determine the extent of their use and effectiveness (Rehan et al., 2019). Antigua and Barbuda, a twin island state in the Eastern Caribbean with a population of approximately 110,000 persons have been the beneficiary of many ICT initiatives over the years

with the goal of improving the academic performance of students and becoming current with the use of technology in teaching and learning. The unitary state of Antigua and Barbuda was selected as the focus of this research since the researcher is a citizen of Antigua and Barbuda and an educator who wishes to ascertain if the ICT initiatives introduced in schools have been effective. It is important to note that the research is focused on public secondary schools since all ICT initiatives to date have been implemented in public secondary schools.

The research sought to determine the extent of use of ICTs in the core curricula of public secondary schools by assessing the extent of their use by teachers during instruction and students for learning, and for other school-related activities. The research also sought to establish if there is some correlation between the ICT knowledge of teachers and their use of ICTs for pedagogical purposes since this could have implications for the degree of integration that takes place in public secondary schools. Further, the research sought to determine the extent of use of components of ICTs by students for learning activities in schools as well as identify the infrastructural and environmental factors that have impacted the use of ICTs in public secondary schools. Like many developing countries in the Caribbean, Antigua and Barbuda is desirous of keeping abreast with technology and the ICT initiatives introduced into the education system were expected to contribute to an output of technologically literate citizens as theorized by Ibrahim et al. (2022). Since there is lack of evidence regarding the effectiveness of ICTs in schools, the findings of the research will reveal the ICT status of public secondary schools in Antigua and Barbuda which will provide data for improvement in the process, if necessary, especially since technological innovations are progressing at a rapid rate (Livingstone, 2019).

The main aim of the research was to establish the scope of ICTs use in public secondary schools and their effect on learning to provide data to inform the ICT integration status and to

advise future ICT-related decisions in the education system. To achieve this aim, objectives were formulated which provided the foundation on which the research was built.

Objectives of the Research

The research objectives defined the main aim of the research and provided the scope and direction required for the research to maintain its focus. The objectives which guided the research were to:

1. examine the content of the core curricula designed for public secondary schools in Antigua and Barbuda for the reflection of ICT components.
2. explore the extent to which the confidence and comfortability of teachers contribute to the integration of ICT components contained in core curricula of public secondary schools in Antigua and Barbuda.
3. determine how the ICT knowledge of teachers affects their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda.
4. examine the extent of use of ICT components by students for core curricula learning activities in public secondary schools in Antigua and Barbuda.
5. determine how the school environment promotes effective integration of ICT components in core curricula content of public secondary schools in Antigua and Barbuda.

Based on the overarching aim of the research which is to assess the degree of integration of ICTs in the core curricula of public secondary schools, the research objectives sought to ensure that every aspect of ICT use in public secondary schools was examined. Objective number one (1) examined the content of the core syllabuses used in public secondary schools to determine if ICT components are present and to what extent. Objective number two (2) sought to

ascertain if the confidence and comfortability of teachers contributed to the integration of ICT components and to what extent. It is believed that once teachers have sound knowledge of ICT use for teaching, they will feel more confident in using ICTs in the classroom which most likely will translate into a level of comfortability in use. According to Hogarty et al. (2003a), confidence and comfortability are considered complementary since teachers' confidence suggest some measure of comfort and efficient use of ICTs to enhance teaching and student learning. This idea was tested for significance as it relates to the use of ICTs as part of this research. Further, objective number three (3) was used to find out if the ICT knowledge of teachers affected their pedagogical use to improve learning and to determine the degree to which it impacted ICT integration. Students are also considered to be key users of ICTs at schools and to determine if ICTs formed part of their learning activities, objective number four (4) was formulated. The aim of objective four (4) was to ascertain the use of ICTs by students for learning activities which was also linked to use by teachers for pedagogical activities. Research objective five (5) sought to determine if the school environment promoted ICT integration and to what extent. Overall, the research objectives sought to examine every aspect of the school for ICT integration to adequately assess the ICT integration processes which exist in public secondary schools in Antigua and Barbuda.

Having been an educator for several years, the researcher is aware of the value of evaluating education initiatives to determine their effectiveness and sustainability, hence the main aim of this research. The findings of the research will add to the existing literature on ICT integration in the curricula of public secondary schools and will provide insight and clear guidelines for Antigua and Barbuda as it continues to strive to achieve greater learning by integrating ICTs in the curricula. Additionally, the researcher believes that the information

gleaned will be able to guide other territories in the region and further afield who have similar goals and resources as they negotiate the integration of ICTs in their education systems.

Nature and Significance of the Study

The focus of this research was to assess the integration of ICTs into the core curricula content of public secondary schools in Antigua and Barbuda. The study required an in-depth look at public secondary schools and their inculcation of ICTs in their teaching and learning operation. According to Kissi et al. (2021), the incorporation of ICTs in the curricula of schools will not only assist students in understanding what is taught and encourage them to use ICTs for learning but will also serve as a teaching tool for teachers as they deliver their lessons. Further, Kissi et al. (2021) are of the view that teachers' knowledge and use of ICTs will influence the ICT integration process in the curricula of schools. It is therefore imperative that an assessment of ICT integration in the curricula of schools include teachers use of ICTs for teaching and students use for learning as well as other aspects of the schools' operation related to teaching and learning.

As part of the assessment process, this research examined the core curricula content of public secondary schools and their ICT components; ascertained the ICT knowledge of teachers and their use of ICTs for pedagogical activities; determined the use of ICTs by students for learning; identified the challenges that mitigated the use of ICTs and determined the suitability of school environments for implementation of ICTs in the curricula so that a determination can be made about the use and efficacy of the process in schools. The research was conducted using a sequential explanatory design using mixed method approach employing a combination of qualitative and quantitative methods to gather data about the integration of ICTs in public secondary schools. Wambugu and Njoroge (2021) defined a mixed method research as one that

employs a systematic inquiry which uses a combination of quantitative and qualitative approaches concurrently or sequentially in one study for data collection, analysis and in the interpretation of the findings. In a mixed method research, the results obtained through one method are supported by another method which is purported to make the research study stronger (Sahin & Oztürk, 2019).

The research included the collection of data from teachers related to their ICT knowledge levels and pedagogical use of ICTs in the teaching process by using a teacher questionnaire. Data was also gathered from students with the use of a student questionnaire on their use of ICT components for core curricula learning activities which is quantitative in nature. The qualitative approach, on the other hand, was used to collect data from educational leaders using interviews with open-ended questions to determine the status of the integration of ICTs in their schools. A document review of the core syllabuses used for teaching secondary students also formed part of the qualitative data collection.

Being cognizant of the possibility of factors militating against the ICT integration process in schools, the research sought to examine those factors as well as the schools' environments to determine if they promoted effective integration of ICT components in core curricula content of public schools. The use of ICTs in schools may be influenced by a myriad of internal and external factors to include availability of devices, the ratio of devices to the number of students, access to ICT equipment, the design of the school curricula, technical and administrative support, and the ICT knowledge of teachers. Additionally, the students' use of ICTs in their learning in and out of class was also the focus of this study since the students' use of the technology would be a major factor for any improvement in learning. The research therefore examined the elements

in schools that may have some effect on the ICT integration process to determine its effectiveness over the years.

A major component of the research was to determine whether the core curricula content reflected components of ICT since ICT integration in the teaching and learning process usually involves a reorganization of the curricula, the ICT knowledge of the users as well as the pedagogical delivery of subject content. Curricula content is expected to utilize the various media involved in technology to bring about change in learning. Therefore, since the use of ICTs is important in the delivery of the content for core curricula, the research sought to determine the degree to which it was embedded for use in the core curricula of schools by conducting document reviews. Key areas that were examined for ICT components included the learning content of the documents, the suggested teaching strategies, and methods of instruction for teachers and the learning experiences to be used by the students as they engage in the use of ICTs for the core subjects in schools. Additionally, the extent to which ICTs were implemented in practice was examined through observation of teachers in practice. The different methods of data collection provided complementarity of data and created an avenue for triangulation of all data collected.

A review of the Ministry of Education records revealed a 2003 ICT Policy document followed by a revised policy document in 2013 which outlines the way in which ICT integration should be structured, but there is a lack of evidence of the status of ICT integration in the teaching and learning landscape of public secondary schools. Additionally, there is lack of evidence to indicate that evaluations of ICT initiatives have been conducted as they were introduced into public secondary schools over the years. Evaluation or assessment is a necessary component in any education initiative and having been an educator for quite a few years, the

researcher has witnessed many attempts at ICT integration in the secondary school system without proper evaluations being done. The researcher is aware of the value of evaluating school initiatives to determine their effectiveness and sustainability, hence the reason for this research.

The researcher is cognizant of the role of ICTs in education especially considering the disruption to teaching and learning in schools due to the complete shutdown of schools during the height of the COVID 19 pandemic. Like many developing countries around the world, many students were left without access to education during that period. According to UNESCO (2023), digital innovation in education is important and this was confirmed when during the COVID-19 pandemic, countries without sufficient ICT infrastructure and sound, well-resourced digital learning structures suffered significant disruptions to learning which resulted in learning loss for students. Further, UNESCO (2023) reported that at least one-third of the students around the world were without access to education during school closures during COVID for more than one year. It is therefore important that education systems embrace technology by "providing access to educational opportunities, enhancing the relevance and quality of learning, building ICT-enhanced lifelong learning pathways, strengthening education and learning management systems, and monitoring learning processes" (UNESCO, 2023 p. 1). The research sought to determine if ICTs integrated into public secondary schools in Antigua and Barbuda have been embraced by the users of the technology to enhance the quality of learning by examining the way they are used to teach and learn.

One significant aspect of this research was that the findings would be able to inform policy makers (The Cabinet of Antigua and Barbuda which is the main decision-making arm of the government, The Minister of Education, the Director of Education, Curriculum Officers, benefactors, and other stakeholders) on the status of ICT integration in public secondary schools

and will serve as a guide for future ICT integration programmes. Policy makers will be able to make informed decisions and effectively plan further ICT integration projects based on the findings of this research (Cetin & Solmaz, 2017). Educational leaders are active participants in the ICT integration processes of schools and would be directed primarily by the findings of the research. Educational leaders are integral in guiding the integration process in their schools and would be able to use the findings to effectively plan and execute ICT implementation projects in their schools.

The research results would also be beneficial to teachers by informing them about the levels of ICT integration in their schools and what they could do to improve instruction based on a variety of perspectives evidenced in literature. The findings could provide the platform for teachers to consider changing their instructional techniques from a teacher-centred approach to teaching, to one that is more student-centred and constructivist in nature (Livingstone, 2019). It could encourage teachers to focus on new teaching strategies and methodologies to improve the way students learn rather than using traditional approaches to teaching. According to UNESCO (2023), successful integration of ICTs in education requires rethinking the way teaching and learning take place and focusing on the role that teachers play in applying ICTs to augment and transform learning. Collaborative learning, problem solving, and the radical constructivist approach would be best practices in the teaching of core curricula, once ICTs are encouraged in schools. UNESCO (2023) further underscores the value of ICT and the need to understand the role that ICTs play in education especially as it relates to curriculum assessment, pedagogy, application of digital skills, the organization and administration of schools and the professional development of teachers. The findings of the research may be beneficial to administrators and teachers since an effective ICT integration in core curricula will foster creativity and innovation

and encourage the customization of teaching resources and methodologies to cater to the diverse needs of the learners. Students at public secondary schools may also be major beneficiaries of the research since the way they are instructed and the way they learn may be improved once ICTs are effectively integrated into the education system. Mutisya (2020) claims that ICTs help to improve students' creativity and their development of problem-solving skills.

The significance of the findings also has implications for the researcher who is responsible for curriculum development in public secondary schools. According to UNESCO (2022), teaching and learning should not be driven by ICTs, but they should be used to facilitate education. The way curricula are planned, developed, and executed in Antigua and Barbuda may change based on the revelations of the research. The purpose of the research was to assess the ICT integration into the core curricula of public secondary schools and the findings would reveal the status of the integration. The research may be beneficial to curricula developers and educators who are desirous of incorporating ICTs since the findings of this research would reveal the status quo of the integration process in Antigua and Barbuda which could form the backdrop to be used to plan curriculum reform with the incorporation of ICTs as its major focus. If the past integration processes were effective, then policy makers would strive to make the processes even more effective, but if the processes were not effective, then the findings will reveal what needs to be done to make them more successful. The curricula used in schools would need to reflect ICT components, and as the person in charge of the curriculum development unit, the findings have great significance for next steps in that unit.

The information gleaned from the study could add to the existing literature on ICT integration in core curricula of public secondary schools and will provide insight and clear guidelines for Antigua and Barbuda as it evaluates present initiatives and considers other such

initiatives for years to come. The existing literature is replete with research on ICT integration in schools in developed countries, but there appears to be a paucity of information relating to its integration in curricula in developing countries in the Caribbean. The benefits of this research are significant for Antigua and Barbuda as the government is desirous of making Antigua and Barbuda into an economic powerhouse in the next five (5) to ten years. Considering this goal, the effectiveness of ICT integrations based on the culture, practices, and resources available in this developing state are central to its success. Additionally, Antigua and Barbuda forms part of the Caribbean Community (CARICOM) which operates within one space with countries that have similar needs, so the information gleaned from this study will be able to guide other territories in the region as they navigate the integration of ICTs in the curricula within their education systems.

Research Questions

Information and Communication Technologies (ICTs) have been at the crux of many changes in education systems worldwide (Livingstone, 2019) and will continue to influence the quality of education in Antigua and Barbuda and around the world. Being aware of the attempts at ICT integration into core-curricula content design and implementation in public secondary schools in Antigua and Barbuda, this study will seek to assess the ICT Integration process to determine the extent of their use in the teaching and learning process of public secondary schools. The problem being research concerns the extent of use of ICTs for teaching and learning in public secondary schools in Antigua and Barbuda to provide evidence of the effectiveness of past ICT initiatives to enable data-driven decisions when planning future ICT initiatives.

The government of Antigua and Barbuda and its benefactors have spent millions of dollars on ICT initiatives in public secondary schools to include the issuing of Samsung tablets

for students, laptops for teachers, eBook devices loaded with content for textbooks, and the most recent initiative being laptops for teachers and students with access to the online platform with the eBook contents of a number of subjects. While there is some evidence to show that these initiatives were attempted to integrate ICTs in schools, there is lack of evidence to show that the emerging technologies have been accepted and utilized in schools for teaching and learning, hence the genesis of this research.

Assessing ICT components present in the core curricula of public secondary schools would require reviewing and collecting data on the curricula that are presently in use to determine if ICT components are embedded in them. This will be consistent with an ICT integration programme in a school which according to Cetin and Solmaz (2017), is a critical aspect of an evaluation process if change in curricula is to be detected hence the alignment to research objective one (1) which seeks to determine the extent to which the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflect ICT components. Further, it is important to establish the extent to which the confidence and comfortability of teachers in using ICTs contributed to their integration in the classroom. Uslu (2017) indicates that teachers who fully embrace the technology and are familiar with using them to teach are more likely to exude confidence in their use and show more comfortability when using them in the classroom. This inquiry formed the basis of research objective number two (2). To achieve that objective, the research evaluated the level of confidence teachers have in using ICTs and by extension ascertained their comfortability by obtaining data from them through a questionnaire. Further, observation of practice was also used to determine their comfortability in using ICTs to teach in public secondary schools. To assess the integration of ICTs in the core curricula entailed determining the ICT pedagogical knowledge of teachers (research objective number 3) to

ascertain if their use of ICTs involved those strategies and methodologies that are ICT related to encourage positive change in learning (Koehler et al., 2013). Further, students use of ICTs for learning would need to be assessed to determine use of ICTs for learning and this will be addressed by research objective four (4). Research objective five (5) surrounds the schools' environment and their conduciveness to promoting effective integration of ICT components in core curricula content of public secondary schools in Antigua and Barbuda for teaching and learning, as well as for school administrative purposes. The research was therefore guided by the following research questions to achieve the objectives of the research:

1. To what extent does the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflect ICT components?
2. To what extent does the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools in Antigua and Barbuda?
3. How does the ICT knowledge of teachers affect their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda?
4. To what extent do students use ICT components for core curricula learning activities in public secondary schools in Antigua and Barbuda?
5. How does the school environment promote effective integration of ICT components in core curricula content of public secondary schools in Antigua and Barbuda?

Research Hypotheses

To assess ICT integration into core-curricula content of public secondary schools in Antigua and Barbuda and knowing that teachers play a critical role in integrating ICTs in the teaching and learning process, the research sought to determine the relationships between the

knowledge of teachers, their confidence and subsequent comfortability in using ICTs for teaching and establishing how this translates into use by students, since what students do in the classroom is dependent upon the objectives of the lessons set by the teachers. Based on what may be construed as logical progression, the research opted to test the relationship between the ICT knowledge of teachers and their use of ICTs in the classroom as well as sought to determine if there is a correlation between the confidence and comfortability of teachers and their use of ICTs in the classroom. To execute this process, the research was guided by the following research hypotheses:

Hypothesis 1

H_0 There is no significant difference between the ICT Knowledge of Teachers and the Integration of ICTs in the classroom.

H_1 There is a significant difference between the ICT Knowledge of Teachers and the Integration of ICTs in the classroom.

Hypothesis 2

H_0 There is no significant difference between the Confidence and Comfortability of teachers in using ICTs and the Integration of ICTs in the classroom.

H_1 There is a significant difference between the Confidence and Comfortability of teachers in using ICTs and the Integration of ICTs in the classroom.

The research hypotheses were used to determine if there is a significant difference between 'the dependent variable of 'Integration of ICTs in the Classroom' with two independent variables which were the 'ICT Knowledge of Teachers in the classroom' and the 'Confidence and Comfortability of teachers in using ICTs'. Hypothesis number one (1) sought to determine if there is a significant difference between Teacher Knowledge of ICTs and the Integration of ICTs

in the classroom. This was aligned to research question three (3) which sought to determine how the ICT knowledge of teachers affected their use for pedagogical activities in class. The second hypothesis sought to verify if there is a significant difference between the Confidence and Comfortability of teachers in using ICTs and the Integration of ICTs in the classroom. Teacher confidence is aligned with teacher comfortability for this hypothesis since teachers who show confidence in their use of ICTs for teaching may show more comfortability in the use of the technology. This hypothesis was aligned with research question two (2) which sought to ascertain if the confidence and comfortability exhibited by teachers correlated to the extent of their implementation of ICTs contained in the core curricula of public secondary schools in Antigua and Barbuda.

The research sought to address the research questions by collecting data from questionnaires administered to teachers and students, interviews with educational leaders, observations of classroom practice sessions and the examination of existing core curricula documents used in Forms 2 to 4 in public secondary schools in Antigua and Barbuda. The hypotheses were tested with the data collected from the teacher questionnaire to establish if there is a significant relationship between the ICT integration process and the ICT knowledge of teachers, and between the extent of implementing ICT components contained in the core curricula and the comfortability and confidence of teachers in the instruction process. The teachers' knowledge of ICTs for this research includes their use of ICTs for pedagogical purposes.

The presence of ICT components in the core curricula was determined by examining core curricula for evidence of ICT components by conducting document analyses of the core syllabuses for the specified classes. The extent of implementation of ICT components in the core

curricula were ascertained by their use by teachers for instruction and by students for learning. The data for this aspect of the research were collected using teacher and student questionnaires. It was also necessary to find out how the ICT knowledge of teachers influenced their use of ICTs for pedagogical activities and the data was captured in the teacher questionnaire. Likewise, the extent of use of ICTs by students for learning was also necessary in the assessment of the integration process in schools, and the students' questionnaire was significant in providing the data for that aspect of the research. Additionally, observation of teachers as they negotiated their lessons, provided data on the use of ICTs for instruction for both teachers and students. Interviews conducted with educational leaders provided data for the research question related to the suitability of the schools' environments for ICT integration.

CHAPTER 2: LITERATURE

Antigua and Barbuda have had injections of several technological initiatives into public secondary schools over the years and the efficacy of those initiatives as they relate to teaching and learning has been unclear. Many of the initiatives appeared to have been unplanned and probably politically motivated, and there is lack of evidence to indicate their use and effectiveness. Cetin and Solmaz (2017) postulate that there are many sub-dimensions to the ICT integration process which may vary for a multiplicity of reasons, and they include the types of education systems available, the value of ICTs in the country and the grade levels to be affected. They further suggest the need to conduct comprehensive assessments to evaluate ICT integration in education to effectively plan for other technological initiatives. The purpose of this research, therefore, is to assess the Integration of Information and Communication Technologies (ICTs) into the core curricula of public secondary schools in Antigua and Barbuda to determine their use and effectiveness for improving teaching and learning.

The state of Antigua and Barbuda, like many other countries in the Caribbean and parts of the world, is desirous of being current in the realm of incorporating information and communication technologies (ICTs) into the education system. Livingstone (2019) advocates the need for education systems to embrace technology indicating that technological changes are taking place rapidly in education and the use of ICTs is becoming mandatory. Technology in education is critical and can be beneficial if implemented appropriately to meet the needs of educators and students by using it as a supportive material for instruction and learning (Cetin & Solmaz, 2017). Further, it was recommended that while planning the integrative process, technology should be used in all subject areas for teaching and learning instead of focusing only

on the use of technological devices as tools for writing reports, creating letters and other document preparation purposes (Cetin & Solmaz, 2017).

To gather background information on the integration of ICTs into the core curricula of schools, a thorough literature review was conducted which included the review of books, journals, and articles about ICT integration in the classroom. The review focused on many peer- reviewed, scholarly researched sources from databases to include ProQuest and Education Resources Information Centre (ERIC) which were the principal databases for the study. Google Scholar and Science Direct were also used to provide materials for the research. Yahoo and Google were the search engines used as auxiliary sources for information. The literature review focused mainly on ICT and learning and addressed key constructs such as information and communication technology (ICT), the impact of ICTs on teaching and learning, ICTs in public secondary schools in the context of Antigua and Barbuda, independent learning, assessment, radical constructivism, technology education, curricula content design, core curricula and ICT-ready environments. The literature searched were wide and varied and contributed to the plethora of information used for this research.

Theoretical/Conceptual Frameworks

This research was developed based on critical theoretical frameworks which were used to provide the context required for the research. The research focused on an assessment of the integration of ICTs into the core curricula of schools, which indicates the possibility of change that may need to be accepted as it relates to teachers, students and school administrators embracing the change. The research also concentrated on the environment required for the change to occur which is also critical to the acceptance of the change. Further, the use of ICTs for teaching and learning involves teachers using them for pedagogical activities, and students

working independently with ICTs which would provide them with opportunities to accept some responsibilities for their learning.

A number of theoretical frameworks were considered but the ones most applicable to the research included the Theory of Change which examines how individuals react to change especially in a learning environment (Reinholz & Andrews, 2020); the Unified Theory of Acceptance and Use of Technology (UTAUT) which relates to the dimensions that must be examined to determine acceptance of change (Al-zboon et al., 2021), and the Technological Pedagogical and Content Knowledge (TPACK) Model (Koehler et al., 2013) which focuses on the need for teachers to be equipped with the technological, pedagogical and content knowledge for the use of ICTs for learning to be effective.

Theory of Change

Education like many other social systems in a country is subjected to changes to make education systems run more effectively with the goal of improving teaching and learning. ICT initiatives that have been implemented in public secondary schools in Antigua and Barbuda over the years are associated with the Theory of Change which, according to Reinholz and Andrews (2020) is an approach whereby underlying assumptions about a particular project involving change are made explicit and the desired outcomes are used to guide the planning, implementation, and evaluation of the programme. According to Laing and Todd (2015), a theory of change is an approach to change involving the planning, implementation, and evaluation of an initiative in the organization and explains how a project is expected to achieve its outcomes through the taking of specific steps within the context of the change. Laing and Todd (2015) further posited that to approach change at an institution, a deductive approach may be followed whereby existing research and knowledge are used to guide the process. It was also

suggested that an inductive approach may be used by observing the situation to gather data, or the employment of a mental approach by using the knowledge and experiences of the stakeholders to execute the change. As change takes place in education, it is important to ensure that there is a purpose for the change and the need to plan by using existing information for the change to be effective (Meyer-Looze et al., 2019).

Change initiatives like the integration of ICTs in the curriculum of schools that are not grounded in change research inclusive of change theory are limited in two ways: (1) the initiative may not succeed, because it does not rely on the information developed by change researchers, and (2) if the change is not built on what is already known in the field, the initiative is unlikely to contribute to knowledge that can be generalized (Reinholz & Andrews, 2020). According to the Theory of Change, as ICT changes are implemented, those initial changes should have been implemented based on hypotheses which are then investigated and revised as the project progresses (Reinholz & Andrews, 2020). Based on the principle of the theory of change, projects involving change will constantly be reconsidered, and revised data gathered that indicates if the changes are working and how their efforts are progressing.

According to Reinholz and Andrews (2020), it is important that programme initiators can state how the programmes are intended to work so that their intentions are clearly specific. Further, Reinholz and Andrews (2020) are of the view that such indications will make it easier for evaluators to know what is being implemented and to determine if the initiative is effective or would require some form of intervention. Evaluators will also have to realize that there will be challenges in staff accepting changes and innovations even if they are implemented for improvement. While Seiuli (2020) is of the view that implementing change will always encounter problems with people affected by the change, he believes that the issue may not be

with the change itself, but with the nature of the knowledge and skills that are necessary for the change to take place and with the attitudes of the people expected to embrace the change. Meyer-Looze et al. (2019) are of the view that change is more of a network rather than a linear process and success and sustainability are most likely to increase if the process is driven by a purpose with a future goal, if stakeholders are identified, if students' results is the focus, if there are processes and structures to support the change and if research resources are used to support the change process.

Seiuli (2020) asserted that technology in education can be a powerful tool to transform learning since it can be used as a bridge for teachers and students to achieve learning objectives as well as decrease equity and accessibility gaps that may be present. It is further believed that collaborative efforts along with the methods and approaches used by educators can be improved using technology. Integrating ICTs in teaching and learning may be considered a form of educational reform or change which requires teachers becoming acquainted with new methodologies with the main goal of improving outcomes through the alteration of those methods (Philpott & Oates, 2016). Research has shown that for change to be effective, it must first be accepted as expounded in the Unified Theory of Acceptance and Use of Technology which follows.

The Unified Theory of Acceptance and Use of Technology (UTAUT)

Being cognizant of the abundance of literature on the use of ICTs in increasing the efficiency of the education system (Al-zboon et al., 2021), the thrust behind integrating ICTs in the curricula of schools in Antigua and Barbuda is no different. It is believed that the introduction of ICTs in an educational organization or school has several benefits to include improving the performance of students (Aina, 2013), and enhancing the attitudes of students

towards learning (Gasaymeh, 2017). Other researchers such as Hanafi et al. (2017) have cited increased motivation of students as a benefit of ICT use, and Lim (2022) is of the view that ICTs in institutions have increased access to education for students, enhanced equity, improved quality, reduced education cost as well as increased employment opportunities.

The introduction of ICTs in an educational institution would require planning and implementation if they are to be adopted by the users of the technology (Al-zboon et al., 2021). Additionally, it is important that the use of ICTs is validated, and their adoption verified by school administrators, teachers, and students to determine the success of the implementation in schools. One way in which the acceptance of ICTs may be determined is by using the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Al-zboon et al., 2021) which was developed from a combination of a few technology acceptance models established earlier into a universally accepted model for the use of technology (Wedlock & Trahan, 2019). According to Williams et al. (2015), the earlier models included The Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Motivational Model (MM), the Theory of Planned Behaviour (TPB), a combination of TPB and TAM, the Model of PC Utilization (MPCU), the Innovation of Diffusion Theory (IDT) and the Social Cognitive Theory (SCT). The UTAUT Model was developed, tested, and validated by Venkatesh et al. (2003) which established its relevance and highlighted its dominance over the previous theories. This research involves the application of change based on several assumptions classified as variables as endorsed by the UTAUT framework, hence its relevance to the research.

According to Venkatesh et al. (2003), UTAUT uses four (4) main variables to determine acceptance and adoption of technology to include performance expectancy, effort expectancy, social influence and facilitating conditions. The first variable referred to as performance

expectancy is defined as the degree to which the individual using the technology believes that it will improve his performance on the job. It was created from earlier constructs of perceived usefulness from TAM/TAM2 and C-TAM-TPB where the user believes that using it will enhance job performance, extrinsic motivation from Motivational Model (MM) with the user believing that it will help in achieving valued outcomes, job fit with the belief that the system will enhance performance, relative advantage where the user believes that using the innovation creates an advantage over what was there before and expectation of outcomes where the personal expectations are related to the consequences derived from behaviours. Venkatesh and his team are of the view that expectancy theory takes attitudes into consideration such as perceived consequences, rewards, motivation, and values of the individuals experiencing the change.

The second variable is effort expectancy which refers to the ease with which the individual can use the technology, and it includes the concepts of perceived ease of use as in TAM/TAM2 where the individual believes that using the system would not require effort. Effort expectancy also relates to the original construct of complexity of MPCU which refers to the extent to which an individual believes that the system is relatively difficult to understand and use. Another conceptual definition of effort expectancy relates to the ease of use as in IDT which is the degree to which using an innovation is difficult to use. Integration of ICT in the curricula of schools requires stakeholders to be prepared to work with the technology for it to work.

The third variable is social influence which relates to the degree to which the user of the technology perceives that important people within the organization or otherwise believe that they should use the technology. Venkatesh et al. (2003) identified social influence as part of the original construct of subjective norm involving the original scales of TRA; TAM2; TPB/DTPB; CTAM-TPB and it may influence individual behaviour through the degree of compliance

exhibited, the level of identification exhibited with the product and the degree of internalization of the product.

The fourth variable concerns facilitating conditions which relate to the degree to which the user of the technology believes that the organization and the infrastructural development of the organization are in place to support the use of the technology. It involves the construct of perceived behavioural control from the original scales of TPB/DTPB and C-TAM-TPB and reflects the internal and external constraints on behaviour. Additionally, facilitating conditions also relate to the original construct of MPCU by including factors in the environment such as laptops and internet connectivity that make it easy to complete an action. Compatibility is also a factor to consider in relation to the facilitating conditions in UTAUT since the innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters which would make the innovation more acceptable.

Technology affects the way teachers teach and students learn, and it is instrumental in impacting how vast amounts of knowledge is processed and managed (Wedlock & Trahan, 2019). It is also noted that educational technologies can meet the increased global demands for education which is accessible and cost-effective to all. Further, educational technologies have been known to enhance the quality and effectiveness of teaching and learning within the classroom and beyond (Christensen et al., 2011). Wedlock and Trahan (2019) opined that even though many teachers still engage in face-to-face instruction, society believes that educational technology offers great potential and has embraced and accepted the use of technology in and outside the classroom even though in a few cases there have been resistance, frustration, and scepticism over its use. Further, Wedlock and Trahan (2019) asserts that while educational technology use in schools continues to happen, it is important that curriculum and instructional

strategies be used to unite the students with the technologies to encourage learning. Jonassen (2003) is of the view that the most efficient use for technology in schools is when the device itself encourages active student engagement in an activity and enhances thinking and learning at the same time.

Wedlock and Trahan (2019) conclude that educational technology can contribute greatly to student learning, but educators need to be aware of the increased demand for technology and its implications for teaching and learning. The planners and implementers of technological initiatives in schools should consider the constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions as expounded by the UTAUT framework to assist in achieving effective ICT integration in schools.

Technological Pedagogical and Content Knowledge (TPACK) Framework

The integration of ICTs into the core curricula of public secondary schools has implications for teachers who need to have knowledge of content and knowledge of ICTs as technological tools as well as in the pedagogical use of the technology to encourage learning in the classroom (Doyle & Reading, 2012). To effectively integrate ICTs into the teaching and learning process of schools, teachers are not only required to have content knowledge, but must also have knowledge of technology and pedagogy which underscores the value of the TPACK framework to this research. Koehler et al. (2013) defines TPACK as a conceptual framework that shows the connection between teachers' understanding of content, pedagogy and technology and the way they interrelate with each other to create effective teaching. According to Koehler and Mishra (2008) cited in Irwanto (2021), TPACK is critical in teachers' successful integration of ICTs into their instruction and Willermark (2018) is of the view that the TPACK theory

reveals that constructive teaching and learning in this digital world should emphasize the complex relationship between content, pedagogy, and technology.

TPACK was born out of the need to explain to teachers the process of successfully integrating technology in teaching and learning (TPACK, 2012). It was revealed that for teachers to successfully insert technology in their teaching, they should have Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK) (TPACK, 2012). Doyle and Reading (2012) state that teachers' ICT use refers to skills in their knowledge, abilities, understandings, and attitudes that are considered inextricable when used in the context of pedagogy. Studies have shown that the technological knowledge and skills that teachers possess influence their use of technology in the teaching process (Aydin & Gurol, 2019; Japhet & Usman, 2018). Additionally, researchers found that teachers repeatedly used ICTs for information gathering and organizational strategies when preparing lessons (Brun & Hinostroza, 2014; Ola, Anders et al., 2017). The TPACK is a tool that was used in an ICT integration study in Tanzania for examining the ways in which technology can pedagogically support teachers and the knowledge of students while keeping pace on the technology, content, and pedagogy contexts (Brantley-Dias & Ertmer, 2013; Khan, 2014).

TPACK as submitted by Voogt et al. (2013) refers to technological, pedagogical, and content knowledge to sharpen the awareness of teachers if they are to effectively integrate ICTs in the classroom. The Pedagogical Knowledge of Content model defines the teacher's ability to teach content that has been pedagogically adapted to students of varying capabilities rather than just providing content knowledge for specific subjects (Abbitt, 2011). Content Knowledge, on the other hand, refers to the content that teachers teach to students in each subject area that consists of facts, concepts, theories, and principles (Ball et al., 2008; Kleickmann et al., 2013)

but integrating ICTs into the curriculum would require technological knowledge of content as well as pedagogical technological knowledge of ICTs to enhance learning (Mutisya, 2020).

The TPACK model is used in this research as a reference point to ascertain teachers' knowledge in the technological and pedagogical use of ICTs in their classrooms. The main elements of TPACK which formed the focus for this research are the technological and pedagogical constructs because while content knowledge is mandatory for teaching, knowledge of technology and pedagogy are not considered as prerequisites for teaching in Antigua and Barbuda. The TPACK framework assisted in addressing research question number three (3) in relation to the knowledge of teachers affecting their use of ICTs for pedagogical purposes since the model reveals that teachers must have technological knowledge of content as well as pedagogical technological knowledge to be effective when integrating ICTs in the classroom. Additionally, research question two (2) which addresses the extent to which the confidence and comfortability of teachers contribute to the integration of ICTs relates to the technological and pedagogical content knowledge, since teachers' confidence in teaching using ICTs is more likely to correlate to their knowledge of technology and pedagogy as indicated in the TPACK framework. Furthermore, the model assisted in answering research question four (4) which relates to the students' use of ICTs for core curricula learning, since teachers who are not competent in using ICTs will not be able to guide the ICT integration process for the students in the classroom.

In summary, the major theoretical frameworks for this research relate to the Theory of Change, the Unified Theory of Acceptance and Use of Technology (UTAUT), and the TPACK model which addresses knowledge, technological and pedagogical skills of teachers which are integral to the integration of ICTs in the core curricula of secondary schools. Areas of discussion

that form sub-themes of the literature as they relate to the research questions include ICT integration in the curricula, technology integration, the impact that ICT has on teaching and learning, challenges affecting ICT integration and barriers to ICT integration in education.

Structure of the Dissertation Literature Section

Information and Communication Technologies (ICTs) have been seen worldwide as great tools for educational change in the enhancement of teaching and learning (Fu, 2013). Christensen, Eichhorn and Prestridge (2018) postulate that ICTs should support curricula activities in ways that are not only engaging but meeting instructional goals. ICT integration should focus primarily on learning and the curricula rather than technology as a single entity which many educators seem to embrace as the reason for the pedagogical intervention.

Additionally, the study concentrated on a review of theories related to the research to ascertain the degree to which those theories are associated to ICT integration process in secondary schools. Citations from a myriad of researchers who expounded on ICT integration in curricula were also included. These theories are critical and laid the foundation for this research to advance new theory in ICT integration as it relates to Antigua and Barbuda and other developing countries especially if the existing theories are insufficient or do not fully relate to developing countries (Randolph, 2009).

The literature was developed in response to the research questions of the study using several themes surrounding the concept of ICT Integration in core curricula of public secondary schools in Antigua and Barbuda. It was important that the education system that presently exists in Antigua and Barbuda be examined, and a determination made of the impact of the ICT initiatives to the education system over the years. This exploration was followed by an examination of the current situation regarding the state of the core curricula which sought to

address the first and second objectives of this research relating to the presence of ICT components in the core curricula of public secondary schools and the extent to which the confidence and comfortability of teachers in using ICTs contribute to their use for teaching.

The literature also addressed the research objective which focused on the pedagogical use of ICT by teachers and sought to determine if the ICT knowledge level of teachers had a positive effect on ICT use in the public secondary school classroom. The extent of use of ICTs by students for core curricula learning activities was also explored to better understand its level of integration. Additionally, the school environment and its readiness for ICT integration was examined and hindrances or challenges facing the ICT integration process in the curricula of schools were also taken into consideration. The literature reviews analysed books, journals, and articles about ICT integration in instruction to gain insight into the integration process in schools. Online databases such as ProQuest and ERIC were used along with additional sources of information such as ProQuest Theses and Dissertations and search engines such as Yahoo, Science Direct and Google Scholar. The literature reviews were guided by the research questions and addressed the key constructs pertinent to the ICT integration by using the following structure:

1. Concept of Technology Integration in Education.
2. Stages of ICT Integration for Teachers in Schools
3. Emerging ICTs for Curriculum Content Design in the 21st Century.
4. Current Trends of ICT Integration in Antigua and Barbuda
5. ICT Initiatives for Secondary Education in Antigua and Barbuda
6. Smart Learning Environment and ICT Integration in Curriculum Content Design
7. Hindrances to Effective ICT Integration into Core Curricula Content Design

The section of the literature review themed ‘Concept of Technology Integration in Education’ played a major role in the literature review since it encompassed every aspect of the aim and purpose of the research. The section was deemed necessary for inclusion in the review process since it examined existing literature exploring the concept of radical constructivism as a paradigm for teaching and learning relating to the integration of ICTs in schools. Further, it examined ICT integration with a view to determining the processes involved in ICT integration and the challenges faced by schools in their attempts at integration. Although the focus of this research was on the assessment of ICT integration into the core curricula of public secondary schools in the small island developing state of Antigua and Barbuda, the information gleaned on ICT integration from the more developed countries provided great insight for the conduct of this research.

The section of the literature addressing the Stages of ICT Integration for Teachers in schools’ is also a critical aspect of the research especially in relation to research question three (3) which focused on the ICT knowledge of teachers and its effect on their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda. The inclusion of the stages of ICT integration that teachers encounter was considered critical to the literature since it provided a foundation to determine the challenges faced by teachers as they grapple with ICT integration. It is therefore important to understand the stages that teachers involved in the ICT integration process are expected to traverse to mitigate the issues they face and institute measures to address them. Further, teachers are expected to be equipped with the necessary ICT knowledge and pedagogical skills to empower them to prepare their students for the 21st Century.

The section which focuses on ‘Emerging ICTs for Curriculum Content Design in the 21st Century’ was considered an integral part of the literature review since it referenced current ICT

initiatives that are used to make learning with technology more effective. The section expounded on literature relating to curricula in the past and the methodologies used to teach in teacher-centred classrooms versus current classrooms with the utilization of those ICT skills and strategies that are required to prepare learners for the 21st Century. It was also important to capture the current trends of ICT integration which form part of the infrastructural development of Antigua and Barbuda and has implications for full integration in schools. This section was considered integral for review since it examined ICTs that presently exist in secondary schools in Antigua and Barbuda with a view to determining the level of their incorporation into the education system. The section has relevance for research question three (3) which focuses on the ICT knowledge of teachers and its effect on their use of ICTs for pedagogical activities in schools in Antigua and Barbuda.

An integral section of the literature review chronicles the ICT initiatives that have been introduced in public secondary schools in Antigua and Barbuda for the last ten (10) years. This section of the literature was critical for review since it indicates the nature of the initiatives and identifies the direct beneficiaries of the initiatives. The review in this area was geared towards identifying the level of integration with a view to gaining greater insight into the status quo of integration in public schools Antigua and Barbuda. Since educational leaders, teachers and students in public secondary schools were impacted by the ICT initiatives, the section provided insights into aspects of research questions three (3), four (4) and five (5).

Critical to the research was the need to address what constitutes the appropriate school environment that would be conducive for successful ICT integration. The exploration of a Smart Learning Environment and ICT Integration in Curriculum Content Design was deemed necessary for review to specify some of the requirements of classrooms if they are to be geared towards

successful ICT integration. This section aligns specifically with research question number five (5) which addresses the conduciveness of the school environment in promoting effective ICT integration. The hindrances or challenges facing schools when implementing ICTs were also reviewed in this section of the literature.

Concept of Technology Integration in Education

Information and communication Technologies (ICTs) according to Dei (2018) is the use of technology to manage and process information using several devices to include computer systems with computer software, laptops, tablets, smart phones, and white boards which are used to complete several processes involving the transmitting and retrieval of information. Ratheeswari (2018) opines that ICT refers to any technology that gives anyone access to information through telecommunication hence the need for ICTs to form part of workforce competencies if economies are to be progressive and successful. Technology integration in this research refers to the process of incorporating technological tools and services like the use of computers or laptops, tablets, mobile phones, projectors, the world wide web and the internet as part of the learning environment which will be integral to the changes made to the curriculum as well as to educational infrastructure and facilities if ICT integration is to be realized (Koretsky & Magana, 2019).

ICTs form an important part of the education system of many countries and are especially representative of how young people interact on a day-to-day basis since they are digital natives (Harrell & Bynum, 2018). The literature indicates that students are always connected to their devices and researchers are of the view that ICTs must be incorporated into the teaching and learning process to prepare students for the 21st Century (Harrell & Bynum, 2018). Further, Mutisya (2020) contends that ICTs are associated with improving students' creativity, their

abilities to reflect on their learning and their development of problem-solving skills. It is the belief of some researchers that integrating ICTs in education could create the environment where the quality and effectiveness of teaching and learning are enriched (Sahin, 2014). Further, Sahin (2014) embraces the value of ICT use in schools and identifies three (3) reasons why it important to integrate ICTs in education: (1) The increased use of ICTs in the workplace which means that students who are employed with those skills will benefit the national economy of a country; (2) ICTs are becoming an essential skill and will become the way of life of all individuals and (3) Pedagogically, teaching students to use ICTs for learning will provide them with access to resources, enrich their learning and cultivate their use of critical thinking skills. Researchers are of the view that awareness towards the use of ICTs is on the increase in classrooms globally so that just using words alone to communicate ideas, skills and attitudes is fast becoming obsolete (Ojo, 2005). Qualter (2011) weighs in on the value of ICTs to students by stating that integrating ICTs in education provides the students with opportunities to examine their ideas and to compare their views with world views which will enhance their conceptualization of ideas.

Dei (2018) is of the view that education is a social activity which needs to move from the traditional teacher-centred activity to one that encompasses digital media and information. Further, it is believed that ICTs are changing school syllabuses in various ways including the type of methodologies that teachers use to deliver their lessons. Dei (2018) conducted a qualitative study to assess the adoption and use of ICT in teaching and learning in secondary schools in Ghana. Like this research, the study focussed on 10 secondary schools, but the participants included 40 teachers and 40 students. Data for the study were collected from primary sources such as observations and questionnaires, and secondary sources such as libraries, websites, databases, and journals. A key finding of the study was that there is a significant

relationship between the acquisition of ICT skills and usage and adoption by teachers in schools. In addition, the study identified factors that inhibit ICT usage in schools which relate to cost of technology, technology and skills, management and leadership and environmental related factors. The study was limited to the extent that there were disparities in the presence of ICTs in urban secondary schools and little or no ICTs in rural secondary schools. The study was able to provide this research with key insights into issues faced, and challenges encountered in ICT integration in secondary schools.

Research is replete with the value of ICT as a great resource to facilitate teaching and learning and the ICT knowledge of teachers plays an integral role in the process. UNESCO (2011) identifies teacher development as critical for integrating ICT in education and advocates three stages of development for teachers to include (1) Technology Literacy of teachers which will enable them to guide their students into using ICTs for learning (2) Knowledge Deepening of students which encourages the students to have comprehensive knowledge of their subject matter and applying that knowledge to situations in real life and (3) Knowledge Creation which requires the students to work independently and create knowledge which they can use to live fulfilling and prosperous lives. Research question number three (3) addresses the ICT knowledge of teachers in relation to their use for pedagogical activities and the stages of development for teachers advanced by UNESCO (2011) are key developments in the integration process.

UNESCO (2011) is of the view that ICTs can prepare students to become model citizens and productive members of the world of work if teachers encourage the use of ICTs to stimulate problem solving and creativity in the classroom. UNESCO (2018) strongly advocates for the integration of ICTs into education and believes that technology has the potential to provide innovative solutions to empower learners to take part in quality lifelong learning prospects, to be

able to access information and knowledge for them to fully participate in society. UNESCO (2018) postulates that successful integration of ICTs into teaching and learning requires the rethinking of the roles of teachers in the planning and implementation of ICTs, hence the role they played in the development of the recently revised UNESCO ICT Competency Framework for Teachers (ICT-CFT) to guide the integration process. According to UNESCO, ICTs can be employed to support several focus areas in education such as Understanding ICT in Education, Curriculum and Assessment, Pedagogy, Application of Digital Skills, Organization and Administration and Teacher Professional Learning. In an education system, teacher knowledge and skills are at the centre of the ICT integration process and must be taken into consideration when such initiatives are considered.

The emphasis for today's knowledge-based society is on the teaching of skills to a generation of learners that are digitally oriented and less on the mastery of subject content (Mutisya, 2020). Further, it is advocated that the curriculum be changed from one that is content based to one that uses skilled based approaches. An important aspect in the integration of ICT in education is the need for teachers to be skilled in the use of ICTs with access to proper ICT infrastructure and proper planning and support of educational leaders (Palagolla & Wickramarachchi, 2019). If ICT integration in education is to be effective, teachers must be aware of its value in facilitating and motivating students' learning and conceptualization, how they communicate ideas and gather information needed and how they analyse the information gleaned (Cleaves & Toplis, 2012). Most importantly, integrating ICT in the process of teaching and learning provides opportunities for teachers to be creative and practice learner-centred strategies in the classroom.

Information and Communication Technology education is a way in which society expects its students to be taught knowledge, skills, and competencies to motivate and engage them and enable them to relate what they learn to the workplace and create economic viability for the economies in which they live (Singh, 2017). Further, Singh (2017) purports that basic education is important for all students to access and apply knowledge but in a digital world, such an education must include ICTs if students are to fit into the global village.

In a conventional classroom, emphasis is placed on content and the textbooks are written with the content in mind with teachers focusing on lectures and the rehearsal of content to consolidate learning (Singh, 2017). In the contemporary classroom, however, the focus is based on competency and performance, and the teacher is concerned more with the capabilities of the students and how the information is used rather than what the information entails (Singh, 2017). The concept of students making use of the knowledge refers to the theory of radical constructivism which according to Stabile and Ershler (2016) focuses on how students relate to the knowledge and make meaning when they interact with the content and the processes that are involved in the interaction. Xu and Shi (2018) affirmed that the main idea behind the constructivist theory is to have an environment that is learner-centred with the knowledge and understanding being socially constructed by the students. Information and Communication Technology (ICT) has become the emerging technology that is changing the landscape of education systems (Livingstone, 2019). Livingstone (2019) examined the place of Information and Communication Technologies in curriculum design and development based on evidence of rapid technological changes taking place in education around the globe and with ICTs becoming mandatory in the classroom. Livingstone (2019) assessed literature on curriculum and what it entails, the important role of curriculum in teaching and learning, curriculum design and

development, and the role that ICTs play in curriculum design and development. Livingstone established that ICTs should be integrated into existing curricula because they would stimulate pedagogical innovations, revolutionize instructional practices, and foster learner engagement. Education has been known traditionally as a social activity with the teacher having a relatively high degree of face-to-face interactions with students daily (Dei, 2018), but integrating ICTs is purported to encourage students to learn independently. In the constructivist classroom, students are actively involved in the construction of knowledge rather than being passive consumers of information with the teacher as the facilitator (Xu & Shi, 2018).

Technology in education highlights the concept of radical constructivism in education also known as pedagogical constructivism which is characterized by a number of principles as purported by Brdicka, (2001), Hejny et al. (2004), Molnar et al. (2007) and Dostal (2013) cited in Juvova et al. (2015) which include (a) emphasis that is placed on activities in the classroom and the increasing of the students' motivation for learning (b) a methodological approach to solving problems by finding and making connections and associations and the interdisciplinary transfer of information (c) ensuring that the principles of continuity and consistency are maintained (d) applying methods of teaching based on the students' needs (e) ensuring that there is mutual communication between the teacher and the students (f) learning from action research (g) working with school representatives and (h) working with errors and failures in an effort to improve. Juvova et al. (2015) are of the view that to adhere to the stated principles, there is a need to acquire and use appropriate and contemporary teaching resources including textbooks that are created based on constructivist knowledge. The benefits of the constructivist approach in using the emerging technology over the more traditional approach to teaching are clearly articulated in Table 1 by Voogt (2003) as cited in Mikre (2011). According to Stabile and Ershler

(2016), self-directed learners can make meaning or construct knowledge of their world and are engaged in constructivist-based knowledge. Self-directed learning, according to Oinam (2017), is an approach to learning in which the learner has a great sense of autonomy for his learning, relies on active rather than passive learning, has accountability and responsibility for his learning and decreases the learning time in the classroom.

Table 1

Overview of Pedagogy in the Traditional Versus Emerging Pedagogy

Aspect	Traditional pedagogy	Emerging pedagogy for the information society
Active learning	Activities prescribed by teacher	Activities determined by learners
	Whole class instruction	Small group
	Little variation activities	Many different activities
	Pace determined by the programme	Pace determined by learners
Collaborative	Individual	Working in teams
	Homogenous groups	Heterogeneous groups
	Everyone for him/herself	Supporting each other
Creative	Reproductive learning	Productive learning
	Apply known solutions to problems	Find new solutions to problems
Integrative	No link between theory and practice	Integrating theory and practice
	Separate subjects	Integration between subjects
	Discipline based	Thematic
	Individual teachers	Teams of teachers
Evaluative	Traditional pedagogy	Emerging pedagogy for the information society

Note. Adapted from Mikre, (2011, p. 5).

The core idea of this research is to assess the integration of ICTs into the core curricula of public secondary schools, and inherent in that process is the need to determine the status of the integration and its effect on learning. Radical constructivism is a core factor of the research since the reason for ICT integration was to encourage student engagement to enhance learning, and the constructivist theory relates to learning taking place in a learner-centred environment where knowledge and understanding are socially constructed by the learner (Xu et al., 2018). The constructivist theory is Piagetian based and uses the process of assimilation, accommodation, and equilibrium as the foundation on which complex understanding of knowledge is created (Stabile & Ershler, 2016). Further, the learners can intellectually adapt the knowledge and fit it into what is currently known to interpret the world around them (Stabile & Ershler, 2016). The idea of the integration of ICTs into the core curricula of schools as purported by Xu and Shi (2018), is to enable learners to work on their own with the teacher acting as facilitator rather than imparter of knowledge.

The constructivist theory has as its main aim a learning environment with principles of constructivism surrounding the learner, and Mutisya (2020) claims that ICT adds to that environment by increasing the learners' creativity, reflection, and problem-solving skills. In this research, ICT integration embodies radical constructivism since it touches every facet of a learner's life in and out of school to improve learning (Mutisya, 2020). The learner is taught by a teacher who values active learning and uses student-centred teaching strategies and ensures that they are practiced in the classroom (Kivunja, 2018).

Research questions one (1) of this research focus on the reflection of ICT components in the core curricula of public schools and the extent to which they are present. Core curricula subjects are done by all students in Antigua and Barbuda especially in the lower levels of public secondary schools, and integrating components of ICTs in those subjects will affect learning for many students. According to the tenets of radical constructivism, student learning will be more self-directed and or regulated with opportunities provided for problem solving. Qualter (2011) concludes that ICTs provide learners with the opportunities to negotiate learning using ICT tools and encourage them to enhance their ideas through their interaction with the world around them. The link of ICT integration to radical constructivism is upheld by the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2011) which claims that effective integration in teaching and learning depends on the teacher's ability to use the setting for learning in new ways by blending the emerging technology with new ways of teaching and creating an active classroom by encouraging social interaction, collaborative problem solving and group work.

UNESCO (2018) advocates for social and economic goals involving students being exposed to ICT skills in classrooms to enable them to be reflective, creative, and adept at problem solving in the workplace. Key in that goal is for the students to be responsible and constructive learners so that they may exist comfortably in a society that is ICT-rich. Additionally, UNESCO (2018) also endorses acknowledging ICT-rich classrooms as the foundation for enabling students to be knowledgeable and resourceful so they can make informed decisions, direct their lives effectively and be able to fulfil their potential in life. UNESCO is of the view that teachers are significant in the ICT integration process and have created the ICT Competency Framework as a guide for teachers to assist in helping students

become collaborative, problem-solving, creative learners and innovative and engaged members of society.

The increasing emergence of technologies and the acceptance of ICTs in education is believed by many researchers to be a way for education to be promoted on a wide scale (Ramesh & Dibaba, 2017). According to Bass (2007), the integration of ICTs in education has many benefits especially considering its contribution to the enhancement of education which will assist in the development of a country. Among the many benefits cited by Bass (2007), is the increase of achievement levels of students since it will counter the high number of students to teacher ratios in some countries as well as the lack of teaching resources that may be experienced. Additionally, the use of ICTs helps schools in overcoming obstacles related to distance since technology is ubiquitous and students will be able to access learning wherever they are located. Ramesh and Dibaba (2017) agrees with the benefits of ICTs by stating that they improve the learning process by providing teachers with several educational interactive resources that contribute to the motivation of students and their subsequent acquisition of skills. Using ICTs, teachers are provided with the opportunities to revolutionize their craft with stimulating educational content, and teaching and learning methods or strategies that are more effective. Developing countries like Antigua and Barbuda are even more aligned to the benefits of ICTs in education especially as it relates to the lack of dependence on the presence of physical media like printed texts for information since with technology there is access to experts and other professionals in many areas of interest in any part of the globe at any time required. (Ramesh & Dibaba, 2017).

ICTs in education can improve teaching and learning in all subject disciplines by increasing motivation, thinking and engagement in the process (Ramesh & Dibaba, 2017). Once

the process is planned, students are kept engaged and they work as individuals or in teams to construct their knowledge and make it more meaningful for them. Students will use ICTs to gain access to vast amounts of information that is not readily available in printed texts; they are able to reflect on and manage information available to them; they are provided with the opportunities to form, produce, and test their ideas and assess and share what they understand with others. Ramesh and Dibaba (2017) concludes that incorporating ICTs in education provides the opportunities for teachers to use several teaching strategies and methods to engage their students which lays the foundation for a quality education for students. ICTs in general provide both teachers and students with a wider range of educational tools and resources and enable them to function with greater flexibility as they execute their duties.

While the literature is replete with information on the use of ICTs to improve learning, there is literature which suggests that there is some measure of uncertainty regarding the value of ICTs in the curricula of schools to improve learning (Kachakova, 2020). In response to a 2012 European Commission statement in its Communication 'Rethinking Education', it was revealed that technology is a "key lever for more effective learning and to reducing barriers to education, in particular social barriers." (European Commission, 2012, p. 9). Kachakova, (2020) sought evidence to substantiate the statement by reviewing evidence from a number of international studies (International Association for the Evaluation of Educational Achievement (IEA) - Results of the International Computer and Information Literacy Study (ICILS) for 2018; OECD – Students, Computers and Learning: Making the Connection (2015); and European Commission's 2nd Survey of Schools: ICT in Education), which revealed controversial findings that suggest that ICTs may not be as effective in improving learning as some literature suggests. Kachakova, (2020) have indicated that there is empirical evidence to prove that teachers who claim that

laptops and the internet serve as distractions from class engagements and student learning are correct in their observations. The findings from the case studies also revealed that some teachers were of the view that ICTs were valuable for research while others believed that they encouraged a cut and paste culture among students (Kachakova, 2020; Tiilikainen, 2018). According to Kachakova, (2020), the results of the case studies revealed that a teacher who predicts a better quality of education is more significant than the use of ICTs since they will do what is necessary to secure the quality education which they predicted. The results of the ICILS (2018) study revealed that having access to technical devices and to the internet does not mean that students have the knowledge and skills to use them. The IEA (2019) report indicated that "Digital natives are not digital experts: Young people do not develop sophisticated digital skills just by growing up using digital devices" (slide 10). Technology in education offers opportunities for improvement in learning but its success is dependent upon how it is used (Kachakova, 2020; Lim, 2022). Careful planning and evaluation of the stages of integration are needed for integrating ICTs in the curricula of m schools for the process to be effective and successful (Uslu, 2017).

Stages of ICT Integration for Teachers at School

Teachers are expected to use modern approaches in their delivery of instruction with constructivism at the core by using student-centred strategies in their classrooms (Livingstone, 2019). They are expected to use ICTs in their instructional practice and every effort must be made to ensure they are trained in the pedagogical use of ICTs as part of the integration process (Uslu, 2017). Further, Uslu is of the view that since teachers are expected to incorporate technology into their teaching, it is critical that the managers of the process are aware of the stages involved in the integration process and address those issues that may impede smooth

implementation. According to Uslu (2017), it is important for planners to examine the stages of integration as well as the factors affecting the stages to better equip them for the process. The stages in the integration of technology for teachers according to Uslu (2017) include stage one (1) in which teachers resist the use of technology and deny the benefits that may be derived from its use; stage two (2) where the teachers focus on personal use of technology and begin to get familiar with the technology; stage three (3) where the teachers increase their personal use of technology and feel comfortable using the technological terms associated with their progress; stage four (4) where the teachers are convinced of the need for change and embrace technology as an integral part of instruction; and stage five (5) where the teachers fully embrace the technology and focus on using ICTs for student-centred instruction where the students are encouraged to use higher order skills in their learning. Following acceptance of technology by teachers, the students become the focus of instruction and teachers usually find creative learning-centric ways to teach the curriculum (Uslu, 2017). Livingstone (2019) promotes the use of ICTs as part of the curricula of schools by claiming that:

> Information and Communication Technologies should be considered and integrated into educational curricula because they can revolutionize instructional practices and stimulate pedagogical innovation; foster learner engagement; cater for student learning diversity; promote learner independence and autonomy; increase learner interaction and communication, and support intellectual expressiveness and creativity of learners, application, and lifelong learning. (p. 180)

Livingstone (2019) is of the view that considering the increased use of ICTs to improve the pedagogical practices of teachers to optimize learning, the designers and developers of curricula should incorporate technology at the onset to provide more broad-based learning

opportunities for learners by using a wide range of learning resources to encourage creativity and lifelong learning.

The literature on stages of ICT integration for teachers is limited but Yücel et al. (2010), have indicated that to ensure effective integration, it is critical to know the teachers' stages of technological integration to offer the support required. Yucel et al. (2010) conducted a study to determine teachers ICT stages according to the CEO Forum's standards and factors affecting the integration process, since teachers were expected to use ICTs to teach. The study included a sample of 200 randomly selected teachers out of 460 teachers working in primary schools in Turkey. The teachers were administered an ICT integration questionnaire and only 149 of the instruments were returned. The findings revealed that teachers may be categorized in three different stages in ICT integration. The study further revealed that the feelings of inadequacy of teachers aligned with stage one where teachers have limited ICT knowledge while the ICT knowledge of teachers was the most important variable at the third (highest) stage of ICT integration. One limitation of the research is the limited empirical research done to determine teachers' actual ICT integration stages. The paucity in that area of research impacted the depth of information reviewed on the stages of teachers' ICT integration for this research.

The CEO Forum on Education and Technology (1999) standards cited in Yücel et al. (2010) suggests five (5) consecutive stages of ICT integration that are referred to as entry, adoption, adaptation, appropriation, and invention. At the entry stage, the teachers' knowledge of ICTs is extremely limited, and the students familiarize themselves with the technology and are engaged in learning to use the technology. At this stage, teachers are uncomfortable with technology and are not able to assist the students with their attempts at use. Any assistance with technology is given by other personnel instead of the teacher. Instruction in class at that stage is

teacher centred. Adoption is the second stage of the teachers' integration process and teachers are beginning to use the technology for teacher centred instruction. Teachers use ICTs to enhance their productivity either through their own initiatives or based on what is required by the school, and they engage in traditional tasks with the technology. At this stage, teachers begin to see the power of the technology for use in school-related activities.

The third stage is called adaptation, and it is denoted by teachers using technology to enrich the curriculum by using the knowledge that they have acquired about technology. Teachers at the adaptation stage usually direct students in their learning rather than engage them in self-directed learning. The fourth stage reported by Yücel et al. (2010) is the appropriation stage where technology is integrated. The teachers become aware of the potential of ICTs to improve learning and engage students in the use of critical thinking skills, and more complex concepts and skills than they would have encountered if they were without technology. The final stage is called invention where teachers discover new ways in which technology may be used in instruction to improve learning. The teachers' new knowledge of technology at this stage enables them to establish learning environments in the classroom by creating learning experiences that require higher order thinking skills as well as mastering basic skills and concepts. Yucel and his team are of the view that there should be a reclassification of the five (5) stage ICT integration of Teachers proposed by the CEO Forum to one that advances three (3) stages of ICT integration for teachers based on the findings of their research. The proposed stages by Yucel et al (2010) combine adoption and adaptation as stage one, followed by appropriation and invention. They purport that advancing to a higher stage is not necessarily linear, but teachers will become more competent in the use of ICTs to create learning environments that will encourage higher order thinking by students.

Knowledge of the stages of ICT integration of teachers indicate the level and type of training required so that the training given is appropriate for classroom practice, provides authentic and hands-on practice, provides immediate help if required and provides opportunities for teachers to work and share with their colleagues (Yücel et al., 2010). The need for teachers to be knowledgeable in ICT education is expounded by Livingstone (2019) who claims that with learning technologies, teachers' perceptions of technology and its use in instruction are key to its adoption in schools, and especially in curricula practices. Additionally, the more teachers integrate ICTs in teaching, students' achievement will improve, and the professional knowledge of teachers will also increase (Guma et al., 2013) cited in Aslam et al., (2020).

According to UNESCO (2018), the stages of teacher development are critical for integrating ICTs in education. The organization promotes three stages of development for teachers which include the technological literacy of teachers which empowers them to teach their students and encourage them to use ICTs for learning; the deepening of knowledge of students which encourages them to have sound knowledge of their subject content and apply that knowledge to real life situations; and knowledge creation which requires independent learning by the students and the creation of knowledge which they can use to live fulfilling and prosperous lives.

At the knowledge acquisition stage, the teachers are encouraged to assist students of differing backgrounds, ethnicities, and gender to engage in the use of ICTs for learning so that they can become productive citizens. UNESCO expects teachers to be aware of national goals and work towards achieving them by developing the digital skills required to assist their students. Teachers are also expected to be aligned with student centred approaches to learning and engage students in active authentic learning. Changes in pedagogical practice involving the

use of technological tools and digital content are expected as part of whole class activities, group work and individual student activities (UNESCO, 2018).

Once teachers attain the knowledge deepening stage, teachers are expected to give more support to students of diverse backgrounds to enable them to use technology to solve more complex problems that they encounter in real life situations. The teachers are expected to identify social priorities and use specific activities in the delivery of the curriculum to solve the problems that are encountered. According to UNESCO (2018), "The pedagogy associated with this level includes collaborative problem-solving and project-based learning, in which students explore a subject deeply and bring their knowledge to bear on complex, everyday questions, issues and problems" (p. 24). At this level, the teachers encourage students to work in groups for extended periods to solve problems by employing open-ended digital tools that are subject specific.

The final stage is the knowledge creation stage where the teachers become more involved in knowledge creation, innovation, and lifelong learning. UNESCO (2018) indicates that "the curriculum goes beyond a focus on school subjects to explicitly include Knowledge Society skills needed to create new knowledge, namely skills for: problem-solving, communication, collaboration, experimentation, critical thinking and creative expression" (p. 23). In this classroom, the teacher is seen as a master student and facilitator of knowledge who is constantly engaged in educational experimentation, action research, and innovation in collaboration with colleagues and outside experts to arrive at new knowledge about learning and the art of teaching.

Research questions three (3) and four (4) relating to the ICT knowledge of teachers and the use of ICTs by students for learning, correlate to the ICT teacher development stages identified by UNESCO. The effectiveness of ICTs to develop quality education has been

accepted worldwide (Aslam et al., 2020) and the ICT knowledge of teachers is a core element in that process. Guma et al. (2013) cited in Aslam et al. (2020) revealed that having ICTs in the classroom has created innovations for learning such as ready access to information, online learning, and reduced hardcopies. Applications involving the use of ICTs create improvement in quality teaching (Jamil et al., 2017), so it is imperative that teachers are at the ICT adaptation stage in which they can enhance their teaching (Yücel et al., 2010).

Emerging ICTs for Curriculum Content Design in the 21st Century

ICTs have become an important part of teaching and learning over the years as educational approaches seek to become more modern. Instructional practices have shifted from the traditional face to face teacher-centred approaches to ones that are more contemporary in nature with the teacher acting as the facilitator rather than the sage on the stage where the teacher provides the knowledge for the students (Livingstone, 2019). The focus of educational practitioners in developed and developing countries is to enhance learning by providing enriching learning experiences using several instructional resources that will keep students engaged (Livingstone, 2019). The use of technology in schools is becoming more and more evident and more mandatory as part of the education process. This section of the literature will focus on curriculum content design for the 21st Century and the role that ICTs play in the process.

It is important to understand the term curriculum as it is used in educational institutions. Curriculum, according to Hlebowitsh (2005) has its origin from the Latin word ‘currere’ which is related to the idea of a racecourse in a horserace which involves the rider having a specific focus which is to win the race. Hlebowitsh acknowledges that as a racer travels the course, the scenery and terrain will change, the weather and wind speed will also affect the race which is like

curriculum changes in an educational institution. Curriculum will also be affected by the influence of social forces such as the emergence of technology and political decisions which occur on a regular basis (Wiles et al., 2002). Additionally, the paradigm shifts pertaining to what students should learn and what is considered current and necessary will also affect curriculum design and development.

Curriculum, according to Livingstone (2019), may refer to the complete plan for learning used in a learning institution or it may refer to an individual course or subject offered in an educational institution. Curriculum means different things to different people, but the definition that is aligned to this research is a derivative from several definitions coined by Pillai (2015) which states that "Curriculum is a comprehensive plan for an educational programme/institute/course to offer new or improved manpower to accomplish the rising needs of a dynamic society" (p. 5). To sum up the term curriculum, Livingstone (2019) posits that it refers to all educational activities that relate to why students learn, the types of materials they learn, how they go about learning and how well they learn. Such a focus on the learners suggests a learner-centred curriculum where the activities, needs and interests of the learners take precedence and they become the protagonists of their learning by constructing their own knowledge (Livingstone, 2019).

Curriculum and syllabus are sometimes used interchangeably but do not mean the same thing. According to Livingstone (2019), a syllabus refers to instructional content that has been organized into teachable units, and the focus of a syllabus is the content that is selected for instruction and how it should be taught. In the context of this research, the term curricula will refer to the Caribbean Secondary Education Certificate (CSEC) syllabuses used for the core subject areas of public secondary schools as it relates to the content to be delivered and the way

it is organized for instruction. It must be noted that each subject area has a dedicated syllabus which guides the instruction process in schools.

Curriculum design is determined by several factors to include basic needs, social and cultural factors, talents of individuals, ideals of individuals and what are considered traditional (Pillai, 2015). Curriculum design over the years has been impacted by many theorists who claim that the curriculum should encourage learners to be innovative and critical thinkers who are able to create meaning and construct their own knowledge (Livingstone, 2019). Among the first set of curriculum theorists was Tyler (1949) who posed four (4) questions which form the core of a curriculum and should guide the design of the curriculum. The first question relates to (1) the educational aims that can be achieved; the second question is in relation to (2) the instructional experiences that may be used to achieve the aims identified; the third question covers (3) the arrangement of the experiences to make them effective and the last question deals with (4) the ways in which the achievement of the aims may be determined. Tyler (1949) theory has the learner involvement and the learner outcomes at the heart of his theory which is in keeping with the theory of radical constructivism proposed by Piaget. Oladottir (2013) expounds on the need for the learners to be the focus of the teaching and learning experiences hence the presentation of the five (5) Pillars of Learning to include: learning how to learn and to know, learning to be, learning to be sociable and live together, learning to do, and learning to transform oneself and society. Bearing those pillars in mind, a curriculum should be designed and developed to support innovativeness, application of knowledge and the creation of lifelong learning capabilities which would encompass the integration of ICTs in curriculum content design (Livingstone, 2019).

Technology is becoming increasingly important as a platform to increase learning in the classroom and has assisted in unlimited access to information materials and human interaction

through improved communication (Livingstone, 2019). However, as it relates to the way in which technology is used in the classroom, Boukhechba and Bouhania (2019) claim it is important for educators to realize that there is a difference between just bringing a piece of technological equipment into the classroom for general use and bringing the equipment to serve a specific educational purpose which is planned. It is critical for educators to use the technology for instruction and for the students to be provided with the tools that will enable them to be agents of social change (Pillai, 2015). The advice proposed by Pillai on the use of technology for teaching and learning relates to research questions three (3) and four (4) which seek to determine if teachers use ICTs pedagogically for instruction and students use ICTs for learning.

The internet is ubiquitous, and the presence of ICTs has created a worldwide interconnected village where users are provided with the means to communicate on a regular basis from anywhere in the world (Livingstone, 2019). ICTs offer a diverse range of online resources and have the potential to transform learning and teaching. These sentiments are promoted by Lai (2011) who claims that education leaders see digital technology as a tool which could fully or partially transition learners from the traditional classroom with four walls using the face-to-face modality to one that is virtual and enables the learners to work anywhere and at any time at their own pace. Many developed and developing countries could relate to this phenomenon during the COVID 19 pandemic when educational institutions were mandated to close, and students were forced to learn remotely.

The integration of ICTs in the curricula design of schools according to Livingstone (2019) can result in learners working independently and autonomously with a wide range of educational experiences. Additionally, the students create knowledge and play leading roles in their own learning with the teachers serving only as facilitators of the process. Students are

motivated in such an environment, and they engage in query so that they can develop their intellectual abilities and make meaning of the information. The presence of ICTs in the curricula content increases students' interactivity (Persaud & Persaud, 2019) and encourages collaborative and cooperative learning among learners. Technological tools provide a myriad of possibilities for learning to take place in the form of skills and competencies for the learners especially if they are planned as part of the curriculum design process (Laurillard, 2012). Some researchers are of the view that the inclusion of ICTs in the curricula content design of programmes create opportunities for broad-based learning using a wide variety of tools and other resources (Livingstone, 2019; Raturi et al., 2011). Sharma (2008) is of the view that if ICTs are to be integrated into the curricula designs of schools, there must be policies in place to guide the process and the necessary training and awareness programmes done with teachers and students to ensure that they have the same perceptions of their use and subsequent adoption in curricula.

The literature on the use of ICTs in the classroom are varied in their use in the classroom. Yildirim (2007) posits that teachers use ICTs to prepare learning resources and assessments rather than for the creation of opportunities for critical thinking in their students. Similarly, Palak and Walls (2009) and Tezci (2011) claim that teachers use technology to support their existing teaching methods and rarely for the fostering of student-centred learning. ICTs are added to the curricula of many educational institutions and are mainly used as add-ons to traditional teaching practices of teachers without a plan for meaningful transformation in the teaching learning process (Lai, 2008). According to Livingstone (2019), technology by itself cannot transform teaching and learning but it is the way in which the technological tools are used in the learning environment that will determine their effectiveness in teaching and learning. Cetin and Solmaz (2017) also supports the value of technology integration in curricula as being more

than the acquisition of hardware by claiming that it requires the adoption of the technology into various subject disciplines and using them for students to acquire skills such as creative problem solving, critical thinking and other 21st century skills. Once teachers embrace and use ICTs pedagogically, learning barriers that were present in the traditional classroom are broken, and abstract concepts are simplified using simulation (Mutisya, 2020).

Studies have shown that ICTs integrated into curriculum content design also heightens students' enthusiasm to learn, increases their engagement and provides access to information that may not be readily available (Urbina & Polly, 2017). Further, the researchers contend that schools use education software to ascertain areas of weakness or struggle for students and support them with the assistance needed, as well as providing an increased level of communication and timely feedback on the work provided by learners. According to Tiba and Condy (2021), technology may be used to cater for different learning styles of students whether it be visual, auditory, or tactile and researchers, Yang and Chun (2018), are of the view that the diverse needs of the students may be addressed by teachers providing online resources for those students who had difficulty understanding concepts in class.

Another area of focus for integrating ICTs in curricula is by using the Technological Pedagogical Content Knowledge (TPACK) model which outlines the process of successfully embedding technology in teaching and learning (TPACK Org, 2012). Palagolla and Wickramarachchi (2019) are of the view that successful and effective ICT integration in schools require the ICT competency of teachers, proper ICT infrastructure, the support of school leadership and proper planning. Teachers are critical in the process of effectively integrating technology into the instructional process by ensuring that there is sound knowledge of pedagogy and content (Ammade et al., 2020) and by realizing that it provides them with the opportunity to

practice the use of innovative student-centred pedagogies in authentic learning situations (Mutisya, 2020). TPACK Org (2012) asserts that for teachers to successfully embed technology in their teaching, they should have what is referred to as Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK).

According to the TPACK Org (2012) framework, TCK refers to the way in which technology is used in specific subject disciplines to facilitate deep learning while TPK involves the selection and management of the technology to facilitate learning. TPACK Org (2012) is aware that learners are unique and operate differently in various contexts to include grade levels, school specific factors, demographics and school culture which suggest that no one combination of technology, content and pedagogy can be used to fit all teaching and learning situations. It is important that as teachers plan their learning experiences in their subject disciplines, they should make use of the TPACK model to ensure that technology is part of the process to enhance learning (Mutisya, 2020).

ICTs integrated into curricula for a specific purpose with the requisite support will be of increased benefits to students inclusive of enhanced learning opportunities, easier ways of accomplishing tasks, and practical preparation for life in a global market (Thompson, 2016). In summary, Gomathi (2020) insists that for ICT integration to be sustainable, the curricula should not only contain digital components but should be integrated into the various subject disciplines and permeate all pedagogical activities.

Current Trends of ICT Integration in Antigua and Barbuda

The government of Antigua and Barbuda has sought to build the twin island state into an economic powerhouse. This section of the literature chronicles the progress of ICT infusion into the landscape of Antigua and Barbuda to provide the backdrop for the ICT initiatives that have

been implemented in schools. The information in this section is relevant to research questions two (2) and five (5) where the emphasis is on the extent of ICT integration in core curricula of schools and the role of the school environment in promoting effective ICT integration. The current trends of ICT integration island wide will determine to some extent the success of any ICT integration process in schools. Students are expected to be trained as learners that will fit seamlessly into the 21st Century, having acquired a myriad of skills and competencies needed to exist in such an environment. It is also the aim of the government for Antigua and Barbuda to be a leader in technology in the Caribbean region. Technology is needed in every aspect of life in a developing country and schools must make every effort to ensure that they meet the individual needs of students through the approaches that are used to engage the students. Research indicates that this may be achieved by a paradigm shift from the traditional teacher-centred approach with the teacher passing on the information to passive students, to one that is more student-centred with students engaged in learning independently by using ICTs. An approach that sees learners actively engaged in their learning by constructing knowledge for themselves and making sense of their experiential world is constructivist in nature (McDougall et al., 2010). The constructivist approach causes students to focus on higher level concepts and according to McMahon (2009), there are significant correlations between using ICTs and the acquisition of critical thinking skills.

The government of Antigua and Barbuda is a member of the Caribbean Community (CARICOM) and is desirous of equipping its citizenry with the necessary skills and competencies required to fit into any society. The skills are critical especially considering the existing CARICOM Single Market and Economy (CSME, 2019) agreement where citizens of the Community must be digitally trained since they have the option of living in any territory and

working without restraints or specific approvals by territories in the Community. In 2013, to fulfil the mandate of preparing its citizenry for the global market and ensuring that technological skills are inculcated into the curricula of schools, the Ministry of Education articulated a vision of integrating ICTs across every level of the education system (ICT in Education Policy for Antigua and Barbuda, 2013). Based on its ICT vision, the government of Antigua and Barbuda is aware that knowledge-based activities have become increasingly important as a way of life, and it is this recognition that has prompted government to encourage the use of Information and Communication Technologies (ICTs) in its daily activities. To assist with the mandate of ICT integration in the country, the Ministry of Education in partnership with UNESCO and the Commonwealth of Learning (COL) collaborated to revamp the existing ICT policy of 2003 and prepared the ICT in Education Policy for Antigua and Barbuda (2013) to facilitate educational reform and create the paradigm shift required from teacher-centred teaching and learning to be more student focused (ICT in Education Policy for Antigua and Barbuda, 2013). The policy document provided an overall plan for the integration of ICTs in the education system. Through the introduction of a new ICT in Education Policy for Antigua and Barbuda, it was the hope of the Ministry of Education to respond to the change which technology would bring to the nature of work in the 21st Century workplace which was referred to as the 'Knowledge Revolution' (ICT in Education Policy for Antigua and Barbuda, 2013).

Bearing the need for its citizenry to engage in more technological activities as part of their daily activities, Antigua and Barbuda began the process of change by integrating technology in every facet of life (International Telecommunication Union (ITU) Statistical Reports, 2018). The International Telecommunication Union (ITU) Statistical Report is a report on several countries reflecting their status of Information and Communication Technology markets relating to infrastructural development, government policies and initiatives to improve access and use of

technology in the countries. Based on a survey done in 2017 and updated in 2018, it was reported that Antigua and Barbuda have made great progress in the market for services related to ICT. The report further highlighted that the level of mobile penetration for Antigua and Barbuda surpassed many regional and international countries. It was also reported that unlike the mobile cellular component, mobile broadband levels were lower in Antigua and Barbuda than in the region and this created a potential problem since most of the population including schools used the broadband service.

The ICT integration process also welcomed the Government-Assisted Technology Endeavour (GATE) in 2013 which was geared towards the development of information and communication technology services, encouraging children and young adults to learn using technology, with the hope of inspiring entrepreneurship in the young, and positioning Antigua and Barbuda as the ICT capital in the region. The initiative was a collaborative effort between the Ministry of Information and two (2) major technology companies namely Digicel and LIME (Government of Antigua and Barbuda, 2012). The programme focused on the development of the professional skills of young people and adults as well as their IT skills to position them to continue their education in educational institutions locally, regionally, and internationally.

The ICT Cadet programme was another programme geared towards the integration of ICT in Antigua and Barbuda. It targeted unemployed school leavers to receive training in ICT skills (Installation, upgrading, configuration, diagnosing and troubleshooting, motherboard/processors/memory, preventive maintenance, printers), introductory networking skills and training in new media (graphic design, video editing, journalism, photography, web navigation, editing and uploading) to provide a launching pad for young people to become entrepreneurs. According to the ITU Statistical Report (2018), the government of Antigua and Barbuda also focused on ICT accessibility especially in the field of education through a programme called ‘Connect

Antigua and Barbuda Initiative' which was launched in 2013. The focus of the programme was for the citizenry to acquire computer literacy skills beginning at early childhood up to the tertiary levels of the education system with the goal for all to become empowered through technology. The Connect Antigua and Barbuda Initiative was geared towards making ICT available to the various communities on the islands through Community Computer Access Centres (CCAC) and Mobile IT Classrooms. The CCAS were opened in the communities and operated after general working hours and provided classes in introduction to computers for children in schools and members of the community as well as intermediate and advanced computing for the community. Schools were able to use the CCASs during school hours for their introduction to computers classes (Government of Antigua and Barbuda, 2012).

The thrust of the government of Antigua and Barbuda to make every facet of the country ICT ready was overseen by the Ministry of Education especially as it related to the use of ICTs and training. To integrate technology into its operations and to ensure that the proper ICT infrastructure is in place, the Ministry of Education engaged an Education Management Information System (EMIS). It was based on the premise that the country needed to build a workforce that was creative and good at problem solving to generate knowledge (UNESCO, 2011). Further, UNESCO affirmed that the use of technology would create citizens that are knowledgeable and resourceful to enable them to lead effective satisfying lives.

EMIS in the education system in Antigua and Barbuda was a management system that linked all schools to the Ministry of Education headquarters. The idea of an EMIS system was introduced in 2006 since it was felt that within a modern education system, decisions should be data driven, hence the need for an EMIS. Managers and instructors alike must use data to develop, tailor or customize programmes on a national level, school level, class level, as well as for individual students, to improve the education product or processes that currently exist.

However, it was felt that with the introduction of technology, the time in which data is captured, analysed, and interpreted would be reduced significantly. This quick process allowed for earlier interventions and more appropriate solutions to be developed or selected for problems or challenges faced in the education system. Being cognizant of this, in 2006 under the Basic Education Project 1, the Ministry of Education decided to pilot an EMIS for full implementation in 2010 (EMIS Review Report, 2014).

Subsequently, in 2010, an official deployment of the aBusstar EMIS was launched. The overarching goal was to engage the eighty-four (84) public and private schools functioning at that time in using the tool, thereby making data more readily available to the decision makers in the Ministry of Education. The system was expected to improve the efficacy of the data collection process with the aim of transforming the sector into one that was data driven. The initiative also sought to improve the daily operations at the school level. This was expected to be accomplished through the automation of processes such as the recording of attendance, the generation of reports and storing and computing of grades. The system also sought to give education leaders, teachers, and parents ready access to data, anytime and anywhere. Embarking on this initiative meant that the Ministry of Education saw value in using the technology to closely monitor and more frequently evaluate performance of students (EMIS Review Report, 2014).

The education management system subsequently encountered technological challenges which hindered its optimal performance. The aBusstar EMIS being a dynamic tool, needed reliable internet access. There was also the need for adequate hardware at the different levels of the education system, at the Ministry of Education headquarters and in schools, to cater for the number of end users required to access the tool daily. The initial installation was chaotic,

however, hardware was installed and internet access, although not fully stable was made available. More hardware became available under the 20/20 Initiative, in which teachers were given laptops and internet access (EMIS Review Report, 2014).

There was still a major deficiency with the EMIS system since the Ministry of Education did not own servers nor had access to servers to securely store the data generated by the EMIS. As a result of the deficit in servers, all the data in the EMIS system was housed on the software provider's server for which there was an associated cost and high risks. This was a constraint that needed to be addressed, not only to reduce cost but also to ensure the privacy and the integrity of the data, hence the introduction of a new EMIS (EMIS Review Report, 2014).

In 2018, a new Education Management Information System (EMIS) called Sydavi EMIS Solutions was introduced. The system was piloted in several primary and secondary schools and is presently in use unofficially in a number of those schools since it was not officially adapted by the Ministry of Education due to cost factors. Those schools that have opted to pay for the service with their school funds have indicated that the Sydavi EMIS is exceeding their expectations. The Sydavi EMIS caters for different levels of access in education to include Ministry of Education, Education Officials, school administrators (principals and EMIS administrators), Management Teams (heads of departments and level heads), teachers, students and parents and guardians (Sydavi EMIS, 2018).

Access to Sydavi EMIS during the trial phase for the Ministry of Education officials was varied and provided them with the ability to execute a number of processes to include: assignment of staff to various educational institutions, registration of personnel such as parents and students, transfer of personnel, collection of data, reporting statistics, monitoring of subordinates such as teachers in the various departments, monitoring of students in a department

and the viewing of historical data related to security best practices. School administrators were able to use Sydavi EMIS to monitor staff and students, assign students to student groups, create, and edit forms, assign staff and students to forms or grades, record and view form or grade attendance, record and view comments from forms or grades, create and edit classes, assign staff and students to classes, generate reports, and manage other data. Management teams and teachers were also able to perform several actions that would enable them to perform a myriad of tasks in a shorter period than using the traditional method (Sydavi EMIS, 2018). Fu (2013) summarized that if technology is to be used in the integrative process, the infrastructure must be available with ample support from technicians. Fu (2013) further believes that if the support structure available in schools is high, teachers' efforts to integrate technology in their teaching will also be high. The Sydavi EMIS is gaining momentum in the schools in Antigua and Barbuda that have embraced it, and it was indicated that an internet system that is reliable and fast is needed to optimize technology in schools and this led to the introduction of Fibre Optic cables for a more effective internet service in schools.

The use of technology in schools requires an increase in reliable internet in addition to adequate hardware and software to be effective. The situation in schools in Antigua and Barbuda is like schools in other territories in the region where most technological devices require internet service that can handle the demands daily. Secondary schools in Antigua and Barbuda need reliable internet to support the Information Technology Labs, the operation of the EMIS where available, use of laptops by teachers and students for online activities and the functioning of eBooks presently in use even though the students have access to some content offline. The government of Antigua and Barbuda decided to invest in fibre optic cables to ensure that the internet service in schools is quicker than the original copper wires which were designed to

transmit only voice (Antigua Public Utilities Authority (APUA), 2018). Fibre optic internet is internet that is transmitted through special strands that are bundled together into optic cables which transmit light which can bend and transmit images, texts and sounds to the end user (APUA, 2018). Fibre optic internet is faster and more dependable than its predecessors and is being used to boost the internet service in secondary schools in Antigua and Barbuda. According to APUA (2018), fibre optic internet connection allows users to access, upload and transmit information at speeds that exceed traditional internet mediums, such as copper based DSL or cable connection.

The internet is ubiquitous, and it plays several critical roles in education to include being a good source of information, enabling communication far and near, providing an enabling environment for creativity and for providing instructions as needed Nachmias et al. (1998) cited in Dinc (2017). According to Liu (2017), the internet provides learners with what is termed web-based learning activities which may be defined in several ways. One way of learning on the internet is web-supported learning which is referred to as distributing or posting information in a face-to-face context. The internet may also be used in a web-enhanced format which provides internet resources to improve face to face learning or it may be web-delivered which is a course that is done completely online. Another consideration is that the internet may be web-enabled which supports the face-to-face courses with online activities. Dinc (2017) is of the view that the internet provides educational websites with a plethora of text-based information for use by students but that they lack pedagogical insight. On the other hand, Dinc (2017) believes that websites can be used to improve the quality of learning outcomes due to the abundance of information available, the ability to use them for assessment purposes and the instant feedback and collaboration that are linked to accessibility to the internet and websites. The advent of fibre

optics in schools in Antigua and Barbuda heralded an increase in internet connectivity and ready access for all staff and students.

The teaching of ICT is an essential component in the development of the citizens in Antigua and Barbuda. The quality of education that its citizens receive with the use of ICT for learning is critical to the economic development of Antigua and Barbuda as a small island developing state. Antigua and Barbuda have embraced ICT to propel its citizenry to becoming ideal Caribbean citizens in accordance with the vision of the Caribbean Community (CARICOM, 2019) where they are expected to function as independent and critical thinkers and use science and technology to solve problems.

ICT Initiatives for Public Secondary Education in Antigua and Barbuda

The education system of Antigua and Barbuda has an education structure that begins at the early childhood or preschool level through to primary, secondary, and tertiary levels. There are 13 private and 13 public secondary schools while primary schools are made up of approximately 40 schools for both private and public ownership. Initiatives relating to schools in Antigua and Barbuda, particularly in public educational institutions, must first be authorized by the Director of Education unless it is an initiative that is sanctioned by the Cabinet of Antigua and Barbuda which is the leading body that controls policies and coordinates the activities of various government ministries in Antigua and Barbuda (Caribbean Elections, 2021).

The educational system of Antigua and Barbuda is responsible for ensuring that its citizens have the skills and competencies required to navigate their way throughout the workforce within the country or any territory where they wish to reside. Countries prepare their citizens for globalization by using technology in all institutions of learning, which would account for the number of initiatives introducing ICTs in public secondary schools in Antigua and

Barbuda over the years. Masango et al. (2022) are of the view that readiness of a country to integrate ICTs in education is dependent primarily upon the country's willingness to integrate technology and the schools' readiness to do so. They are of the view that the process should involve all stakeholders in education to include the Government, Ministry of Education, schools' personnel including the educational leaders, teachers, students, and parents to some extent.

The role of ICTs in education is promoted by the United Nations (UN) in its 2030 Agenda for Sustainable Development (UN General Assembly, 2015) as it strives to improve the state of the nations in the world by using the Sustainable Development Goals (SDGs) as its focus. Of significance to this research is the SDG number four (4) which encourages the use of ICTs to improve access to inclusive and equitable education to provide good quality education for all. The SDG number four (4) expects countries to achieve its principles by matching the needs of the learners to the skills required for the 21st Century. According to Schwab (2016), such an achievement would require a fusion of the technologies that existed over the years to provide a product that is a combination of digital, physical, and biological structures to cater for the overall development of the learners.

Bearing the United Nations sustainable development goal number four of providing quality education in mind (UNESCO, 2017b), and the need for its citizens to be ICT ready, the government of Antigua and Barbuda has been engaged in or has permitted several ICT integration initiatives in public secondary schools over the years. In 2013, under an initiative called the Government Assisted Technology Endeavour (GATE) project, all public secondary school teachers received a laptop and reduced internet rates in their homes to encourage the use of technology in schools. Sixteen hundred laptops were distributed to public school teachers

while secondary school students received an overall total of three thousand Samsung tablets enabled with 4G LTE broadband internet connectivity with free internet in their homes from 7:00 o'clock in the morning to 7:00 o'clock in the evening during the week and a discounted rate during the evenings and on weekends (Government of Antigua and Barbuda, 2012). These devices were introduced to bring about a paradigm shift in the education system and enhance students' learning. To support the use of the devices throughout the learning environments, schools received free Wi-Fi access under an EDU2020 initiative which was the outcome of a contractual agreement between the telecommunication company LIME, and the Government. The purpose of the overall initiative was to transform student learning by creating the shift from teacher focused to student-centred teaching and learning and providing the teachers with opportunities to practice creative learner-centred pedagogies in authentic learning experiences (Mutisya, 2020).

As part of the GATE project EDU2020 initiative, training was offered to teachers in the use of information technology skills and the application of those skills in the classroom. About 150 teachers were trained in Microsoft Suite and technology integration as well as in the preparation of learning content and resources (Government of Antigua and Barbuda, 2012). Additionally, in the EDU2020 training initiative, 50 educators registered in a Commonwealth Certificate for Teacher ICT Integration (CCTI) course and 25 educators completed the training course 15 months later. It was a 'train the trainers' course with the main goal of facilitating further training of teachers to address the advancement of ICT integration in Antigua and Barbuda. The successful educators were ICT resource persons and had the responsibility of training other educators by providing mentorship through support to teachers as they navigated their way towards the implementation of ICTs into teaching and learning practices.

Other ICT initiatives followed since Antigua and Barbuda, like many other countries, embraced technology as an integral part of schools' curriculum offerings. Christensen, Eichhorn and Prestridge (2018) assert that technology supports curricula activities in ways that are engaging to support learning by ensuring that learning activities meet instructional goals. According to Ghavifekr and Rosdy (2015), ICT integration in the curricula of schools is relevant especially considering its use by many students on a day-to-day basis for learning. In such an environment, teaching and learning are technology-based and the students' familiarity with technology will contribute to effective learning with the use of ICT components (Jamieson- Procter et al., 2013). Ghavifekr and Rosdy (2015) asserted that ICT in education is crucial not only for the physical environment of the school but for learning to continue even when the teachers and students are at different locations from each other. Teaching and learning from different locations were evidenced with the advent of the Covid-19 pandemic in 2020 which resulted in the full lockdown of schools resulting in a change in modality of teaching from a face-to-face modality to one that was fully online. Teachers had to adjust the way they prepared and delivered their lessons and students had to adjust the way they learned.

In 2016, the Ministry of Education of Antigua and Barbuda embarked on an ICT initiative with the introduction of a digital learning platform with electronic interactive textbooks to public secondary schools called the eBooks Initiative (Ebook Report, 2020). According to Gakibayo et al. (2013), electronic textbooks (eBooks) are books written on subject disciplines that are available in digital format and can be used in the classroom to deliver the curriculum and for other academic purposes. Masango et al. (2019) reviewed a study in South Africa with the use of eBooks which resulted in issues concerning the adoption of the technology. The Masango team was of the view that the adoption and use of eBooks in the Gauteng province in South

Africa were slow, and the potential benefits were yet to be fully realized in select schools that experienced the paperless classroom project. The study in Gauteng revealed that the eBooks used were those that were listed on the National Curriculum Assessment Policy Statements (CAPS) catalogue which were the only authorized eBooks that were allowed to be used as core textbooks. The eBooks selection was similar in Antigua and Barbuda where the electronic textbooks used were selected by the Ministry of Education and were mandated for use by all public secondary schools.

This platform which supported the eBooks was provided by a United States based Indian company called FortunaPix and the content is accessible by laptop, tablet, or android devices. The content of the textbooks may be downloaded and stored which alleviated the need for internet when using the eBooks. The OneLern platform used for the textbooks also provided access to other services offered by the developers of the platform. The eBooks initiative was institutionalized to provide digital textbooks for students in public secondary schools as a way of integrating technology into the classroom. In addition, the initiative made it easier for students to transport several textbooks to school at any one time without the added weight of the physical books. The Ministry of Education also considered the initiative to reduce the cost of textbooks since the upgrading of the content of the eBooks would be done online rather than having to purchase new textbooks every three (3) years, which is the designated life of a physical textbook. The programme was expected to begin in a pilot format with six (6) public secondary schools but was later migrated into a public-schools pilot programme with all public secondary schools. The initiative expected that all students and teachers in public secondary schools would be provided with a device loaded with content for the 20 subjects that were digitized for the various levels.

In a technological age, the use of technology with the use of eBooks was encouraged as one of the best strategies for teaching and learning. Another idea behind the eBook initiative was to enhance the students' learning experience using technology with the textbooks on one platform (EBook Report, 2020). Many students are technologically savvy, and the use of the devices was not considered to pose a significant challenge to the students. The platform has many useful features to include the ability to administer self-grading assessments and the automatic collection of the grades for these assessments, the ability for teachers to post content for the students such as videos and links, highlight specific areas of a topic and screen sharing with teacher and students. For this initiative to work effectively, it required the involvement of all stakeholders: the Ministry of Education technicians, Board of Education (the financiers for the eBooks), school administrators, teachers, students, and Book Scheme Managers.

The eBooks initiative comprised of twenty (20) subject disciplines including the core subject disciplines of Mathematics, English, Social Studies, and Science written as digital textbooks on a platform for use by the students in public secondary schools in Antigua and Barbuda. The books were written by the platform developers content writing teams using the Caribbean Secondary Education Certificate (CSEC) syllabuses as guides with assistance from local authors. The CSEC syllabuses are used by secondary school students for the duration of their studies at the schools in preparation for exit exams which are negotiated in the last year of their tenure before their enrolment in post-secondary educational institutions. The introduction of the digitized texts was done on a phased basis with the creation of the content of some books taking longer than others because of changes to the CSEC syllabuses at the time. The transition from traditional textbooks to digitized texts was thought to be advantageous based on the goals of the government, since it catapulted public secondary schools into the realm of ICT integration

and literally reduced the weight that students would have to carry to school daily since the texts for several subjects were condensed onto the one device (EBook Report, 2020).

The digital platform developers for the eBooks in Antigua and Barbuda is the FortunaPix Incorporation which has been at the forefront of eBooks technology globally and is presently operating in several Caribbean islands. The developers provide education-specific devices to students and teachers which involves the migration from print books to eBooks along with the inclusion of a Learning Management Platform called OneLern which is used in the education process to improve students' performance. The OneLern platform presented to public secondary schools in Antigua and Barbuda was conceptualized, designed, and developed to model the way in which books are utilized by students using modern technology. The eBooks were intended to provide a learning experience where the textbooks are delivered digitally (just like an electronic book) but the content, analytics, and other tools are built in a way that the overall learning experience is interactively enhanced. The eBooks include a pedagogical flow with the way the content is packaged and involves the use of multi-sensory content (FortunaPIX, 2021). Arham et al. (2021), in a study involving 171 Malaysian students on the use of eBooks for the purpose of online learning, found that it was effective, and recorded success in improved students learning. Similarly, to what was done for the eBook's initiative in Antigua and Barbuda, the Malaysian researchers made suggestions for even greater success by recommending the creation of tutorial videos for the learners to navigate the eBooks platform.

The coronavirus pandemic has caused the learning landscape in Antigua and Barbuda to shift from face-to-face learning to a blended modality and in some cases fully online. This situation has resulted in institutions of learning implementing the use of technology to support teaching and learning in schools (Education Endowment Foundation, 2020). Remote learning

generally uses technology and requires access to computers and internet. If students are unable to acquire the technology and connectivity, then learning will not be effective (Education Endowment Foundation, 2020).

A new laptop initiative was implemented in 2021 to provide laptops for all teachers in public primary and public secondary schools and for all students in public secondary schools to enable students and teachers to function in synchronous and asynchronous teaching and learning modalities. According to the Education Endowment Foundation (2020), students can learn during remote learning, but it is important for the elements of effective teaching such as clear explanations, scaffolding, and feedback to be present. Since May 2020, the Covid-19 pandemic resulted in all schools in Antigua and Barbuda resorting to a mixed modality of learning with a combination of remote learning and face to face learning when the epidemiological situation allowed for that to happen. Alternatively, the country has had two total shutdowns which resulted in full remote learning for all schools. Full or partial remote learning demands that all students and teachers have access to the relevant technology for learning to take place. In 2016, with the launch of the eBook's initiative, students in public secondary schools were issued with devices which contained their textbooks in digital format but in 2021, students were issued with laptops on which to house their textbooks and apps related to their learning. Additionally, the teachers were issued with laptops loaded with the textbooks on the OneLern pedagogical platform which was designed to improve instruction with the textbooks available offline in the event of remote learning (Ministry of Education, 2021).

Further, in the year 2020, with the arrival of the Covid-19 pandemic and the inevitable move towards remote learning, the Ministry of Education embarked on a programme to train every educational leader, teacher, student, and parents on the use of Google Classroom to be

used for teaching and learning during the remote learning period. Google Classroom is a platform that is designed to create a space for teachers and students to interact with a variety of learning tools in multiple classrooms (Google Classroom, 2021). Each teacher and student were provided with a google classroom identification email and password for access to Google classroom from anywhere on any device, giving the students and teachers some amount of flexibility in their engagements. Having trained every principal, teacher, student, and several parents on the use of google classroom, the Ministry of Education was more prepared for remote learning in terms of the learning space but still had the challenge of providing connectivity for students and teachers in their respective communities if the Google classroom is to be effective during remote learning.

Antigua and Barbuda is a twin island state with Antigua being the more developed main island and Barbuda being a smaller more underdeveloped island. There is one secondary school in Barbuda which is public and the resources in Antigua are expected to be equivalent to those in Barbuda. Barbuda, however, has an internet infrastructure which does not perform optimally and often prevents staff and students from being an active part of online activities especially remote learning since connectivity is limited. As a result, teaching and learning in Barbuda using technology requiring internet support is often compromised. The Aptus initiative was introduced as a solution to the internet connectivity issues in Barbuda in 2021. The Aptus technology is a system geared towards making mobile learning viable with no connectivity and teachers and students can access information for teaching and learning with any mobile device that has wireless capabilities. As part of the introductory measure for Barbuda, training for instruction using Aptus was done, learning resources were designed and content uploaded to Aptus to provide resources for teaching and learning (Aptus Training Document, 2021). Barbudan

teachers were trained to use Open Education Resource materials, Khan Academy and Storyboard to plan lessons so that learning will be optimized. Two (2) major benefits of the Aptus device, according to Balaji et al. (2015), is that it is relatively inexpensive, and the teachers can control what content students are able to access.

Dei (2018) is of the view that the use of ICTs provides educators and students with opportunities to learn how to function in an information and communication technology age. Dei (2018) further postulates that school curricula must change to include technology, and educators need to focus on new methods of teaching using technology rather than the traditional methods of teaching. Castro-Sanchez and Aleman (2011) are of the view that students who learn using ICT are better able to use data and information and can recognize the quality of the learning materials that they wish to use. The researchers believe that ICTs should therefore feature prominently in curricula to help promote the development of well-rounded citizens within the educational system.

Smart Learning Environment (SLE) and ICT Integration in the Curriculum

Considering the aim of the government of Antigua and Barbuda to enable its citizens to become technologically enriched and be able to work in workplaces that are technologically enabled, schools must be prepared to be the breeding grounds for those 21st Century citizens. The country sought to achieve its goal by creating Smart Learning Environments (SLE) for its learners to function using ICTs, thereby improving their quality of life, and creating sustainability for the country (García-Tudela et al., 2020). It was the belief of the government that the school environment should reflect a move away from the traditional classrooms where students were only exposed to learning within the four walls to a ‘classroom’ where the mode of learning was either synchronous or asynchronous. Bautista and Borges (2013) cautioned that a

SLE should not be confused with a traditional classroom that is equipped with many technological devices while following a traditional methodology. Bautista and his team are of the view that smart environments should revolve around discussions concerning the innovative roles the teachers will play, the new roles of students, the types of content taught, the resources to be used and the progress made in the teaching engagement in the classroom.

According to Zhu et al. (2016), the concept of SLE refers to an educational paradigm where the 21st Century competencies are emphasized by engaging learners in Technology Enhanced Learning (TEL) with the use of technological devices such as mobile devices, artificial intelligence, the internet, and other technological developments as parts of the learning environment. According to Amin et al. (2018), smart classrooms may form part of the Technology Enhanced Learning environment and are centred around technology-based actions that support teaching and learning that are more meaningful. In a smart classroom, learning is augmented by technology, including computers, software that is specialized, systems for audience response, listening devices for special needs individuals, networking, and audio and viewing capabilities. The smart class is an innovative way to transform conventional teaching and learning into student-centred learning using technology (Baby & Chellamani, 2018).

The smart learning environment saw the use of technology shifting over the years from a chalk and board to a classroom where information is projected using the multimedia mechanism to one with a classroom layout that is fixed and unified with enhanced didactic pedagogy, but according to Yang et al. (2018), teachers' technological pedagogy knowledge is usually lacking and is often observed through the absence of student-centeredness which is a requirement for independent learning. Huang et al. (2012) define a smart classroom as one that consists of a physical learning environment that enables teaching content distribution, class management,

access to educational resources, and instructional interaction, all coupled with contextual awareness. Although the definition of a smart learning environment focused on some aspects of pedagogy, Bautista and Borges (2013) are of the view that pedagogical changes are not fully taken into consideration to make learning effective. The Organization for Economic Co-operation and Development (OECD) (2015) surmised that countries that invested large sums of money in computers and classroom technologies did not show improvement in the performance of students. Yang et al. (2018) agreed with the need for more than the presence of technology alone in the classroom by purporting that access to the internet and digital resources for each student in a smart learning environment are vital for improving learning but equally important is pedagogical fit which is a key component for teaching and learning in a smart learning environment.

Curriculum development should align with the needs and current demands of a society and the expectations of a country which are purported to be the best ways to be successful in an educational program (Alsubaie, 2016). Similarly, curricula in Antigua and Barbuda are developed based on the needs of the society and should reflect the integration of technology in all subject disciplines in keeping with the ICT related goals of the country. As with many countries around the globe, curricula in Antigua and Barbuda are not static and are revised every five to seven years to address the changes that may be necessary as the needs of the country are addressed. As the country moves towards achieving the goal of preparing its citizenry to fit seamlessly into the global society with the necessary 21st Century skills and competencies, the process must start in schools and ICTs must be reflected in the National Curricula. Gomathi (2020) shows agreement with the need for ICTs to be in the curricula of schools by stating that if

ICT integration is to be sustainable, digital literacy components should be seen in the curricula of schools and ICT should be integrated into the various subject disciplines in schools.

ICT integration involves implementing changes that affect what educators teach and is reflected in the curricula of schools (UNESCO, 2017). Curricula are not static and IG Global (2018) maintains that the degree of ICT integration in education is observed in school curricula change and affects how teaching and learning are conducted in schools. The level of ICT integration in schools is dependent upon the school environment including the available infrastructure, motivation and acceptance by educational leaders and teachers and the pedagogical knowledge of the teachers (IG Global, 2018). Kurian and Ramanathan (2016) is of the view that it is important for teachers to be competent in the use of ICT for its integration in the curricula to be successful. Behar and Mishra (2015) opined that ICT integration fails when the focus is more on technology tools rather than on the educators and their pedagogical use of the technology.

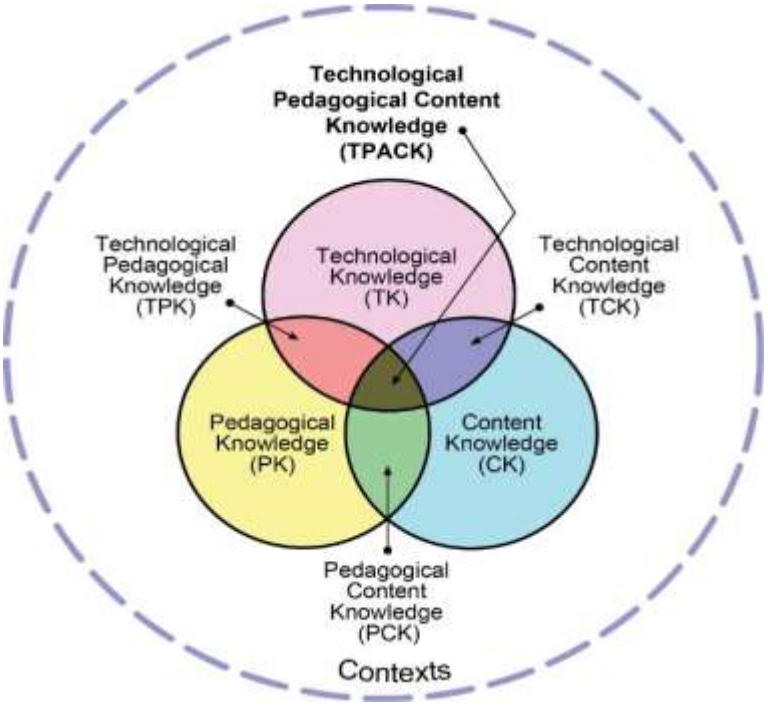
In a historical comparative analysis study of ICT integration in schools between Turkey and Singapore, Cetin and Solmaz (2017) concluded that ICT integration is important but will prove more beneficial and effective when it fulfils the needs of the students by its use as a supplementary resource for instruction. The findings of the Turkey and Singapore study also revealed that before integrating ICTs into schools, it is important to ascertain the aims, goals, and outcomes of the initiative at the commencement of the implementation process and assess the previous projects to determine the strong and weak aspects of the project to inform the new initiative. Most importantly, according to Cetin and Solmaz (2017), in planning the implementation process, focus should be on incorporating ICTs in all subject areas for the

learning and instruction process rather than on the students' abilities to use the technological devices.

There are many models which guide an ICT integration process in the curricula of schools, but they differ in terms of how they examine the effects of a wide range of environmental and external factors such as equipment, management of resources, infrastructural development, technology, government policies and cultural constituents, as well as personal characteristics such as attitude, belief, intention, skill, and perception (Akcil et al., 2021). The model that relates to this research is the Technological Pedagogical Content Knowledge (TPACK) model which describes the elements of effective implementation and provides a step-by-step approach in the implementation process (Akcil et al., 2021). The TPACK model according to Mishra and Koehler (2006) outlines the basic knowledge that teachers need when teaching using technology and knowledge that is required for the teaching of technology at the level of classroom delivery. A teacher's understanding of pedagogy, technology and content is necessary to ensure an effective delivery of discipline-based technology enhanced teaching of the curriculum (Mishra & Koehler, 2006). It is significant to note that for ICT integration in curriculum content to be effective, teachers must be proficient in the three (3) areas that make up the TPACK Model as can be seen in Figure 1. For quality and efficiency to be maintained in the physical classroom and in online classes. It is critical that teachers are positioned in the green area displayed in the chart in Figure 1 which indicates teacher competency in the key areas of teaching and learning with technology.

Figure 1

Technological Pedagogical Content Knowledge Model (TPACK)



Source: Adapted from Mishra and Koehler (2006)

The TPACK model expects educators to have technical knowledge and content knowledge which are known together as Technological Content Knowledge (TCK), as well as pedagogical knowledge and content knowledge known as Pedagogical Content Knowledge (PCK) and technological and pedagogical knowledge known as the Technological Pedagogical Knowledge (TPK). The TPACK model revolves around teachers having sound knowledge of the three areas which is supported by Padmavathi (2016) who postulated that ICTs may be used to access and manipulate content (TCK) and provide some understanding of the way in which

technology may be used to enhance learning (which relates to TPK used in combination with PCK). Padmavathi (2016) further supports the use of ICTs as a model for curriculum design by indicating that it is a framework in which the three (3) components may be used effectively to teach subject matter or content by negotiating the relationships between them.

Research studies indicate that teachers using technical skills along with computers is not enough for teaching to be effective; it is felt that they must redesign and use teaching strategies involving the combination of technology, content knowledge and pedagogy to build 21st century skills (Padmavathi, 2016). Further, the curriculum should provide opportunities to teach using technology in a practical way and teachers should strive to infuse technology in an effective way that promotes learning. Haddadian et al. (2013) proffer that adding ICT components to existing curricula has been known to extend learning and elevate the rate of student learning but Latchem (2013) cautions that due to the dynamic nature of technology, teachers must be wary about implementing new initiatives without thinking about maximizing their implementation, the problems that may arise and the sustainability of the initiatives.

The integration of ICTs in the national curricula in Antigua and Barbuda became even more critical because of the coronavirus pandemic since alternatives to learning in the traditional teacher-centred physical classroom became increasingly important at all age levels (Stahl, 2021) as the country was shut down and schools went into full remote learning. The abrupt move to online learning meant that teachers had to move from a face-to-face modality with a curriculum related to chalk and chalkboard in some cases and digital whiteboard for teaching and learning, to one involving the use of ICT devices such as laptops, smart phones, and tablets to teach using apps like zoom, google classroom, google meet, WhatsApp, and Edmodo. In Antigua and Barbuda, the move to online modality revealed issues to include inequality in devices available

for use by teachers and students, little or no access to the internet and in some cases lack of training in online teaching for several teachers. According to Shaikh and Algannawar (2019) and Hamzeh (2014), ICT and education are deeply linked and would require an active classroom, good teaching skills and the use of modern technology for it to be effective.

The narrative of smart classroom is also relevant and appropriate for students with special educational needs. Kaur et al. (2022) is of the view that a tailored approach to education may help all learners, but smart classrooms are more important for students who may need special education assistance. Kaur and his team suggest that the use of technology in the classroom provides teachers with the opportunity to cater to the individual needs for all students whether they may be because of learning difficulties, neurodivergence issues, attention deficit disorder, mobility disabilities, or mental-health difficulties. A smart classroom according to Kaur et al. (2022), is a classroom that is made up of various components that work together to provide an interactive and engaging learning environment that enhances teaching strategies, develops students' abilities, improves their academic level, and allows them to engage more actively in the learning process. The smart learning environment will assist in improving learning for all students.

ICTs can revolutionize teaching practices once they are implemented into the curricula of schools with purpose and proper support structures, and they will produce benefits that are relevant and specific to the learners such as enriched learning opportunities, learning diversities, appreciation for life, autonomy, independence, and after school preparations which reflect intellectual expressiveness and lifelong learning (Livingstone, 2019). It is therefore necessary to provide education and support from all stakeholders to ensure that ICT programmes are implemented successfully and that students are prepared for life.

Hindrances to Effective ICT Integration into Core Curricula Content Design

ICTs are influential tools to effect educational change and reform in many societies (Fu, 2013). The unitary state of Antigua and Barbuda is no different and has had many ICT integration attempts in education over the years. Although the reason for integration is to provide students with more enhanced learning opportunities, it provides an avenue for students to avail themselves of the information, skills, and competencies which they need to live normal lives (Aydin & Gurol, 2019). Research has shown that the integration of ICTs in education is a complex phenomenon with many hindrances that have impacted their use over the years. Fu (2013) elucidated that those hindrances may be at different levels of the education system including the teacher level, student level, administrative level and at the ICT infrastructure level.

Research studies have reported the value of using ICTs for educational reform and the enhancement of student learning (Hew & Brush, 2007; Fu, 2013) but a critical factor in their use is the teachers' positive beliefs in ICTs in education since that will determine the students' access to the learning environment (Hong, 2016; Singhavi & Basargekar, 2019). According to Singhavi and Basargekar (2019), the teacher's role in an ICT enabled class changes from that of an ICT user to an ICT leader. In such an environment, the pedagogical delivery in the classroom moves from being teacher-centric to student-centric. If teachers are unwilling to implement ICTs in the curriculum, the students will not be given the opportunity to practice using them in the classroom (Hong, 2016). The technological knowledge of a teacher is a major predictor of the integration of ICTs in teaching (Amuko et al., 2015), and evidence indicates that teachers who presented neutral or negative attitudes towards the integration of ICTs in the curricula lacked the knowledge and skills required to implement such a practice (Bordbar, 2010). The competence of

teachers and their attitudes towards integrating emerging technologies in their teaching and learning are critical to the success of ICT integration (Ayub et al., 2012).

Hong (2016) further highlights the critical role that teachers play in the ICT integration process by noting that the mindsets of teachers must change to ones that embrace technology if learning with ICT in their classes is to be effective. Saxena (2017) on the other hand, is of the view that teacher attitude alone is not a barrier to integrating ICTs in the curriculum. Saxena feels that the integration process is highly influenced by the technical and pedagogical support and scaffolding available to the teacher when an attempt at integration is made. Saxena (2017) suggested that support and scaffolding may be manifested through access to available technologies and their failure rates, the training opportunities presented to teachers and the philosophy of the school as it relates to integration as well as the application of technology in the school.

Teachers' knowledge and experience may also act as a hindrance to effective ICT Integration in curricula (Saxena, 2017). According to Oblinger and Oblinger (2005) cited in Saxena (2017), many teachers were born before the year 1980 when technology and the use of the internet became a part of the school environment, so their acquisition of the knowledge, skills and competencies required to use ICTs effectively in teaching would have to be learnt from the ground up. If teachers do not have the technical background and they are expected to integrate technology into their teaching and achieve mastery or some amount of proficiency in the process, the effectiveness of the process will be compromised (Saxena, 2017). Additionally, teachers who may be competent in their core subjects and formally trained in instructional technology may have little knowledge on how they could incorporate that knowledge into their curricula design and teaching practice (Hardy, 2003). To achieve successful ICT integration, teachers must be

trained to understand how the technology works as well as how to be effective when integrating ICT in their teaching (Markauskaite, 2007). Kafyulilo et al. (2015) are of the view that pedagogical training is critical since it was ascertained that the confidence of teachers who participate in pertinent ICT professional training courses is positively boosted when they engage with technology in their classrooms.

In schools where ICTs are integrated into the core curricula, students are also affected by hindrances that may hamper their use of technology for learning (Fu, 2013). Teachers' attitude towards integrating ICTs in schools may impact the students' attitudes towards ICTs which may affect the effectiveness of the effort (Saxena, 2017). It is important for teachers in schools to have a positive attitude towards ICT use to successfully incorporate the technology into the school curriculum and utilize it during teaching and learning ((Buabeng-Andoh, 2012). Research indicates that teachers fear that ICTs may replace them in the classroom and as a result are reluctant to embrace them (Shawa, 2020). Mohammed et al. (2018) dispelled the fear of technology replacing teachers by stating that technology cannot be used to replace the teacher in the classroom since the human element is still needed to address educational challenges that children face. ICTs are beneficial to the education system since they provide teachers and students with the opportunity to learn new things and develop new ways of teaching and learning (Dei, 2018; Qaddumi et al., 2021). Additionally, teachers may perceive ICTs in education as impacting negatively on students in schools since the borderless access to education may provide learners with access to morally inappropriate, harmful, and abusive materials (Lim, 2022). This may cause teachers to develop a lack of appreciation for the benefits of ICTs for teaching and learning which may make them reluctant to integrate them in their classes (Alkahtani, 2017; Mafuraga & Moremi, 2017).

Frederick et al. (2006) found that other challenges affected students using ICTs in schools to include those with special needs, student mobility and anxiety experienced with the results of standardized tests. Students may also be negatively impacted by limitations in technical skills that may cause reduced access to ICTs in the classroom, lack of real time feedback from teachers and reduced interaction with teachers and fellow students (Whelan, 2008). Another negative impact of ICTs in education, according to Lim (2022), is that instead of encouraging students to conduct critical research and deepening their knowledge of the subject content, some students may resort to copying and pasting too much information from the online sources which may lead to academic misconduct and plagiarism. Lim (2022) is of the view that to avoid such situations, teachers and students would need to be trained on the ethical use of technology.

Although teacher factors are significant hindrances to ICT integration, inadequate resources such as infrastructure, support training, technical support, administrative support, and time also negatively impact the integration process (Amuko et al., 2015; Fu, 2013). While ICT in the curricula of schools may be seen as cost effective because one teacher could reach many students via the internet, white board, or other multimedia (Aguyo, 2010), the overall cost of acquiring hardware and software and upgrading and maintaining the infrastructure could prove to be very costly (Twinomujuni, 2011 cited in Francis et al., 2017). ICT integration into the core curricula of schools has been hindered by the infrastructural and facility issues of the schools (Ghavifekr & Rosdy, 2015) and research has shown that a key factor hindering the use of ICTs in the curricula of schools is insufficient technology equipment and lack of ICT labs (Ghavifekr & Rosdy, 2015; Fu, 2013). Investing in ICTs for schools may be an additional cost but the cost required for supporting ICT implementation is considered a major problem and a barrier for many schools especially in developing countries (Laaria, 2013).

As schools strive to effectively integrate ICTs into the core curricula content design of schools, a major issue that often emerges is the poor correlation between the availability of funds to purchase the technologies and the price of the technologies that are available on the market (Johnson et al., 2011). To compound the issue, the digital technologies advance at a rapid rate and curricula development evolves at a slower pace but teachers are expected to keep abreast of the emerging technologies as they emerge and schools are not financially able to provide the resources needed (Johnson et al., 2011). Additionally, the lack of support from top management of schools for teachers to integrate ICTs in their classes may also prevent integration into the curricula of schools (Ghavifekr & Rosdy, 2015).

Summary

Information and Communication Technology has transformed the landscape of teaching and learning from one that is traditional in nature with the teacher being the focus of the teaching and learning process and transmitting knowledge to the students, to one that is more student-centred or radical constructivist in nature where the students are engaged in independent learning using critical thinking skills to arrive at an understanding of the world in which they live (Xu et al., 2018). Dei (2018) supports this view by claiming that ICTs in schools provide opportunities for educators and learners to operate in an information technology era with curricula change and new methodologies being the focus in schools.

Antigua and Barbuda endorsed the need for ICTs to be an integral part of the core curricula of public secondary schools to facilitate the creation of citizens that are regionally and globally adaptable and accepted. To achieve this goal, several technological initiatives have been introduced into public secondary schools over the years to include the one tablet per child and one laptop per teacher initiative, electronic textbooks and the most recent initiative which is

one laptop per teacher and student along with affiliated community initiatives such as community access centres and free internet in homes. An Information Technology policy was created in 2003 and updated in 2013 to guide the integration process but the efficacy of the ICT initiatives is yet to be determined hence the reason for this research. The ICT initiatives are indicative of the country's understanding and acceptance of the value of ICTs to be integrated in the curricula to promote optimum learning (Livingstone, 2019).

The literature abounds with information on the improvement of learning when ICTs are integrated into the curricula of schools and according to Livingstone (2019), their use can revolutionize the delivery of education, stimulate pedagogical activities, encourage the engagement of learners, cater for their individual needs, and add to the quality of their lives. Further, the design and development of curricula incorporate technological learning tools and resources to foster creativity and lifelong learning in the students (Livingstone, 2019). Gomathi (2020) is of the view that ICT integration into the curricula should be sustainable and should show evidence of digital literacy components in the various subjects in school and be an integral part of all pedagogical activities. UNESCO (2017) acknowledges that curricula are dynamic and should reflect changes in teaching and learning if ICTs are introduced in schools. UNESCO further purports that the curricula of schools are critical sources to examine for serious attempts at ICT integration and an examination of the syllabuses for core curricula used in public secondary schools in Antigua and Barbuda provided pertinent information to answer Research Question one (1) for this research. The document review of the core syllabuses provided evidence to determine the acceptance of technology and use of ICTs for teaching and learning.

There are many studies which show that technology-based teaching with teachers engaging in pedagogical delivery of content is more effective than the traditional teaching

(Ghavifekr & Rosdy, 2015), and the classroom with the emerging technologies has been heralded with the creation of an active learning environment that is more effective for the educator and the learners than the traditional classroom (Xu & Shi, 2018). Further, it is purported that ICT in the classroom helps in classroom management since students tend to be attentive and focused on tasks (Ghavifekr & Rosdy, 2015). Research has shown that the integration of ICTs in the curricula of schools is faced with many challenges, and to ensure that it is effective, there must be proper planning of the implementation process with support by the management of the school (Ghavifekr & Rosdy, 2015). Technology integration in schools will result in huge success and benefits both for teachers and students if it is systematically implemented from the beginning stage and ongoing maintenance is adequately provided (Ghavifekr & Rosdy, 2015). To promote effective learning as well as to meet 21st century teaching skills, it is necessary for teachers to be literate and have good skills and knowledge when it comes to using ICT. One of the key areas to address the problem of the research was to determine if ICTs were used for teaching and learning since the ICT initiatives introduced in public secondary schools in Antigua and Barbuda were done at the secondary level. The critical aspect relating to use by teachers was addressed by examining the ICT knowledge of teachers and their use of ICTs for pedagogical activities. It was noted however, that the literature focused primarily on developed countries that have access to resources to assist in the integration process but provided little or no information on developing countries and the challenges they face in integrating ICTs in the classroom.

The literature is replete with information on the benefits of integrating ICTs into curricula and the need for ICTs in curricula to be evaluated to determine their efficacy as they relate to teaching and learning, as well as to inform similar initiatives which may follow (Rehan et al., 2019). Assessment of the integration of ICT in the curricula includes finding evidence of ICT

components in the curricula, assessing the way teaching and learning are done, ascertaining that there is proper technological infrastructure, determining teachers' knowledge of content and the pedagogy of teaching and acceptance of the integration by educational leaders and teachers (IG Global, 2018). The consensus in many ICT studies is that successful ICT integration requires the involvement of policy makers, educational leaders, teachers, students, and other stakeholders who form part of the education system (Fu, 2013).

While the literature is rich with information regarding the use of ICTs in schools to improve teaching and learning, there are also hindrances to ICT integration in schools which must be borne in mind if integration is being planned. Alkahtani (2017) and Mafuraga and Moremi (2017) suggested barriers to ICT integration that may include fear of change which mainly affects teachers who feel secure in what they have been doing for years and are reluctant to try something new for fear of failure. In some cases, there is inadequate time for planning of new strategies involving the use of ICTs for instruction, and when attempted, teachers lack the confidence to execute the plans due mainly to lack of knowledge of ICTs. Additionally, the literature addressed teachers lack of pedagogical knowledge of ICTs for teaching as a significant hindrance. According to Livingstone (2019), just having the technological tools alone is not enough to improve learning but knowing how to use them pedagogically for instruction will reap positive results in student learning. Lack of accessibility to ICTs was also noted as a barrier for ICT integration (Alkahtani, 2017), and poor or lack of internet connectivity was a major barrier named in many research studies (Dei, 2018). The review of literature also revealed that technical support is critical if ICTs are to be effectively integrated in the curricula of schools (Saxena, 2017). Further, Dei (2018) is of the view that a successful ICT integration requires clear policy direction at all levels with acceptance from all stakeholders.

This critical literature review examined and discussed the facets of the integration of ICTs in the core curricula design of public secondary schools in Antigua and Barbuda. It was important to determine the theoretical frameworks that best addressed the significance and purpose of the research and the three (3) theoretical frameworks selected included (1) The Theory of Change which signals the need to be clear regarding the assumptions about a project involving change so that they are used to guide the planning, implementation and evaluation of the programme (Reinholz & Andrews, 2020); (2) The Unified Theory of Acceptance and Use of Technology (UTAUT) Framework which addresses four (4) variables needed to determine acceptance and adoption of technology to include performance expectancy, effort expectancy, social influence and facilitating conditions (Venkatesh et al., 2003); and (3) the Technological Pedagogical and Content Knowledge (TPACK) Framework which shows the connection between teachers knowledge of content, pedagogy and technology and the way they interrelate with each other for effective teaching (Koehler et al., 2013).

The literature reviews also involved searching existing literature for ICT themes that were relevant to this research. The concept of Technology Integration in Education was reviewed to determine what is technology, the processes and the current trends involved in integration ICTs in education. It was revealed that ICT integration in education is trending in many countries across the globe with the intention of preparing the students with ICT knowledge and skills necessary for life. It was also noted that students engaged in learning using ICTs were best taught in student-centred classrooms where they are responsible for their own learning as purported by the radical constructivist theory.

Another area of interest in the review of literature was the emerging ICTs for curricula content design in the 21st Century classroom. This search revealed classrooms where teachers

moved away from being the givers of knowledge to perform the role of facilitators who make learning engaging and meaningful for the learners. The thrust of this aspect of the literature was for teachers to use ICTs pedagogically to improve learning rather than just using technology as a utility tool for the purpose of making charts and other manipulatives, or just for communication purposes and other functions.

This research relates to an assessment of ICTs into the core curricula of public secondary schools in Antigua and Barbuda, so it was necessary to examine the current trends of ICT integration as well as the ICT initiatives that have been initiated in Antigua and Barbuda to determine how they compare to current trends in literature. Existing literature identifies several ICT initiatives that have been implemented in schools with varying degrees of success. It was revealed however, that significant to the successful implementation of ICT initiatives in schools is the need to have sound policy directives, acceptance and adoption of stakeholders, adequate resources, training, and evaluation of programmes to guide future initiatives. One key gap identified in the literature is the approach that small island developing states would be expected to use for successful integration of ICTs in the curricula of schools considering the limited resources that are available. The findings of this research would provide data on challenges faced by small developing countries in the ICT integration process and possible ways in which they may be overcome.

The search of literature was extended to include what constitutes a smart learning environment and the role that ICTs would play in the curricula in such an environment. This search revealed the need for adequate ICT resources and the necessary training of teachers in the use of technology for effective integration of ICTs in the curricula. The smart learning environment revealed a paradigm where 21st Century competencies were employed in the

classroom using technology and it was revealed that if those competencies are not well established and the technologies are not current, the integration process would be compromised. The research also required an examination of the learning environments in schools to determine their ICT smartness and provide an idea of the hindrances or barriers that have impacted ICT integration in schools. The literature was clear that for ICT integration in schools to be successful, the schools' environments must be ICT ready with the presence of the necessary hardware, software and ICT infrastructure that are critical for learning.

The literature also identified contradictions to the claim that ICTs can improve learning. Lim (2022) and Kachakova (2020) are of the view that ICTs can establish unethical practices in students rather than improve learning. Students have been known to practice academic misconduct by plagiarizing other people's work and there is evidence of diminished mental arithmetic and literacy skills because of using technology (Tiilikainen, 2018). According to Kachakova (2020), technology in schools offers a myriad of opportunities to improve learning but its success depends on its use.

The review of the existing literature makes it clear that ICT integration in the curricula of schools provides opportunities to improve teaching and learning. ICT integration in the curricula of schools should be a well planned and executed process guided by a clear policy which requires the involvement of key personnel in the process to include school administration, teachers, and students (Dei, 2018). The literature is clear that it is important to assess ICT initiatives to determine their effectiveness before implementing further initiatives. The results of the evaluations of existing initiatives should be used to provide guidance for future ICT initiatives for them to be successful. This research assessed the integration of ICTs in the curricula of public secondary schools in Antigua and Barbuda and the findings revealed the

status of the integration and what should be done to make the process more effective. The findings of this research will be added to existing literature about ICT integration for developing countries like Antigua and Barbuda, the rest of the Caribbean and other developing countries worldwide for which there is a paucity of information on ICT integration. Additionally, the findings will provide pertinent information that can assist other territories in the region that may be thinking of engaging in ICT integration in their secondary schools.

CHAPTER 3: RESEARCH METHOD

Introduction

Over the years, several attempts have been made to integrate ICTs into the core curricula content of public secondary schools in Antigua and Barbuda with the goal of improving the learning performance of students. The government is of the view that the technology will encourage the students to be motivated to learn and work independently and would make it easier for teachers to teach. The problem being investigated by this research surrounds the situation that there is lack of evidence to show that ICT integration initiatives in the core curricula of public secondary schools in Antigua and Barbuda have been effective, and there is also lack of evidence to demonstrate that evaluations have been conducted to determine their effectiveness in relation to the way teachers teach and the way students learn. The situation is that ICT integration initiatives in the core curricula of public secondary schools in Antigua and Barbuda are yet to be evaluated to determine the extent of the integration and their effectiveness in teaching and learning. If ICT integration initiatives are to be continued, they must be data driven with data derived from past initiatives else countries will face the consequences of poorly implemented processes (Rehan et al., 2019).

The research focused on public secondary schools to arrive at answers for the research questions since all ICT initiatives in Antigua and Barbuda to date have been implemented in public secondary schools. It is the researcher's belief that the information gleaned from the research will provide data relating to ICT integration in core curricula of public secondary schools in Antigua and Barbuda and would assist the rest of the Caribbean region and beyond in their efforts at integration since it is the goal of most territories in the region to improve the performance of students through the infusion of ICT in the curricula content of schools

(CARICOM, 2019). The findings derived from the research will add to existing literature and provide a framework for further ICT integration initiatives in schools in Antigua and Barbuda, the Caribbean region and for developing countries in other parts of the world. This section of the research acquired data that was attained using a combination of methods which provided greater scope to investigate the issues and offered a more in-depth look at various aspects of the research phenomenon rather than restricting it to only one method (Almalki, 2016). It was felt that no one approach would have been able to satisfy the breadth and depth of the research phenomenon and as a result, the mixed method approach was selected. To effectively address the various aspects of the research, the sequential explanatory design was used to collect data to inform the research. Priority was given to the quantitative data collected and analysed from the teacher and students' questionnaires and these were used to inform the secondary qualitative data collection process from interviews, observations, and document reviews (Wambugu & Njoroge, 2021).

This chapter addressed the mixed method approach which uses a combination of qualitative and quantitative methods to collect data since one method alone would not be adequate to cover the depth of the research. The qualitative methods placed the researcher in the heart of the phenomenon and gave insight by interacting with the situation on the ground. Quantitative methods collect data that are scientific in nature and would complement the data collected using the qualitative method. The research design was sequential in nature with the data collected from the quantitative methods used to inform the qualitative methods thereby ensuring that data not captured in the quantitative process are addressed in the qualitative data collection process. The sequential explanatory design was selected to ensure that the research adequately addressed the problem being investigated.

The chapter expounds on the population and sample of the research which included teachers, students, and educational leaders from public secondary schools in Antigua and Barbuda, since they are the users of the technology. The research sought students of the core curricula from Forms two (2) to four (4) since all students are mandated to pursue Mathematics and English and most students pursue Biology and Social Studies at those levels. Additionally, the ICT initiatives introduced so far have been implemented in public secondary schools hence the reason for their selection for data collection.

Data was collected from educational leaders, teachers, and students and through document reviews. The instruments used to collect data from teachers and students were questionnaires adapted with consent from a pre-designed tool designed by Hogarty et al. (2003b), while data for observation, document reviews and interviews were collected using self- designed observation schedule, document analysis schedule and interview schedule. The chapter also addresses the ethical principles that governed the conduct of the study, outlining the permissions and consents sought and received to conduct the research.

The final section of this chapter focused on the data collection and analysis processes of the research. The principles related to the trustworthiness of data were addressed to include credibility, transferability, dependability and confirmability. In addition, this section of the research also focused on the reliability and validity of data. The chapter outlined the step-by-step procedures used in the data collection process and expounded on the analyses of the data collected based on the alignment to the research questions. Quantitative data were analysed utilizing frequency and percentage tables with Excel as the main tool used. Additionally, the hypotheses for the research were tested using the ANOVA test using the Excel programme. The qualitative data collected were first recorded and reread, coded, then themed. The interviews

were recorded and replayed several times to ensure that the data were accurately recorded for analysis. The quantitative and qualitative methods were chosen to provide complementarity of data, and the findings were triangulated to show convergence or divergence to arrive at the results.

Research Approach and Design

An assessment of the Integration of ICTs into the Core Curricula of public secondary schools in Antigua and Barbuda requires an in-depth look at every aspect of the integrative process so that meaning is realized, and conclusions drawn about the situation. The scope of the research was related to the paradigm of pragmatism which is "pluralistic and oriented towards what works and practice" (Creswell & Plano Clark, 2011, p. 41). Pragmatism uses a combination of methods to achieve research objectives guided by research problems (Dawadi et al., 2021). According to Feilzer (2010), a pragmatic philosophy seeks to help the researcher find answers to what needs to be known based on the research questions. This research adopted a pluralistic stance to conduct the study since it provides an opportunity to capture and examine data from different perspectives to arrive at the findings. It supports complementarity and generalisability of the data which is the objective of the research. The pluralistic approach was used to gather data to best answer the research questions by using a combination of research tools such as interviews, observations, and document reviews to gather qualitative data to understand the phenomenon under review and explain what is happening in the situation (Dawadi et al., 2021). Additionally, some data were collected quantitatively by using questionnaires through the adaptation of an existing survey tool for teachers entitled 'Perceptions of Computer and Technology Research Tool' (Hogarty et al., 2003b). Aspects of the survey by Hogarty et al. (2003b) were also adapted for the students' questionnaire to collect quantitative data which is

supported by the views of the positivists who believe that scientific statements are objective in nature and form the main thrust of scientists (Bryman, 2012). This research employed a combination of methods to provide answers to the research questions to provide complementarity in an ethical manner (Bryman, 2012; Creswell, 2015). This therefore means that a mixed method approach was used to gather data for various aspects of the research.

Creswell and Plano Clark (2011) defined a mixed method approach as one that is based on philosophical beliefs that guide the collection and analysis of data from several sources in one study. Further, the mixed method approach provides the opportunity to widen the inquiry with enough breadth and depth to provide a detailed view of the meaning of the situation or phenomenon under investigation (Dawadi et al., 2021), especially when data is collected from both open-ended qualitative and closed-ended quantitative sources (Creswell, 2003). According to Dawadi et al. (2021), qualitative approaches assist in understanding a situation through results that are indicative by using explorative measures while quantitative approaches are used to derive findings that are objective in nature.

Wambugu and Njoroge (2021) are of the view that it is best to use a mixed method approach when collecting data and have given justifications for the combination of the qualitative and quantitative data to arrive at the findings of the research. Wambugu and Njoroge also purport that the narratives and pictures derived from qualitative research provide meanings to numbers, and the numbers provided by quantitative research add exactitude to the narratives and pictures provided. Further, the researchers are also of the view that the mixed method approach provides stronger evidence to arrive at conclusions and recommendations especially when there is convergence and corroboration of the findings through triangulation.

According to Greene et al. (1989), triangulation is encouraged with the mixed method approach which provides the opportunity to converge results and corroborate what was collected from different methods to arrive at a conclusion. According to the researchers, the mixed method approach provides an opportunity for complementarity to take place where results from one method are elaborated, clarified, and enhanced with results from another method. Further, Greene et al. (1989) advocate that development of that form of research is based on using the results of one method to supplement another method which ensures that all aspects of the inquiry are covered. Shorten and Smith (2017) sum up the value of employing the mixed method as a suitable method to use for this research by indicating that it allows for purposeful data consolidation which gives the researcher an extensive view of the study by making it possible to look at the phenomenon under study from different perspectives and through varied research lenses.

The qualitative method was selected as one of the methods to conduct this research since it is inductive in nature and places emphasis on exploring and understanding a phenomenon (Creswell, 2014) and the data collected provide content that though subjective in nature is considered current (Tracey, 2013). Enosh et al. (2014) purport that the qualitative approach provides greater clarity on the phenomenon being addressed by questioning and listening to the participants. The data collected by using the qualitative instruments placed the researcher in the heart of the phenomenon so that the expressions and body languages were observed which added greater meaning to the data. Some research questions in this research required the assessment and analyses of factors which were obtained from respondents who function within the environment of the phenomenon. The qualitative methods of collecting data for this research included conducting interviews with educational leaders or principals to determine the

administrative and infrastructural support for ICTs at the school level and to determine the conduciveness of the schools' environment for ICT integration as well as to identify the hindrances or barriers affecting ICT integration in the schools (Research Question 5); observation of teachers and students in core curricula classes to determine the extent to which ICTs are used by teachers and students in schools on a regular basis (Research Questions 2, 3 and 4); and the examination of core curricula documents for evidence of ICT integration in the curricula used in the selected forms (Research Question 1). The data collected from document reviews, observations and interviews were qualitative in nature and were combined with data from the quantitative method to create meanings and draw conclusions about ICT integration in core curricula of public secondary schools in Antigua and Barbuda.

The quantitative approach, on the other hand, is the traditional form of research for which data is numerical and collected from many participants which embodies objectivity and science (Enosh et al., 2014). Questionnaires were used in this research to provide data on what currently exists for the phenomenon through several closed-ended questions that addressed teachers' confidence and comfortability in using ICTs and the extent of use of ICTs in the classroom (Research Question 2). The questionnaires also addressed the challenges in the schools' environments which militate against integrating ICTs in the core curricula of schools (Research Question 5). One research question required a review of curricula documents to determine if ICT components are embedded and the extent to which they are integrated (Research Question 1) and another question required an examination of the ICT knowledge of teachers and its influence on the use of ICT components for pedagogical activities (Research Question 3), while another question sought to determine the use of ICTs by students for core-curricula learning activities (Research Question 4). Collecting data for the research questions provided a level of

understanding of the ICT integration process initiated in public secondary schools in Antigua and Barbuda and their influence on the teaching and learning process.

The research design selected is one that can effectively foster a greater understanding of ICT integration in the core curricula of public secondary schools in Antigua and Barbuda. It therefore required an inquiry into several aspects of the operation of schools relating to the integration of ICTs to include reviews of existing core curricula, observations of classroom practice, perceptions of school leadership, school infrastructure and other protocols to determine the status of the integration process. A combination of research methods was realized to collect meaningful data and render purposeful data consolidation to arrive at a better understanding of the area being researched (Dawadi et al., 2021). It was important from the outset of this research to select a methodology that would provide valid and reliable results, and it was determined that a mixed method approach would ensure that data are collected within the various contexts of the research to make the results generalizable (Wipulanusat et al., 2020). Additionally, the use of multiple data collection tools by combining quantitative and qualitative methodologies would ensure adequate exploration of the research problem and minimize bias that may be inherent in research which applies a single approach (Creswell, 2014).

The research design used for this research was the sequential explanatory design which is described by Almalki (2016) as a two-stage design with quantitative data collected to be used as the basis on which to build the qualitative data. In that design, data collected from the quantitative tool informed the qualitative data collection process which according to Almalki (2016) provided an advantage to the researcher in selecting the data that is relevant to the specific research. The other option considered for this research was the concurrent design in which the quantitative and qualitative research methods are conducted concurrently which

according to Creswell (2014), is characterized by the quantitative and qualitative data collected and analysed at approximately the same time. The concurrent design was not selected for this research on the basis that it creates limitations since it does not provide an opportunity to collect data that would not have been captured by the quantitative tools during the data collection process. Further, the concurrent design does not provide the opportunity for follow-up on data collected within the given time frame. Creswell and Plano-Clark (2018) are of the view that in using sequential explanatory research design, the researcher is in a better position which begins with the post positivist assumption to select the data collection tools required for quantitative research and then moves to a constructivist assumption which drives qualitative research to derive a deeper understanding of the data. The rational for selecting the sequential explanatory design was that it provided a sequenced approach with the methods for data collection and analyses which offered an effective means of obtaining answers for the research questions (Wipulanusat et al., 2020). The research design required the quantitative data collection and analyses to be done first to provide a general understanding of the issues being investigated which was then further explained by the qualitative phase of the research which explored participants views in greater depth (Wipulanusat et al., 2020).

Based on the protocol for the sequential explanatory design for research, the adapted, reliable, and validated teacher questionnaire was issued online to the randomly selected teachers of core curricula for forms two (2) to four (4) in public secondary schools for completion upon receipt of the signed informed consent forms by the researcher. The adapted student questionnaire was tested for validity and reliability and once the guardian consent forms were returned to the researcher, the links for the instrument were issued online to the simple randomly selected students pursuing the core curricula in forms two (2) to four (4) for completion. Those

students whose guardians completed the guardian informed consent forms but did not complete the online version of the questionnaire, were issued with paper-based questionnaires for completion. Data from the questionnaires informed the qualitative research tools to provide data for areas that were not fully addressed in the questionnaires.

Almalki (2016) purports that the mixed method approach provides a link between quantitative and qualitative studies which is realistic especially for the researcher of the phenomenon. The current research required the examination of various aspects of the secondary education system which would not have been fully investigated with only one method. To ensure that the research process was thorough, this research accepted the advice of Almalki (2016) who advocates for a research approach that provides more clarity on the educational issue being investigated through the mixed method approach.

Population and Sample of the Research Study

In conducting this research, a mixed method approach was used to gather data. Questionnaires, interviews, observations, and examination of documentation provided data on ICT integration in the core curricula of public secondary schools. The research employed sound ethical principles in the use of human population as samples in the general conduct of the research. In addition to the adult samples comprising educational leaders and teachers, the research engaged students who were between the ages of 11 to 18 years old which required guardian consent from parents or guardian as well as permissions from the Antigua and Barbuda Institutional Review Board (ABIRB) and the Director of Education.

The research collected data from students pursuing the core subjects of Mathematics, English, Science (Biology) and Social Sciences (Social Studies) in Forms two (2) to four (4) of public secondary schools as well as from teachers of those subjects in the same forms. Since

Science and Social Sciences both refer to a cluster of subjects, the researcher selected the most popular subject in each cluster to use in the research. The selection of the specific subjects from the clusters was based on comparative data from the Ministry of Education CSEC Statistics (2022) relating to the number of candidates that sat the exit exams in specific subjects for the last three (3) years. Data was also collected via interviews from the educational leaders of the public secondary schools under review, from the observation of teaching practices and from the reviews of schools' curricula for the core subjects for the specified levels of the schools.

The focus of the study was the middle forms of public secondary schools since those students would have been entrenched in the functioning of the schools for at least two (2) to four (4) years. The form one classes in public schools were not selected for the research since the students' tenure at secondary schools would have been less than one year and they are usually not the primary recipients of any ICT initiatives that have been introduced at the schools. Form 5 students were also not selected as part of the study since all core subject areas are not compulsory at that level. Forms two (2) to four (4) classes were selected since it is mandatory that all students in public secondary schools do the core subjects of Mathematics and English at all levels in secondary schools. Science and Social Sciences, on the other hand, usually form part of the cluster of subjects pursued by at least 95% of the students for the exit exams for the Caribbean Secondary Certificate of Education (CSEC) hence the reason for selecting Biology and Social Studies (Ministry of Education CSEC Statistics, 2022). The teacher population was selected on the basis that the teachers instruct classes in one or more core subject areas to students at the Forms two (2) to four (4) levels.

The sample frame of the research comprised a population of approximately 350 teachers of core subjects in Forms 2 to 4 who are adults over 18 years old and approximately 2,700 public

secondary school students who pursue core subjects in Forms 2 to 4 from 10 public secondary schools. The teachers and students of Form 2 to Form 4 represented that section of the schools' population that have benefited from ICT initiatives in schools over the years. Form 1 is comprised of new students in secondary schools and are usually the last group to benefit from ICT initiatives unless otherwise specified by the benefactors. Form 5 students seldom benefit from those new ICT initiatives that require long-term use and interaction since that level represents the final stage of secondary schooling and the students may be in school for the first term comprising 15 weeks, the second term comprising 13 weeks and part of the third term for six (6) of the 11 weeks in the final term of the school year. Form five (5) students leave the school system early in the third term to proceed on study leave in preparation for exit exams which usually begin in May of the said year. The selected population of students in Forms two (2) to four (4) would have benefitted from at least two (2) ICT initiatives in the last six (6) years. The penultimate ICT initiative included the eBook textbook initiative which began in 2016 with each student and teacher provided with a tablet device loaded with the content 20 of the subjects being pursued in secondary schools. The eBooks tablets were replaced by a more recent initiative of one laptop per person (teachers and students) which took place in the year 2021 to allow teachers and students online and offline access to textbook content and other relevant information during the Covid-19 pandemic.

The sample of teachers were those in the teacher population for 10 public secondary schools who taught at least one of the core subjects of English, Mathematics, Biology and Social Studies at the Forms 2 to 4 levels and the student sample represented those students enrolled at the Forms 2 to 4 levels and were engaged in pursuing the core subjects. Teachers and students were selected using simple random probability sampling for the quantitative aspect of the

research which utilized an existing questionnaire designed by Hogarty et al. (2003b) which was adapted with permission for use with the teachers based on the objectives of the research. The questionnaire for the students was also adapted from the Hogarty et al. (2003b) instrument to capture data specific to ICT use by the students based on the objectives of this research. The teacher sample was selected using simple random sampling based on the number of core subject teachers at each school, ensuring that at least 10 teachers were selected from each school if the total number of teachers based on the selected criteria permitted that number. Some schools are small and have a relatively small number of teachers at the selected levels so in cases where the number of teachers at the target levels was small, less teachers were selected from the pool to ensure that the sample was representative of the population. This suggests that the sample size of teachers from each school may be less than 10 based on the size of the school and the number of teachers teaching the core subject areas at the specified levels. Students of core subjects at the various levels were also selected for the sample using simple random sampling by choosing every fifth student on the list of students at the specified levels. It must be noted that sample size of students at some schools was less than anticipated based on the size of the student population at the specific levels in the schools.

The researcher opted to use the Raosoft Sample Calculator (2004) to calculate the sample sizes for the teachers and students. The sample size for the approximately 2700 student population with a 90 percent confidence level and a six (6) percent margin of error with a 50 percent distribution was calculated as 176 students. The research expected to collect data from 10 schools with an average of 17 students in each school. It must be noted that the number of students in the sample who responded to the questionnaire was 163 students which represented 93 percent of the total responses required and was a significant representation of the population.

The sample size for the 350 teachers using a 90 percent confidence level with a six (6) percent margin of error and a 50 percent distribution was calculated at 123 teachers which represents the minimum recommended sample size for the research. An average of twelve (12) teachers from each school was anticipated to be engaged to provide the required data. It must be noted however, that the actual number of teachers in the sample who responded to the questionnaire was 115 teachers which represented 93 percent of the total responses earmarked for response but was considered representative of the population. The Raosoft Sample Calculator (2004) suggests a 50% response distribution which gives the largest possible sample size for the research to ensure that the results are not skewed. It must be noted however, that the population of teachers and students at some schools was less than expected due to the rural locations which mitigated to some extent the enrolment in those schools. During the period of this research, student population was also slightly reduced since some parents opted to home-school their children due to the Covid-19 pandemic. This resulted in a student sample size that was smaller than anticipated which would account for 163 students rather than the calculated 176 students. The research considered the actual sample sizes for the teachers and students as representative of the population. Please see Table 2 for the sample size configuration for the research.

Table 2

Sample Size Configuration

Category	Target Population	Raosoft (2004) Calculation (90% confidence level, 6% margin of error, 50% distribution) Sample Size	Actual Sample Size	Sample Type
Teachers	350	123	115	Simple random sampling. Considered representative.
Students	2700	176	163	Simple random sampling. Considered representative.
Education Leaders	10	Not applicable	8	Non-probability Purposive expert sampling.
Observed Classes	6 schools	Not applicable	18 classes	Simple random sampling of classes

Ten (10) educational leaders for public secondary schools were the population to provide data from interviews using the non-probability sampling technique of purposive sampling since the population of school leaders in the research was finite and the leaders were typical in relation to their duties and responsibilities at the public secondary schools. The research sampled eight (8) educational leaders since a point of saturation was detected when the responses of the leaders mirrored the responses given by the previous educational leaders. An interview protocol for educational leaders was designed with seven (7) open ended questions which related to a number of factors to include the number of years the leader was in the leadership position, training in ICTs received by the leaders if any, perceptions held by leaders about ICT integration in their

schools, perceptions of their roles in ICT integration, the support given to teachers in ICT integration and the barriers, hindrances or challenges that they perceived prevented effective ICT integration in their schools. The interview schedule was validated by a principal of a private secondary school since he would not form part of the sample for public school leaders.

Probability sampling was also used for the selection of classes for the observation of practice in accordance with the pragmatic approach. Observations of classroom practices were conducted within six (6) of the 10 secondary schools in the population. The schools for the observation of classroom practice were selected using simple random sampling by placing the name of each school on individually folded paper in a bag and selecting six (6) schools from the bag. Classroom practices were observed in three (3) classes, one (1) at each level in any of the four (4) core areas at each school to determine if ICTs were used in practice and to ascertain if they identified with what is documented in the curricula. A total of 18 classroom practices were observed. The schools were numbered for confidentiality and ethical purposes. See Table 3 for classes observed.

Table 3

Classes Observed in Observation of Practice

Schools	**Classes Observed**		
1	Form 2 Maths	Form 3 English	Form 4 Social Studies
2	Form 2 English	Form 3 Biology	Form 4 Maths
3	Form 2 Social Studies	Form 3 Biology	Form 4 English
4	Form 2 English	Form 3 Maths	Form 4 Social Studies
5	Form 2 Maths	Form 3 Social Studies	Form 4 Biology
6	Form 2 Social Studies	Form 3 English	Form 4 Biology

An observation protocol detailing the ICTs used during each lesson, the purpose or use of ICTs in the lesson, students' use of ICTs for independent learning and solving problems during the lesson, and teachers' assignment of homework involving the use of ICTs were used for the activity. Additionally, the components of ICTs identified in the lessons for each subject area were documented. The observations made were recorded in writing, coded, themed, and interpreted to determine the use of ICT components in each lesson from which generalizations were drawn (Lofgren, 2013).

To gather data on the integration of ICTs in the core curricula content design, the core curricula for Forms two (2) to four (4) of public secondary schools were examined for evidence of ICT components. Curricula in Antigua and Barbuda are designed using a spiral approach for all subject areas with the content becoming more complex as the students are promoted into higher levels in the schools. The goal of the process is for students to successfully complete the learning outcomes at each level thereby meeting the required standards to successfully negotiate the Caribbean Secondary Examinations Certificate (CSEC) exit examinations which are negotiated at the Form 5 level. The national core curricula for public secondary schools in Antigua and Barbuda are created from the Caribbean Examinations Council (CXC) Syllabuses and are used by all schools. The documents reviewed for this research were the CXC syllabuses for Mathematics, English, Social Studies, and Biology. It must be noted that the findings of the analyses as they relate to the ICT components present in the core curricula should be commensurate with teaching and learning in all public secondary schools since they follow the same curricula. The document review process entailed an examination of the curriculum for each of the core areas at the three (3) form levels, the identification of embedded ICT components, the creation of codes from the information noted and the categorization of information pertinent to

the research in themes to conceptualize the data (Lofgren, 2013). The document review protocol for the core curricula review employed a Likert-type scale with options ranging from one (1) which indicates 'Not at all' to five (5) which indicates 'Entirely' as it relates to the ICT components embedded in the curricula for English, Mathematics, Biology and Social Studies.

Materials/Instrumentation of Research Tools

The focus of the research was to assess the integration of ICTs in the core curricula of public secondary schools in Antigua and Barbuda which required an in-depth review of every facet of ICT use in schools for teaching and learning. The mixed method approach was used, and quantitative and qualitative methods were employed to collect data from teachers, students, and educational leaders, and through observations and documents review.

The research employed two (2) questionnaires with close ended questions administered to teachers and students. One of the main advantages of questionnaires is the ability to contact and gather data from a relatively large number of people in various locations, and questionnaires are typically used in surveys, where the objective is to be generalisable about the population. (Rowley, 2014). Questionnaires are mostly used in quantitative research, where the researcher wants to profile the sample in terms of numbers such as the age groups, gender or to be able to count the frequency of occurrence of opinions, attitudes, experiences, processes, behaviours, or predictions (Rowley, 2014). Additionally, questionnaires are generally answered by many individuals within a given time frame, and the data gathered may therefore be seen to generate findings that are more generalisable. (Rowley, 2014). One of the limitations of using questionnaires is that the researcher will never be sure whether the respondents have understood the questions, or whether they have taken the time to provide data that is accurate (Rowley,

2014). Another limitation of the questionnaire as a tool is that questionnaires issued online are either incomplete or not done at all by the respondents as was noted with this research.

Interviews were conducted with educational leaders to provide greater insight into what happens at school regarding ICT integration. Interviews provide greater clarity on some areas of interest in the questionnaires that required further details. According to Rowley (2014), interviews are preferable to questionnaires when it is possible to identify people who are in key positions to understand a situation. An observation schedule was used to obtain data about classroom practice for the research. In addition, the core curricula of public secondary schools were analysed through document reviews.

Questionnaire for Teachers

An existing tool entitled *Perceptions of Computers and Technology Instrument* by Hogarty et al. (2003b), was selected by the researcher as a tool that would capture the data required to determine the ICT knowledge level of teachers and their use in schools (pedagogical use and other uses), the confidence and comfortability they have regarding use of technology, the administrative or school support received, and the level of integration in the classroom. The section of the existing research tool relating to 'Technical Support' was not used since the present protocol regarding technical support in public secondary schools does not provide for on-site technical support specialists to address technical issues. Technical issues are either addressed by teachers at the schools who have knowledge of troubleshooting or by personnel from the Ministry of Information when contacted by the Ministry of Education who would have received the report from the schools.

Permission was sought and received from the developers of the questionnaire to use the instrument as part of this research. The designers of the instrument cited that the major purpose

for developing the tool was to create a validated tool to provide the data necessary to glean greater insight in the use of technology in the classroom by teachers and students (Hogarty et al., 2003a). According to the designers, the sample used for the validation process of the existing research tool consisted of 2,000 active teachers with the use of factor analytic and correlational methods to acquire evidence of validity of the scores that were derived from the responses given for the tool (Hogarty et al., 2003a). Of significance to the development of the existing document was the examination of the indicators necessary for successfully integrating ICTs into the classroom and the domains that were used in the final instrument which were basically in tandem with the domains needed for this research. The main thrust of this research is to assess the integration of ICTs in the curricula of schools and according to Hogarty et al. (2003a), the domain of integration of the instrument focused on the teaching methods used by the teachers and the degree to which they used computers and the emerging technology in the classroom. Livingstone (2019) signalled the value of integration as a major component in student engagement in schools.

The adjusted research tool for teachers in this research was validated by five (5) teachers in private secondary schools who were not part of the population for this research. The validation process required minor adjustments to the structure of statements specifically relating to the use of the word ‘computers’ instead of ‘ICTs’ and they were rectified. The validated questionnaire was administered online using the government issued emails of teachers since it provided a more formal approach for the administration of the questionnaire.

Questionnaire for Students

A few research tools were examined to ascertain their suitability for the current research and Hogarty, Lang, and Kromrey (2003b) was the most aligned tool. The researcher opted to

adapt a section of the Hogarty et al. (2003b) tool related to ICT use by learners for the student questionnaire. The purpose of the questionnaire was to determine the knowledge level of students in the use of ICTs and the frequency of their use for learning at school and at home for school-related matters. The tool was adapted to also capture data on the ICT support that students received at school and to garner the students' views on the use of ICTs by their teachers to teach the core subject areas. The instrument was also critical to capture data on the demographics of the students in the schools engaged in the research. There are 14 elements covering use of ICTs by students to include training in the use of ICTs, access to ICTs, use of ICTs for classwork, homework, and research, whether ICTs are used in core areas of study, if they learn when using ICTs, their feelings about ICTs being part of all subjects, their perceptions about their teachers' knowledge about ICTs and the role of the school leaders in encouraging them to use ICTs.

The student questionnaire adapted for this study used the dimensions of 'Confidence and Comfort Using Computers' and 'General School Support' as seen in Hogarty et al. (2003b, p. 2) which relate to an individual's confidence and comfortability in using technology to complete tasks and the support which is received at school when using technology. The final instrument comprised 14 statements with responses arranged on a 5-point Likert-type frequency scale which ranged from 'Not at all' to 'Entirely'.

Private schools were not engaged in the current research so testing of the adapted research instrument for reliability and validity was done with students who are in Forms 2 to 4 at a private secondary school. The purpose of the pilot was explained to the principal of the private secondary school. Permission was sought and received from the principal of the private school to pilot the tool. The pilot testing was done with 10 students in the private secondary school with similar demographics to those in public secondary schools since the current research focuses on

students in public secondary schools. The responses for the pilot were used to determine the reliability and validity of the document and for no other purpose.

Interview Schedule for Educational Leaders

Interviews were conducted with educational leaders to delve deeper into the administrative support and infrastructure at schools in relation to the use of ICTs. The interview schedule according to Thomas (2013) and Yin (2016), is a broad inquiry into the issues that a researcher wishes to explore to prompt detailed information from respondents. It is a qualitative instrument that was used to gather data on the value of ICTs in the operation of public secondary schools and to gain insight into the extent to which technology has been supported and encouraged. In addition, the interview sought to establish the challenges or hindrances which militated against the use of ICTs in schools.

Knowing that an interview protocol serves the purpose of providing a mental framework for the researcher while collecting data (Yin, 2016), an interview protocol was developed with seven (7) open ended questions to guide the interview process with educational leaders via zoom. Areas of focus included the number of years the leader has been a principal generally and specifically at that school; an indication of any training received in the use of ICTs for learning; perception of ICT integration in the school; the perception of their role in the integration of ICT in their schools; support given to teachers to promote ICT integration; and possible hindrances, challenges, or barriers to effective ICT integration in the curricula of schools. Educational leaders were asked to complete the Informed Consent Form before the interviews were conducted. In addition, a pilot interview was done with the principal of a private secondary school to verify the reliability of the tool. Permission was sought from the educational leaders to record the interviews with the promise of anonymity and confidentiality. The recordings were

used to enhance the accuracy of transcriptions and create codes and themes so that the information was accurately interpreted.

Observation Schedule for Classroom Practice

The qualitative aspect of the research employed observations of classroom practice to determine the use of ICTs in teaching and learning. An observation checklist protocol for classroom practice was developed with five (5) key areas to observe using a 5-point Likert scale to capture the use of ICT components reflected in each lesson with options ranging from 'Not at all' to 'Entirely'. It must be noted that the recording of the data for the observation schedule followed a pattern regarding the number of times the teachers used ICTs in the class with 'Not at all' represented by zero (0), 'Small Extent' represented by one (1), 'Moderate Extent' represented by two (2), 'Great Extent' represented by three (3) and 'Entirely' represented four (4) or more. The areas of focus included the teachers' use of ICTs throughout the lesson to teach concepts; teachers' use of ICTs for consolidation of concepts; students use of ICTs for independent learning; students use of ICTs during the lesson to solve problems; and teachers' assignments of homework involving the use of ICTs. As each lesson progressed, the researcher took note of the ICT components used in the lessons from which codes and themes were formulated for interpretation of the results. The observation schedule was used with 18 core curricula classes, three (3) classes in each of six (6) schools at the specified levels and three (3) classes per school represented the average number of classes at each form level in public secondary schools. In this selection, any core area was observed for classroom practice, but the researcher ensured that only the classes of those teachers who have signed the informed consent forms were observed in the observation of practice.

Core Curricula Review

To gather data on the pedagogical integration of ICTs in the core curricula content design, the core curricula for forms two (2) to four (4) of public secondary schools were examined for evidence of ICT components. The national core curricula for the country are utilized by all public secondary schools in Antigua and Barbuda which were formulated by the Ministry of Education based on the Caribbean Examinations Council (CXC) syllabuses for the various core subjects. It is important to note that the national curricula and CXC syllabuses are public documents which are available online. A document review protocol for curricula review was developed with five (5) key areas to identify ICT components in the curricula employing a 5-point Likert-type scale with options which ranged from 'Not at all' to 'Entirely'. Important to note is that the record of the data for the core curricula review followed a pattern with the number of ICT components identified being recorded as 'Not at all' represented by zero (0), 'Small Extent' represented by one (1), 'Moderate Extent' represented by two (2), 'Great Extent' represented by three (3) and 'Entirely' represented four (4) or more components. The document review protocol for core curricula entailed documenting the number of ICT components that were present in the learning outcomes, methodologies, or suggested strategies in the core curricula documents for Mathematics, English, Biology and Social Studies and coding them so that interpretations may be made, and conclusions drawn.

Operational Definition of Variables

Operational definitions were created from variables for them to be measurable (Laerd, 2012) and according to Kerlinger and Lee. (2000, p. 43), they "give definition and meanings to a variable." Furlong et al. (2000) is of the view that researchers must be careful to select operational definitions of variables and measurements that measure what they intend to study.

Slife et al. (2016) expounded on the need for operational definitions to be justified by indicating that knowing how they are formulated and implemented would be critical in the rationalization process of the research.

This research focused on the assessment of the integration of ICTs in the core curricula of public secondary schools in Antigua and Barbuda, and the operational definitions were critical to the research by the details provided for the measurement of data collected and the clear and detailed definition that eliminates ambiguity. Operational definitions are used for measurement purposes, specifying in detail the action that the research will employ to measure the construct (Slife et al., 2016).

Construct: Information and Communication Technology (ICT)

"ICT is the use of technology in managing and processing information with the use of electronic computer system and computer software to convert, store, protect, process, transmit and retrieve information" (Dei, 2018, p. 2). This definition dissects ICT into the measurable constructs of technology especially as it relates to the use of the computer and other ICT devices which assist in executing technological functions in the classroom. IMPICT (2012) adds to the operational definition of ICTs by stating that they involve the process of gathering, generating, processing, and storing information by using hardware, software, the internet, and the global system of mobile communication. Public secondary school teachers and students were equipped with laptop computers to execute their duties and it is significant to note that most participants may refer to ICTs as computers, laptops, digital tablets, and cell phones. Information and Communication Technology is one of the main variables in this research which is necessary for any technological integration process in schools, and it may be measured using laptops, desktop computers, tablets, cell phones, multimedia projectors, televisions, radios, and any device which

uses technology in its operation. In the analysis of the data from questionnaires in this research, indication of the use of ICTs for teaching and learning was measured by converting the data into percentages with the following indicators used as guides: 'limited extent' is represented by 0-25 percent use; 'small extent' is represented by 26-50 percent use; 'moderate extent' represented by 51-75 percent use and to a 'great extent' is represented by 76-100 percent use. Information and Communication Technology forms an integral part of the dependent variable in this research and was used to test the hypotheses of the research with the independent variables of 'ICT knowledge of teachers' and 'Confidence and Comfortability of teachers in using ICTs in the core curricula of schools.

Construct: Core Curricula

In reference to this research, core curricula refer to those subject areas that are mandated for all students (Mathematics and English) and those subjects that most students in secondary schools pursue at the secondary levels of the education system (Social Studies and Science). The operational definition of core curricula subjects for this research are Mathematics, English, Social Studies, and Science (Biology) which are pursued at the secondary level (Ministry of Education Curriculum Policy, Antigua and Barbuda, 2015) and are measurable by the ICTs used for their delivery in schools. The analysis of the data received from the questionnaires and core curricula documents were calculated based on the number of teachers who use ICTs in schools for instruction and for learning. Use of ICTs in core curricula instruction were assessed as a *limited extent* when represented by 0-25 percent; *small extent* when represented by 26-50 percent; *moderate extent* represented by 51-75 percent and *great extent* when represented by 76- 100 percent. Worthy of note is that in Antigua and Barbuda, the CSEC Syllabuses are used for the teaching of the core curricula subjects in secondary schools. The hypotheses of the research

were tested using the dependent variable of 'Integration of ICTs' and the independent variables of 'ICT knowledge of teachers' and 'Confidence and Comfortability of teachers in using ICTs in the core curricula of schools. Core curricula was used as the base for the testing of the hypotheses.

Construct: Technology Integration

Technology integration is the process of making technology easily available and accessible in schools to foster teaching and learning (Wheeler et al., 2000), especially as it relates to the incorporation of ICTs in schools. Technology Integration is a construct that is measurable by the process of manipulating technological tools and services for instruction in schools, such as use of computer systems, mobile phones, multimedia tools, and access to the internet for learning, as well as being a part of the educational environment which includes the ICT changes made to the curriculum as well as to educational facilities (ERIC, 2001). Technology integration in this research were measured by the percentage use by teachers for pedagogical purposes based on responses in the teachers' questionnaire, by students for learning in the students' questionnaire and the percentage use by educational leaders for administrative and other school- related purposes indicated in the interviews. Use of ICTs in this research were assessed as a '*limited extent'* represented by 0-25 percent; *'small extent'* represented by 26-50 percent; '*moderate extent'* represented by 51-75 percent and '*great extent'* represented by 76-100 percent. Technology integration forms the basis of this research and was a major factor in testing the stated hypotheses.

Study Procedures and Ethical Assurances

The current research relates to the assessment of ICT integration into the core curricula of public secondary schools and entails collecting data from several sources within the schools'

population. Before any attempt was made to collect data, the researcher sought and received permission from the Unicaf University Research Ethics Committee (UREC). See Appendix A. Additionally, any activity that involves the use of schools in Antigua and Barbuda would have to be approved by the Director of Education. In keeping with the required protocol, the researcher wrote a letter to the Director of Education requesting permission to conduct the study in public secondary schools and approval was granted. See appendix A. Permission was also sought and received from the Antigua and Barbuda Institutional Review Board (ABIRB) to conduct the research especially since it involved participants under 18 years old. See Appendix A. The ABIRB requested the proposal of the study and the proposed research tools that would be used to engage the participants for their consideration before permission was given.

According to Hope (2015), ethics are ideals that guide an individual's actions that are considered right, and Unicaf Lecture Notes on Research Ethics defines ethics in research as the process of using the correct rules of conduct when doing research. In conducting any research, data may be collected from the participants and once this interaction is expected to happen, the treatment metered out to the respondents must be taken into consideration. Oliver (2010) purports that from the start of the design process, much thought must be given to the nature of the research sample and the methodology that will be used. This process involved interactions with several individuals to gather data which in turn may pose potential ethical issues if the correct process is not followed. The present research involved the use of educational leaders, students and teachers as respondents who supplied data to provide knowledge to explain the phenomenon under review. The protection of the respondents in this situation is explained in the Unicaf Lecture Notes on Research Ethics which states that research ethics ensure that human beings and their data and rights are well protected. The research must be respectful of the

respondents and protect them from harm, distress, disadvantage, and anxiety (Hope, 2015; Unicaf Lecture Notes on Research Ethics). Additionally, the participants had to be fully cognizant of the roles that they were required to play in the research as well as fully understand what their roles entailed. This full disclosure is what is referred to as 'Informed Consent' according to Unicaf Lecture Notes on Research Ethics.

Ethical issues relating to human subjects in research should be addressed when conducting research especially when it may be considered harmful to the participants. Ngozwana (2018) considers research ethics to be morally acceptable conduct that avoids any harm to the participants in research which may be realized using informed consent, the possibility of withdrawing at any time, anonymity, and confidentiality. This research followed several steps to ensure that the ethical principles in research were incorporated in the process. Prior to the collection of data, permissions were sought and received from UREC, ABIRB and the Director of Education to conduct the research. A letter of intent was issued to the Education Officer responsible for secondary schools informing her of the research and what it entails. The Education officer then issued an email to principals of public secondary schools informing them of the pending research and requested their assistance in accommodating the research. The researcher subsequently met with the principals in separate face-to-face meetings to give the background to the research and to solicit their assistance in the process. The researcher requested the lists of teachers and students pursuing the core subjects in Forms two (2) to four (4) from each school to facilitate the simple random selection of teachers and students in each school. Separate meetings were also held with the teachers and students' populations of the 10 public secondary schools that indicated their desire to participate in the research to give the background to the research and to outline their participation in the process.

Once the simple random selection process was completed, the selected teachers and students were informed of their rights to withdraw from the research at any time without consequences and were given the assurance that their responses will be treated with confidentiality and anonymity. The consent forms also outlined the requirements of their participation and gave the assurance of confidentiality and anonymity. The participants were then asked for their verbal consents after which they were issued with the informed consent forms and guardian informed consent forms respectively. The educational leaders were also issued with informed consent forms for their roles in the interview process. In any research project, it is important that the researcher gains the consent of the participants who must be aware of the research and what it entails (Unicaf Lecture Notes on Research Ethics). The participants must be fully informed about the nature of the research and must fully understand the part that they will play in the conduct of the research. In the research under review, however, it was imperative that the participants be made aware of the aims of the research and what they were expected to do without being deceived.

Once the forms were collected, the Informed Consent Forms were numbered and labelled with the name of the school, (for example, Teacher 1 IBW) to align them to their schools specifically for feedback purposes. The same process was done for the Guardian Informed Consent forms with the forms labelled with numbers to denote students as well as the names of the schools strictly for identification purposes. The questionnaires were administered online for COVID-19 safety reasons through the government issued emails which were linked only to the researcher for data collection and analyses purposes. Teachers and students who completed their consent forms but did not complete the online questionnaires were called into separate meetings at their schools where hard copy questionnaires were administered for completion and then

collected by the researcher immediately after. The number of questionnaires anticipated for each group fell below the number required for the research, so another appeal was made to those teachers and students in the sample who did not respond. The process resulted in a total of 115 teachers and 163 students. All physical questionnaires, consent forms, document analyses records, interview records and observation of practice records were stored in a secure filing cabinet with access available only to the researcher.

Ethical Assurances

The research sought to collect data from participants using several instruments to include a teacher questionnaire, student questionnaire, interview schedule for educational leaders and an observation protocol for teachers in practice. Hope (2015) claims that even though the purpose of the research might serve a greater good, the method or means used to collect data must be ethically sound and avoid harm on the participants by ensuring that there is no evidence of disturbance, intrusion, secrecy, embarrassment, lowering of self-esteem and resentment. The aim of the research was to gather data to determine if ICT integration was being used to drive teaching and learning for the improvement of student performance, but the way the research was conducted would require that the respondents be fully knowledgeable about the research and give their consent (Unicaf Lecture Notes on Research Ethics).

The teacher questionnaire employed confidentiality and anonymity for the participants by providing them first with verbal assurance that their names will not be mentioned in any way. Additionally, the teachers were issued with Informed consent forms to be completed and returned as an added layer of assurance of declaration of the process since the introductory section of the form also reiterated the promise of confidentiality and anonymity. As a follow up, the teachers were given an outline of the survey process and were made aware that they were

free to discontinue the process at any time without consequences. The teachers were asked for their verbal consent upon the return of the signed Informed Consent forms, and once received, they were sent the link for the questionnaire via their government issued emails. The completed questionnaires were submitted to the researcher's personal email and were only accessible to the researcher. Teachers who did not complete the online questionnaires were given paper copies issued and collected by the researcher at their respective schools.

The students' questionnaire engaged respondents under the age of 18 years and stringent ethical principles were also employed to ensure the confidentiality and anonymity of the participants. To begin the process, students were identified using simple random sampling and once determined, they were apprised of the study and the role they were expected to play in the process. This was followed by the issuance of Guardian Informed Consent Forms for them to take to their parents who were required to sign before the students were allowed to complete the questionnaire. Upon receipt of the signed Guardian Informed Consent Forms, the students were verbally asked for their consent and once given, they were provided with the link to the questionnaire via their government-issued emails. The completed questionnaires were submitted to the researcher's personal email and were only accessible to the researcher. Students who did not complete the online questionnaires were issued with paper copies of the questionnaires by the researcher and collected by the researcher at their respective schools with permission by the schools' principals.

The interviews with educational leaders were done after the questionnaires for teachers and students were completed. In accordance with the sequential explanatory design, the data from the questionnaires were used to inform the qualitative data collection processes such as the interviews and observation of practices as stated by Wambugu et al. (2021). To organize for the

interviews, the educational leaders were asked to indicate their time schedules so that the appropriate arrangements could have been made for the interviews. Interview schedule was used with educational leaders to gather data on their perceptions of the integration of ICTs in the core curricula of their schools. The educational leaders were selected using non-probability sampling technique of purposive sampling as experts. The leaders were apprised of their participation in the research and the roles they would play in the process. Apart from that, they would have received the Gatekeeper Letters at the start of the data collection process since they were integral to the data collection processes surrounding the research at the respective schools. Verbal consent to participate was also received from the educational leaders followed by the Informed Consent Form which they were required to sign to indicate formal consent of their participation. At the start of each interview, the researcher requested permission to record the process so that the details were available for transcription purposes only and the promise was made to the school leaders that the information will not be shared with anyone. Further, the researcher reiterated that they may stop the process at any time if they so desired.

Classroom observations were also used to collect data on the presence of ICT integration in the classroom practices of core subject teachers. Classroom observation is a natural part of the monitoring and evaluation processes of schools by the Ministry of Education and the researcher opted to observe those classes for teachers who had given consent to participate in the research. To begin the selection process for the observation of practice, the names of the 10 schools used in the research were placed in a bag and six (6) schools were selected based on the requirements of the research. The randomly selected teachers for each school who were used for the questionnaire were given pseudo labels and were placed in six (6) separate bags, and three (3) teachers were selected from each bag using simple random sampling. The 18 teachers were

observed for the observation of practice. To ensure that ethical principles were followed, the researcher did not record or videotape any of the lessons observed. The observations were unscheduled so that the teachers were not given the opportunity to plan the lessons based on a pending visit. This provided the opportunity for the researcher to gather the data without the teachers planning their lessons with the knowledge that they would be observed on specific days. During the classroom observation process, the researcher sat at the back of the class, logged any use of ICTs in the lesson and remained unobtrusive throughout the lesson. Notes were taken of the use of ICT components in any aspect of the lessons and at the end of the lessons, the teachers were asked to verify the accuracy of the information logged.

The ethical aspects of the research were strictly adhered to on the basis that researchers are responsible for their actions when interacting with the participants in their research. Additionally, it was borne in mind that the participants must always be protected from harm and should not be deceived in any way while participating in the research. One major ethical principle that was supported throughout the research was that of confidentiality which involves the protection of confidential communications and records that identify individual research participants (Shamoo & Resnik, 2009). This suggests that what is said or done by the educational leaders, teachers and students should be kept confidential unless they give consent for their information to be released. It is the responsibility of the researcher to ensure that the research conforms to ethical standards and that position was taken very seriously by the researcher.

Data Collection and Analysis

The focus of the research was to assess the integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda. Primary data were collected from sources including educational leaders, teachers, and students in the respective schools to answer the

research questions and test the hypotheses. Additionally, data were collected from other sources to include a review of the core curricula presently in use in public secondary schools. According to Muhannad and Ahmed (2014 p. 8), “Primary data collection is the process of sourcing and collection of raw and live data from the field works”. Mazhar et al. (2021) also described primary data as original and collected from the source for the first time. Primary data are current and up-to-date, and they enable the researcher to create a positive research outcome (Muhannad and Ahmed, 2014). Primary data collection is used when data that are needed for research are not available either because they have not been collected before or are not readily available (Nicoll and Beyea, 1999). Primary data on the research topic under review especially as it relates to integration of ICTs in Antigua and Barbuda or developing countries in the Caribbean are not readily available hence the need for data to be collected. Additionally, current data are critical for the research since curricula, teaching resources and teaching strategies have been revised over the years. Further, primary data are pertinent as the sources used are known and the reliability of the data is maintained (Nicoll & Beyea, 1999).

Data collection for this research spanned every facet of public secondary schools to determine their engagement in using ICTs for teaching and learning. Data were collected from teachers and students from the 10 public secondary schools that responded to the request to participate in the research. An existing questionnaire was adapted and used for each group of participants, and the data obtained were analysed using descriptive statistics represented in graphs in Microsoft Excel. The two (2) hypotheses for the research were tested using the ANOVA statistical test of variance in Microsoft Excel. Additionally, data were collected from interviews with educational leaders which were coded manually, themed and analysed to answer the research question(s) to which their responses were aligned. Data relating to ICT components

were also collected from a review of the syllabuses used by the teachers in the classes under review to determine if ICT components were present and to what extent. The data were analysed using descriptive statistics by identifying the number of ICT components, frequency of use and types of ICT components present in the documents. The data collected from observation of practice were captured by noting the types and number of times ICT components were used in the classes by the teachers for teaching and students for learning. The data were presented using descriptive statistics using Microsoft Excel. Once all data were collected from the research tools and the findings noted, methodological triangulation was used to determine congruence or divergence of the data. The researcher looked for patterns or themes that emerged across the quantitative and qualitative data sets to arrive at the overall findings of the research which helped to strengthen the findings and provide a more comprehensive understanding of the data to answer the research questions.

Of significance to the research is the role that trustworthiness of data plays in qualitative research. Trustworthiness of data is a critical component of the research by showing the credibility, transferability, dependability, and confirmability of the data collected to enable replication by other researchers. Elo et al. (2014) are of the view that it is important to scrutinize every aspect of the analysis process when preparing, organizing, and reporting the results so that a clear indication of the trustworthiness of the study is realized. Lincoln and Guba (1985) are of the view that the main aim of trustworthiness of data in a qualitative inquiry is to ensure that the findings are enough to capture the attention of the audience of the research.

Trustworthiness of Data

Trustworthiness of data plays a critical role in the rigor of qualitative research as it relates to the presentation of data (Amankwaa, 2016), and it provided the support required for the

qualitative aspect of this research to arrive at findings that merited the focus of the research consumer (Elo et al., 2014). According to the advice given by Geertz (2008), the researcher is required to provide a 'thick description' of the phenomenon which is an explanation that is so rich in details that it is considered profound and leaves little doubt about the conduct of the research and reliability of the findings. Trustworthiness of any qualitative research is a subjective reality, but it must be presented in a way that readers and writers find harmony in their constructive processes (Stahl & King, 2020).

The rigor that is involved in the trustworthiness of the data in qualitative research is a process which distinguishes it from ordinary research (Amankwaa, 2016). This research was based on the paradigm of pragmatism where the researcher sought answers to research questions by taking a pluralistic stance to arrive at findings that are considered worthy (Feilzer, 2010). The processes involved in the trustworthiness of data were mainly used to support the research argument of the findings through scientific consistency, as the researcher moved from the research questions to the conclusion and to ensure that the results were worth paying attention to (Elo et al., 2014; Lincoln & Guba, 1985). Researchers employ a multiplicity of research procedures and trustworthiness in creating their research activities and reports (Stahl and King, 2020), however, Lincoln and Guba (1985) indicated that the criteria of credibility, transferability, dependability, and confirmability was necessary in the approach to guaranteeing trustworthiness in qualitative research. The qualitative components of this research were put through the rigor of trustworthiness of data to include tenets of credibility, transferability, dependability, and confirmability to ensure soundness of the findings.

Credibility

Credibility refers to the congruence of the findings of qualitative research with reality which can be compared to internal validity in quantitative research (Stahl & King, 2020). Stahl and King (2020) further indicated that credibility relates to understanding how the reported findings are similar in their relationships. Further, credibility criteria ensure that the results of the qualitative research are accurate or believable and are addressed from the standpoint of the participants in the research, the reader of the report, and the researcher conducting the research (Denscombe, 2017). This research employed methodological triangulation as a method of ensuring credibility by using several sources of information from the field to establish a pattern in the results. The findings from the interviews conducted with educational leaders and the information collected from observations of classroom practice as well as document reviews were linked with the information received from the teacher and student questionnaires to determine the overall findings of the research. As part of the credibility process, the interview sessions with educational leaders were transcribed and shared with the respective educational leaders for member checking to provide confirmation of the correctness of data. According to Stahl and King (2020), member checking is a good way of verifying the researcher's interpretation after the fact. The educational leaders confirmed the data to be correct within the stipulated time frame of one week to complete the process and the information was recorded as accurate. The teachers who formed part of the observation of practice were also asked to check the researcher's written records pertaining to the ICT components used in their classes and once accuracy was confirmed, the documents were recorded as accurate. The researcher also ensured that in addition to the UREC decision to proceed with the research, permission was granted by the Antigua and Barbuda Institutional Review Board (ABIRB) and the Director of Education from the Ministry

of Education in Antigua and Barbuda to conduct the research in public secondary schools. These permissions provided an extra layer of credibility to the research since the relevant bodies were approached for permission and would have checked the details of the research proposal before giving their stamps of approval to conduct the research. The credibility procedures for this research utilized the validity model purported by Creswell and Miller (2000) to assist in selecting the credibility approach best suited for the research. Table 4 shows the validity procedures that were adapted for this research.

Table 4

Validity Procedures within Qualitative Lens and Paradigm Assumptions

Paradigm Assumptions or Lens	**Critical Paradigms**	
Lens of the Researcher	Triangulation of data from research tools used.	Researcher Reflections
Lens of the Participants	Member Checking -educational leaders check interview records. Teachers check records for observation of practice for accuracy on ICTs used as well as the accuracy of rich descriptions given.	Collaboration (insider analysis) Peers (Curriculum Officers review records of ICTs in syllabuses)
Lens of the People (External to the study)	Thick, rich description of every aspect of research for ease of replication.	

Note. Adapted from Creswell and Miller (2000, p. 126)

Transferability

Lincoln and Guba (1985) are of the view that transferability of qualitative research does not aim for replicability like quantitative research but presents patterns and descriptions of such research that may be applicable in other contexts. It is further purported that transfer is only

possible when a thick, rich description is given which portrays in as much details as possible the circumstance of the research so that it may be applied to other situations. Lincoln and Guba (1985) clearly indicated that the thick description should include contextual information about the field work site as it will impact the degree to which the completed research may be transferred or have applicability to an additional site or context.

This research began with a proposal for the study which was accepted for development by the Unicaf Doctoral Committee. To begin the research process, permissions were sought and received from the UREC Committee, the Antigua and Barbuda Institutional Review Board (ABIRB) since it involved participants under 18 years, and the Director of Education in Antigua and Barbuda to conduct the research in schools. The research began to take shape with the review of pertinent literature followed by the determination of the research method and data collection which included the research approach and design, population and sample of the research, materials and instrumentation of research tools, data collection and analyses followed by findings and conclusions.

The population of the research comprised educational leaders, teachers, and students at public secondary schools. The sample for the educational leaders was selected using purposive sampling, while the samples for the teachers and students were selected using simple random sampling from the population of teachers who teach the core subjects in Forms 2 to 4 and from the population of students in Forms 2 to 4 who are pursuing the core subject areas of English, Mathematics, Biology and Social Studies. The Caribbean Secondary Education Certificate (CSEC) syllabuses for the core areas were selected as the curricula for the review process. The documents were reviewed for the number of ICT components that were embedded. To conduct the observation of practice, classes in Forms 2 to 4 were selected using simple random sampling

from the selected secondary schools, and teaching practices were observed in the core subject areas in keeping with the focus of this research.

To begin the data collection process, a letter of intent was prepared and shared with the Education Officer responsible for secondary schools who played a critical role in informing educational leaders in public secondary schools about the planned research. Gatekeeper letters were also prepared for educational leaders of public secondary schools who played significant roles in providing the lists of eligible teachers and students and class schedules to facilitate the data collection process at their schools. Informed Consent Forms were prepared for educational leaders and teachers as adult participants in the research, and Guardian Informed Consent Forms were prepared for the parents or guardians of students under the age of 18 years. Meetings were held with the educational leaders in the secondary schools to explain the research process and garner their support, since the principals were earmarked as participants in the research. The researcher also met separately with the randomly selected students and teachers who were earmarked to take part in the research to explain the research process and to get verbal consents from the participants. Informed consent forms were then issued to the teachers to be completed and signed as evidence of consent, and the guardian informed consent forms were given to the students to take home for their parents or guardians to complete. Once the consent forms were returned, the links for the questionnaires were sent to the designated government issued emails for both teachers and students. The process for the issuance of the questionnaires for teachers and students to complete whether online or manually took approximately three (3) months. Teachers and students who failed to complete the questionnaires in the first instance were reminded via email to complete the questionnaires online. In several cases, participants who did not complete the online questionnaires were issued with printed questionnaires by the researcher to complete

at the same time at their schools. Once the process was complete, the questionnaires were then collected immediately by the researcher. In preparation for the interviews with educational leaders, an interview schedule was created and tested for reliability by an expert in the field and once reliability was confirmed, educational leaders were interviewed via zoom over a period based on their availability. The interviews were recorded with permission from the educational leaders to ensure that the recordings were available for multiple replays to enable accurate transcriptions of the information for the coding and reporting processes. Classroom observations were also conducted based on the schedule of classes issued by the schools, and document reviews of the core syllabuses for the named class levels (Forms 2 to 4) were also done. The most recent versions of the core syllabuses were acquired for this research and worthy of note is that the biology syllabus was reviewed for the Science cognate of subjects and the Social Studies syllabus was reviewed for Social Sciences since they are the most popular subjects pursued for the Sciences and Social Sciences respectively.

Dependability

Dependability as purported by Lincoln and Guba (1985) relates to the measure of trust that may be obtained from qualitative research. Interviews were done with educational leaders for public secondary schools to gather data on the extent of implementing ICTs in the schools and to determine whether the schools' environments were effective in promoting integration of ICTs in the core curricula of their schools. An interview schedule was prepared as a guide for the data collection. Educational leaders were interviewed using the zoom platform with permission granted from them to record and video tape the sessions. Information received was transcribed, coded, and themed for interpretation. The transcriptions of the interviews were given to the educational leaders to member check for accuracy and the interpretations from the interviews

were shared with them to determine if the field notes adequately reflected the information received. Lincoln and Guba (1985) claimed that peer scrutiny communicates trust, hence the reason why that technique was used in this research. In the interest of anonymity and the avoidance of bias in this research, the educational leaders were coded for the presentation of data using letters of the alphabet from A to H.

Document reviews also formed part of the data gathering process of this research by examining the latest versions of the syllabuses for the core areas of English, Mathematics, Biology and Social Studies for evidence of ICT integration. The information gathered was coded and themed and feedback was sought from the curriculum officers for the core subject areas to provide insider analyses of the information created from the document reviews of the syllabuses on integration of ICT components. Further, the thought of peers reviewing aspects of the research encouraged the researcher to use the process of bracketing, which is the practice of separating the data obtained into observations and interpretations to ensure that more care is taken with what is recorded as fact or interpretation of the data (Stahl and King, 2020). Feedback received from curriculum officers for the core areas indicated that the information gleaned from the syllabuses was accurate and representative of what is contained in the syllabuses. The curriculum officers further acknowledged that the syllabuses do not indicate specific ICT components that should be used by the teachers, but teachers are expected to use technology as an important part of their teaching strategies and methodologies since according to CARICOM (2019), all schools are required to prepare students to be critical thinkers and users of technology to become ideal Caribbean citizens.

Confirmability

Researchers who engage in qualitative research are encouraged to get as close as possible to objective reality as the research allows by relying on constructs like accuracy and precision in their research practice (Stahl & King, 2020). This research employed triangulation of the qualitative data received from the interviews with educational leaders on their perceptions of ICT use in their schools, the observations of teaching practice in schools to determine teachers' use of ICTs for pedagogical activities, and the results of the document reviews against the quantitative data received from the teacher and student questionnaires on the engagement of classes with ICT integration. It is important for researchers to ensure that qualitative or action-oriented research meets the standards of trustworthiness for individuals who wish to use the research for their own purposes since the constructs of trustworthiness identified in the research would provide guidance in evaluating the research (Anderson et al., 2007).

One aspect of the confirmability process to be addressed when engaged in qualitative research is the need to give an indication of the researcher's beliefs and assumptions. The researcher is employed by the Ministry of Education with specific oversight for curricula in schools. It is important to note that the researcher does not interact directly with the participants in this research as it relates to curricula-related matters in schools. Curricula matters are channelled through the Education Officers responsible for the respective subjects which will then be discussed at the Ministry of Education level by all officers. It is the researcher's belief that for students to fit seamlessly into the 21st Century, they must be able to think critically and innovatively, and teachers must be able to guide them through the process. One way to accomplish that goal is for teachers to be prepared to embrace the emerging technology as an integral part of the teaching and learning process. The researcher further believes that integrating

ICTs in the curricula of schools is likely to empower students to practice radical constructivism where knowledge is socially constructed by them and will ultimately take responsibility for their own learning (Xu & Shi, 2018).

It must also be noted that the mixed methodology provided the best fit for the research in ensuring that both the scientific and ethnographic aspects are covered to arrive at the findings of the research. According to Dawadi et al. (2021), the mixed method provides meaningful data as well as render purposeful consolidation of the data to arrive at a better understanding of the phenomenon being researched. In addition, Greene et al. (1989) purported that the mixed method of research encourages the use of results from one method to supplement another method to provide adequate coverage of the results. One potential shortcoming of the methodology for this research was the limited time span that was available to collect the qualitative data since it required the researcher to be immersed in the phenomenon for a relatively long period of time to get a comprehensive view of the activity and receive a better understanding of the issue under review. This research was guided by specific timelines which had to be followed to complete different aspects of the data collection process. However, a follow-up study on the integration of ICTs in all subject areas will be able to address this shortcoming since more time will be available to complete the qualitative aspects of the research. While the criteria of credibility, transferability, dependability, and conformability were used to address the trustworthiness of qualitative research, quantitative research depended on internal and external validity, reliability, and objectivity (Eryilmaz, 2022). This section focuses on the validity of the measurements used for the research to show the usefulness, meaningfulness, and relevance of the research. The reliability of the study which focuses on the consistency of the quantitative research measurement tools used to collect the data was also addressed.

Reliability and Validity of Data

Reliability and validity are key indicators that determine the quality of an instrument used for measurement (Kimberlin et al., 2008). Drost (2011) purports that reliability is the extent to which measurements are repeatable under different circumstances with the same results and according to Bollen (1989), it is referred to as the consistency of measurement. Validity, on the other hand, is the extent to which an instrument measures what it is supposed to measure (Kimberlin et al., 2008).

The study employed the use of quantitative measures in the form of teacher and student questionnaires for which reliability and validity measures were applied to guarantee the soundness of the data for the research. Permission for use of an existing questionnaire for teachers was sought and granted from Hogarty et al. (2003) which was subsequently adapted for this research. The teacher questionnaire was adjusted in the section on demographics to include gender, level of education, number of years teaching at a secondary school, and the core subject taught. The other sections of the questionnaire included a section on teacher preparation for the use of ICTs in the classroom, confidence, and comfortability in using ICTs in the classroom, general school or administrative support and the integration of ICTs in the classroom. A total of five (5) sections of the original research tool were used with minor changes since they captured data that would assist in answering the research questions for this research to a great extent. One change included replacing the term ‘Computers’ with the term ‘ICTs’ in a few statements since the scope of the research included not just computers but any device used for teaching and learning that may be considered technological. A minor change included replacing the statement ‘To tutor’ in the section on ‘Integration of Computers into the Classroom’ with the statement ‘To teach new concepts’ since it relates specifically to learning something new which denotes a

change in behaviour. In addition, sections that were not relevant to the research questions of this study were omitted. Those sections included 'Types of Software used to complete School-related Activities', 'Technical Support for Computers', Your Personal Use of Computers' and 'Attitudes towards Computer Use'. The researcher felt that the types of software used to complete school activities were not very critical for this research since all schools would have been issued the same software to use for instruction and administrative activities. Technical support for computers was also omitted because it was established that public secondary schools do not have on-site technicians to address technical issues. The section on personal use of computers was not considered since the focus of the study was on the use of the technology for instruction and not on personal use. Though teacher attitude may play a role in integrating ICTs, the researcher felt that the depth of research required for that aspect of the research would have been too extensive for this research based on the time allocated for the research. However, this research addresses aspects of teacher attitudes and its relevance to the use of ICTs in schools. It is expected that the research be extended in future to delve deeper into the attitudes which teachers have towards ICT use and its impact on the integration process in schools.

Each section of the questionnaire was presented with statements which required teachers to give their opinions using a 5-point Likert type scale configuration and in some cases made provision for statements that were not applicable to the teachers by making the option of 'not applicable' available for selection if needed. Hogarty et al. (2003) tested the validity of the instrument on over 2000 active teachers by using factor analytical and correlational methods. The adapted tool for this research was tested for reliability with five (5) teachers in private secondary schools who were not part of the population of this research but have similar demographics as the population. In addition, the internal consistency of the 33 statements

(Questions 6 to 38) in the four main sections of the questionnaire was tested using Cronbach Alpha to determine the equivalence of the different sets of items used which according to Kimberlin et al. (2008) provides an estimate of the reliability of the measurement based on the assumption that if the items measure the same construct, they should correlate. Cronbach Alpha is a function of the average intercorrelations of items and the number of items in the scale and is the most widely used method to test the internal consistency reliability of an instrument (Crocker et al., 1986; Cronbach, 1951; DeVellis, 2006; Nunnally et al., 1994) cited in Kimberlin et al. (2008). Those researchers further stated that having multiple items to measure a construct improves the reliability of the measurement. The coefficient of the internal consistency of the teachers' questionnaire with 33 items resulted in a score of 0.87 which is good based on the Cronbach Alpha score criteria as can be seen in Table 5.

Table 5

Cronbach Alpha Reliability Test for Items in Teacher Questionnaire

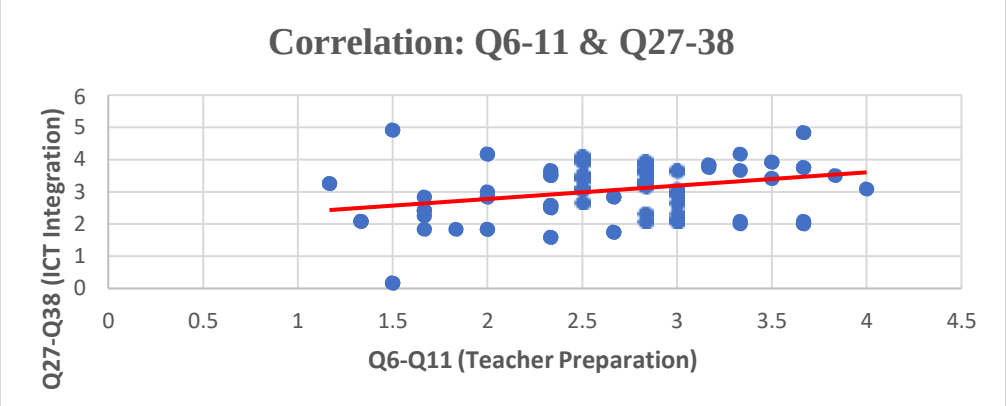
K	**Number of Items**	33
$\sum\sigma^2$	**Variance of all items**	39.54294
σ_t^2	**Group Total Variance**	245.2944
α	**Cronbach Alpha**	**0.865006**
	(Questions 6-38)	

Of significance to this research is the relationship between the dependent variable which is Integration of ICTs which spans Questions 27 to 38 in the questionnaire and two independent variables namely, 'Teacher Preparation in using ICTs in the classroom' which spans Questions 6

to 11 and 'Confidence and Comfortability in using ICTs in the classroom' which covers Questions 12 to 19. Integration of ICTs was represented by Section five (5) of the questionnaire and Teacher Preparation in using ICTs was represented by section two (2), while Confidence and Comfortability in using ICTs was represented by section three (3) in the questionnaire. To determine the correlation between the dependent and independent variables, Pearson's correlation tests were employed using the Excel programme. The correlation test between the section on Integration of ICTs and the section on Teacher Preparation of ICTs in the classroom resulted in a Pearson's correlation r=.29 which is a positive but moderate correlation as seen in Figure 2.

Figure 2

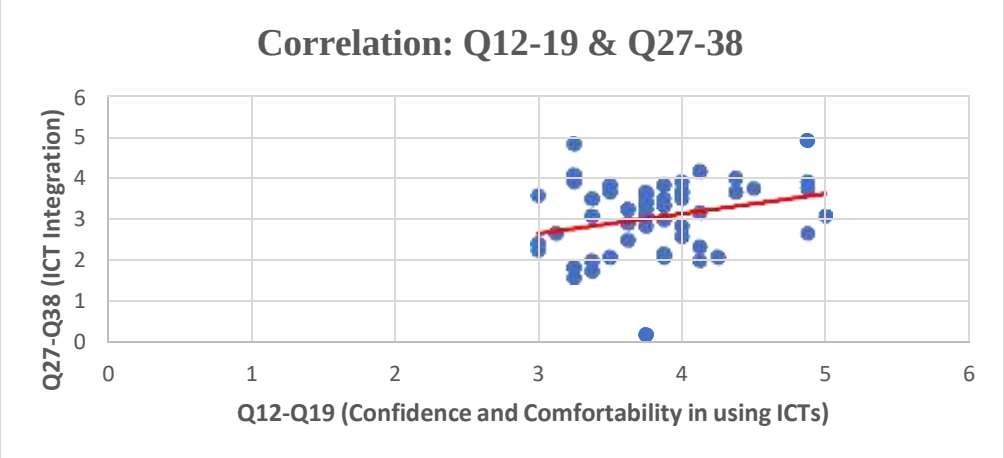
Correlation between ICT Integration and Teacher Preparation



The correlation between the section on the Integration of ICTs (Questions 27 to 38) and the section on Confidence and Comfortability in using ICTs in the classroom (Questions 12 to 19) using the Pearson's Correlation test resulted in a correlation of r= .24 which also represents a moderate but positive correlation as can be seen in Figure 3.

Figure 3

Correlation between ICT Integration and Confidence and Comfortability in using ICTs



Upon completion of the reliability and validity tests, the links for the teachers' questionnaires were made available to the teachers through their government issued emails once the informed consent forms were returned. In some instances, questionnaires were completed manually by teachers who submitted the informed consent forms but did not complete the online version of the document. In those cases, the researcher visited the schools and presented the questionnaires to the teachers to complete having sought permission from the principals of those schools to execute the activity on the said days.

The student questionnaire was also adapted from Hogarty et al. (2003b) for this research and the section on demographics was reconfigured to include information on gender, age, name of secondary school and grade level to provide the basic information on the sample population. In addition, the questionnaire focused on students' knowledge and use of ICTs in school with 14 statements relating to ICT use and knowledge utilizing a 5-point Likert type scale with the options of 'not at all', 'to a small extent', 'to a moderate extent', 'to a great extent' and 'entirely'.

The tool was tested for validity and reliability on ten (10) private secondary school students with similar demographics who did not form part of the sample for this research. The internal consistency of the 14 statements in the student questionnaire using the Cronbach Alpha test produced a coefficient score of 0.84 which is considered good based on the Cronbach Alpha criteria. See Table 6 for the breakdown of the score.

Table 6

Cronbach Alpha Reliability Test Score for Students' Questionnaire

K	14
$\sum\sigma^2$	19.879
σ_t^2	89.341
α	**0.8372948**
(Questions 1-14)	

The links for the students' questionnaires were made available to the students through their government emails once the guardian consent forms were returned. In some instances, questionnaires were manually completed by those students who submitted the guardian consent forms but did not complete the online version. To complete the manual completion process, the researcher sought and received permission from the principals of those schools to have the identified students sit in a classroom to complete the questionnaires issued by the researcher. The completed documents were then immediately collected by the researcher, the data prepared for analysis and then appropriately secured.

Introduction of the Data Gathering Process

Educational leaders were briefed on the research process once the UREC and Antigua and Barbuda Institutional Review Board decisions were granted as well as the approval of the

Director of Education to conduct the research in public secondary schools. The educational leaders were apprised of the various aspects of the research including the questionnaires, interviews and observation of practice which would require interfacing with faculty and students of the schools. In addition, a formal letter from the Ministry of Education explaining the details of the research was sent to all education leaders of public secondary schools after which the researcher spoke to educational leaders on an individual basis about the research. Teachers were also invited to a meeting to explain the research process and to obtain verbal consent. The researcher then issued the Gatekeeper letters to principals followed by the Informed Consent Form to be completed and returned to the researcher. Teachers who were randomly selected using the simple random method were also issued with Informed Consent Forms and the selected students were issued with Guardian Informed Consent Forms to be completed by their parents or guardians which were then returned to the researcher. The randomly selected students were also asked for their verbal consent by the researcher as part of the required research protocol. The teachers and students' questionnaires were administered online due to the lingering presence of the Covid-19 pandemic and the links to the questionnaires were only issued via government-issued emails once the informed consent forms and guardian informed consent forms were returned.

Based on the nature of a mixed method approach, it was deemed necessary to collect data from both quantitative and qualitative sources to adequately answer the research questions and test the hypotheses. Each research tool was developed to collect data for a specific research question but was also used to provide some data for other research questions. See Table 7 for the summary of data collection tools used for this research.

Table 7

Summary of Data Collection Tools and Alignment with Research Questions

Research Questions	Sources of Data	Tools used to Collect Data
1	Core Curricula (Main source of data)	Document Review Protocol
	Observation of Practice	Observation Schedule
	Teachers	Teacher Questionnaire
	Students	Student Questionnaire
	Educational Leaders	Interview Schedule
2	Teachers (Main source of data)	Teacher Questionnaire
	Students	Student Questionnaire
	Observation of Practice	Observation Schedule
	Educational Leaders	Interview Schedule
3	Teachers (Main source of data)	Teacher Questionnaire
	Students	Student Questionnaire
	Educational Leaders	Interview Schedule
	Observation of Practice	Observation Schedule
4	Students (Main source of data)	Student Questionnaire
	Teachers	Teacher Questionnaire
	Observation of Practice	Observation Schedule
5	Educational Leaders (Main source of data)	Interview Schedule
	Teachers	Teacher Questionnaire
	Students	Student Questionnaire

Teacher Questionnaire

To provide quantitative data, a questionnaire for teachers and one for students were used since questionnaires are known for providing data from many participants at any given time. The teacher questionnaire provided data on whether ICTs were used for teaching and to what extent, while the questionnaire for students provided data on their use of ICTs for learning whether in school or for doing homework. The research adapted the Perceptions of Computers and Technology Instrument (PCTI) survey tool by Hogarty et al. (2003b) to determine the extent of pedagogical use by teachers and learning by students. According to Hogarty et al. (2003a), several instruments were examined to determine their suitability for adequately assessing ICT integration in schools and one such tool was designed by Becker and Anderson (1998) cited in Hogarty et al. (2003a), but their focus was more on the history of technology use by teachers rather than as a measure of implementation and integration representing current trends. The primary reason for adapting the Hogarty survey instrument for this research was that it provided a validated instrument to source data for a better understanding of the use of technology by teachers and students in the classroom which is the focus of this research. The selected instrument had several sections dealing specifically with ICT use by teachers with the first section capturing demographics of teachers and their qualifications while the other sections required respondents to respond to statements about ICT use using a 5-point Likert-type scale with responses ranging from 'Not at all to Entirely' or 'Strongly Disagree to Strongly Agree' or 'Not at all to Everyday'. For those items relating to frequency of use, a response called 'Not Applicable (NA)' was provided for those respondents to whom the given options did not apply. See Appendix C. The teacher questionnaire was piloted with five (5) teachers at a private secondary school to test the reliability of the instrument and to ensure that there were no

ambiguities regarding the questions. The private school teachers were not part of the population of this research.

Teacher Questionnaire and Alignment with Research Questions

The teacher questionnaire focused on the demographics of the teachers to include gender, the number of years teaching at a secondary school, the core areas taught and their qualifications which are aligned to Research Question three (3). The data assisted in determining if there is a relationship between the ICT knowledge of teachers and the integration of ICTs in the schools. The section of the teacher questionnaire which addressed the preparation of teachers for the use of ICTs in the classroom also relates to Research Question three (3) which focuses on the knowledge levels of teachers in the use of ICT components for pedagogical activities. Research Question two (2) addressed the degree to which the confidence and comfortability of teachers in using ICTs contribute to their integration of ICT components contained in the core curricula of public schools and it was dealt with in two sections of the questionnaire. The first section relates to the confidence and comfortability of teachers in using ICTs in the classroom and was used to test hypothesis number two (2) in relation to the correlation between the confidence and comfortability of teachers and their influence on ICT integration in core curricula. The literature is explicit in indicating that teachers who are not comfortable in using ICTs will use them to a limited extent or will not use them at all in the classroom (Uslu, 2017). The next section of the questionnaire to address Research Question two (2) is the section on Teacher Preparation for Use of ICTs in class and this was used to address hypothesis number one (1) which is to determine if there is a relationship between the ICT knowledge of the teachers and the extent of integration of ICTs in core curricula. Research Question four (4) was also answered to some extent in the section of the teacher questionnaire entitled ‘Integration of ICTs in the Classroom’ where

teachers indicated `the various ways in which they integrated ICTs in their classrooms for students to learn. Research Question five (5) addressed how the school environment promoted ICT integration which also encompasses the challenges or hindrances militating against integrating ICTs in the curricula of schools. Research question five (5) was also addressed in the section of the questionnaire related to the general school or administrative support that were available on the school plant.

The thrust of the analysis of the data for the questionnaire was mainly to determine the extent of integration of ICTs in the core curricula of public secondary schools by calculating use of ICTs expressed as frequencies and percentages. The data from the questionnaire were captured in Microsoft Excel and presented in graphs and tables in the research. Microsoft Excel was also used to calculate reliability of the instrument by using Cronbach alpha. Correlations of the variables in the questionnaire were calculated using Pearson correlation. Pearson correlation measures the strength of the linear relationship between two (2) variables which may be represented with a -1 to 1 with a value of -1 indicating a total negative linear correlation, 0 suggesting that there is no correlation and 1+ meaning a total positive correlation (Faizi & Alvi, 2023). According to Bluman (2007), correlation is a statistical method which is used to determine if there is a relationship that exists between variables.

The analysis of the responses from the teachers' questionnaire was conducted based on the percentage use of ICTs by teachers in core curricula instruction with 0-25 percent represented as a 'limited extent', 26-50 percent represented as a 'small extent', 51-75 percent represented as a moderate extent and 76-100 percent represented as a 'great extent'. In addition, data from the teacher questionnaire were used to determine if there is a significance difference between 'the dependent variable of 'Integration of ICTs in the Classroom' and two independent variables

which were ‘ICT Knowledge of Teachers’ and ‘Confidence and Comfortability of teachers’ in using ICTs. It must be noted that there were challenges in getting teachers to complete the online questionnaire even though they had completed the Informed Consent Forms. To ensure that there were an adequate number of participants to provide the data, the researcher had to visit each school to issue hard copies of the document for completion of the data collection process. It was time consuming but had to be done to generate a representative sample of the teacher population. The research employed the analysis of variance (ANOVA) to test the significance between the variables for the two (2) hypotheses in the research.

Student Questionnaire

The student questionnaire was adapted from the Perceptions of Computers and Technology Instrument (PCTI) survey (Hogarty et al., 2003b) which sought to ascertain the extent to which students used ICTs for learning. The adapted instrument was divided into two sections: section one which required the demographics of the students to include gender, age and grade level while section two required respondents to respond to statements about ICT use for learning. The responses were placed on a 5-point Likert-type scale with responses ranging from ‘Not at all’ to ‘Entirely’. See Appendix C. The instrument was piloted with a set of 10 students from a private secondary school (who were not part of the population for this research) to test the reliability and validity of the tool. The pilot revealed two (2) statements in the tool that appeared to be ambiguous, and they were reworded to provide greater clarity.

Student Questionnaire and Alignment with Research Questions

The student questionnaire was used to ascertain the students’ use of ICTs for learning. Research Question two (2) which addressed whether the confidence and comfortability of teachers in using ICTs contributed to the integration of ICT components contained in the core

curricula of public secondary schools, and Research Question four (4) which related to the extent to which students used ICT components for core curricula learning activities were reflected in the students' responses to those statements in the tool that covered use of ICTs to do their classwork and homework, to do research and as part of their English, Mathematics, Biology and Social Studies classes. The ICT knowledge of teachers in using ICTs for pedagogical activities (Research Question 3) was also addressed in the students' questionnaire in their responses to their use of ICTs for various subjects in class and homework since these activities are usually initiated by their teachers and are usually based on the ICT knowledge of the teachers. The school environment as it relates to students' access to ICTs to do their schoolwork and encouragement of use by educational leaders (Research Question 5) were also addressed in the students' questionnaire.

The analysis of the data collected for the student questionnaire was mainly to determine the extent of integration of ICTs in the curricula of public secondary schools with a focus on use by the students for learning. Microsoft Excel was used to calculate data for frequencies and percentages and was used to calculate the reliability of the instrument by using Cronbach alpha. Correlation of the variables was calculated using Pearson's correlation. The analysis was conducted based on the percentage use of ICTs by students in core curricula for learning. Based on the responses in the questionnaire, the percentage response reflecting 0 -25 percent was represented as a *limited extent*, 26-50 percent represented as a *small extent*; 51-75 percent represented as a *moderate extent* and 76-100 percent represented as a *great extent.*

Interview Protocol for Educational Leaders

In preparation for the interviews, an interview time schedule was prepared and circulated to the educational leaders gave verbal consent and were issued with Informed Consent Form as

signed agreements to participate in the research. Once the informed consent forms were collected by the researcher, permission was sought and received from participants to record the sessions to facilitate replay to test for accuracy in transcribing the information. The interviews were conducted via zoom with permission sought from each participant to use the video facility to note the expressions of the respondents as part of the process. Anonymity and confidentiality of content were reiterated, and educational leaders were reminded that they could withdraw at any time without consequences. The research relied on semi-structured interview questions for use with educational leaders which provided insight into Research Question five (5) relating to the ICT support at schools, their roles in the integration process and hindrances or challenges they faced in the integration process. Research Question three (3) in relation to the ICT knowledge of teachers and its use for pedagogical instruction was also answered to some extent. (See Appendix C for Interview Protocol). According to Hannan (2007), interview is an appropriate tool to gain insights and provide a way of obtaining opinions and perspectives from individuals about a phenomenon. The instrument was piloted with one (1) principal of a private secondary school for validity. The research targeted all 10 public secondary schools' educational leaders for interview but only conducted eight (8) interviews since a point of saturation was achieved. Saturation was noted when the responses from subsequent educational leaders did not advance any new information. It must be noted that public schools in Antigua and Barbuda operate within the government system, and they all depend on the Ministry of Education (the institution in government which governs or has oversight for public schools) for administrative guidance and for financial support which suggests that the resources and policies available for use in public schools are similar. To analyse the data from the interviews, the audio recordings were transcribed, and the information verified by the respective educational leaders for accuracy to

avoid researcher bias. The transcripts were then re-read to identify codes followed by the creation of themes. After the findings from the interviews were realized, methodological triangulation was done to determine congruence or divergence of the data from other research tools.

Documents Review

Document reviews of curricula used in Forms two (2) to four (4) for the core curricula areas of English, Mathematics, Biology and Social Studies were also used to provide qualitative data for the research. A document review protocol was used comprising of four (4) statements addressing the frequency of use of ICT components found in the core curricula of schools. A 5-point Likert-type scale with responses ranging from 'Not at all' to 'Entirely' was used to capture that data, along with four (4) statements relating to the identification of the actual ICT components that were embedded in the core curriculum for each subject (See Appendix C for Document Review Protocol). The curricula documents at the specified grade levels were examined for evidence of components of ICTs and the information was used to create codes which Boyatzis (1998) claims are the most basic components of raw data that can be assessed in a meaningful way. The data were later converted into themes in preparation for analysis followed by methodological triangulation with other data collected from the other research tools. Research Question 1 (one) which relates to the core curricula reflecting ICT components was addressed in this aspect of the research. Curricula in Antigua and Barbuda are revised every five (5) to seven (7) years and any attempts at ICT integration would be evidenced in the curricula presently in use. According to UNESCO (2017), curricula are critical sources to examine for serious attempts at ICT integration. Based on the number of ICT components identified in the documents reviewed, the data was recorded by indicating the number of ICT components identified in the

document. The number of components identified were recorded as ‘Not at all’ represented by zero (0), ‘Small Extent’ represented by one (1), ‘Moderate Extent’ represented by two (2), ‘Great Extent’ represented by three (3) and ‘Entirely’ represented by four (4) or more components. The document review protocol for core curricula detailed ICT components that were present in the learning outcomes or methodologies of the core curricula documents for Mathematics, English, Biology and Social Studies. The information was then coded and themed so that interpretations may be made, and conclusions drawn. Methodological triangulation was done to ensure objective analysis and prevent researcher bias which is critical in qualitative data.

Observation of Classroom Practice

Another method used to collect data for the research was the observation of classroom practices using an observation protocol. The focus of the observations was to determine if teachers used ICT components in their practice to facilitate learning, as well as to ascertain if they encouraged their students to use ICTs to work independently or to complete tasks in the classroom or for homework. The observations also captured teachers’ use of ICTs to consolidate what was being taught with some alignment to Research Questions one (1) and two (2) which address the ICT components in core curricula, and the contribution that the confidence and comfortability of teachers make towards their use of ICT components in the classroom. The observation schedule comprised four (4) statements relating to teachers’ use of ICTs in lessons to teach or to consolidate concepts, the use of ICTs by students for independent learning and to solve problems as well as teachers assigning homework to students involving the use of ICTs. These actions were reflected as statements using a 5-point Likert scale with responses ranging from ‘Not at all’ to ‘Entirely’ for use by the researcher. The observation protocol also involved a section that required the identification and recording of the types of ICT components that are

embedded in the lessons. Further, Research Questions three (3) and four (4) relating to the ICT knowledge of teachers in using ICTs pedagogically and students use of ICTs for core curricula learning activities were also addressed in the observation of practice. (See Appendix C for copy of Observation Tool). Although observation of classroom practice is a normal part of the monitoring and evaluation process conducted by the Ministry of Education, the observations for this research were only conducted with teachers who had consented to take part in the research and had submitted the Informed Consent Forms. The classroom practices were not voice recorded or videotaped based on the ethical protocols for the research. The observation of practice employed the constructs of core curricula and use of ICTs for teaching and learning; technology integration as indicated by the number of teachers who showed signs of integration in their teaching; and the construct of ICT as part of the teaching and learning process by examining the frequency and type of use.

As part of the observation of practice, the researcher asked the teachers to indicate how they used ICTs in their subject areas. The information was captured in rich descriptions by the individual teachers with four (4) responses for Mathematics, five (5) responses for English, four (4) responses for Biology and five (5) responses for Social Studies. The analysis for the observation of practice was conducted based on the percentage use of ICTs by teachers to teach concepts, consolidation of concepts and to assign classwork and homework, while percentage use by students was observed for independent learning and to solve problems. Percentage use for any of the activities identified was recorded as follows: 0-25 percent use represented as a *limited extent*, 26-50 percent use represented as a *small extent*; 51-75 percent use represented as a *moderate extent* and 76-100 percent use represented as a *great extent.* The information received from the observation of practice was then coded and themed to be analysed, objectively

interpreted and appropriate conclusions drawn. Methodological triangulation was conducted to ensure objective analysis and prevent researcher bias which is critical in findings that are representative.

Application of Thematic Approach

The Thematic Approach was used to collect data through qualitative methods such as interviews, observation of practice and document review as required in this research. Braun and Clarke (2006) describe thematic analysis as a way of identifying, analysing, and creating themes using qualitative data for reporting purposes which according to (Boyatzis, 1998) interprets various aspects of the research. The different phases of the Thematic Approach as suggested by Braun and Clarke (2006) were used with the creation of *a priori* codes to commence the process of coding followed by reading, rereading and transcription, theory driven coding, revision of codes, creating themes, reviewing themes, and then writing the report for the research based on the findings. The themes for the interviews, observation of practice and document reviews were entered into an Excel programme to generate the descriptive statistics on the way ICTs were used based on the context of the tool.

The interviews sought to determine the educational leaders' perception of ICT use at their schools, the role they play as leaders in the integration process and the challenges faced at the school level to hinder ICT integration. The themes developed from the interview process were quantified using frequencies and translated into percentage use based on specific criteria for the analysis. The analysis for the interviews focused on the percentage use of ICTs at school for core curricula instruction in accordance with the educational leaders' perceptions, or the roles the educational leaders play in the ICT integration process at their schools, and the challenges identified with the ICT integration process. The findings were quantified and calculated as

percentages with 0 -25 percent representing a limited extent, 26-50 percent representing a small extent; 51-75 percent representing a moderate extent and 76-100 percent representing a great extent. Additionally, codes were created from the transcripts after reading and re-reading followed by the creation of themes which were used to conduct the analysis. Methodological triangulation was done to ensure objective analysis of the data and the prevention of researcher bias which is critical in presenting findings that are representative. Further, the data were presented in the educational leaders' own words to provide the rich description which form part of the qualitative data collection and presentation process.

The observation of practice sought to determine use of ICTs pedagogically by teachers and use for learning by students. Use of ICTs for instruction was observed and the recorded data were coded and themed. The themes created for the observations were quantified and entered in an Excel file where the frequencies were calculated and converted into percentages as part of the analysis. The findings of the observation of practice were calculated as percentages with 0 -25 percent representing a limited extent, 26-50 percent representing a small extent; 51-75 percent representing a moderate extent and 76-100 percent representing a great extent. Additionally, the teachers were asked about their average use of ICTs for specific purposes in their classes and the descriptions received were presented in the teachers own words as part of the data presentation process.

The document review process required the examination of core curricula for embedded ICT components. Each curriculum document was divided into an introductory section giving the rationale, aims, skills and abilities to be assessed, the recommended approaches to facilitate learning, subject notes, and suggested activities to be used when teaching. The documents were read and reread, ICT components were identified, and the information recorded, coded, and

themed for analysis. A report with the findings was generated for each subject. Methodological triangulation was done with the findings from other research tools to ensure objective analysis and prevent researcher bias which is critical in findings that are considered representative.

To assist in arriving at the findings for the research, two hypotheses were tested with data from the teachers' questionnaire which are critical in determining ICT use for teaching and learning. Teachers are responsible for planning and executing lessons and are integral in how ICTs are used in schools. The focus for each hypothesis was on teachers and their roles in the teaching process with ICTs especially as it relates to their comfort and comfortability in using ICTs in the classroom and their knowledge of ICTs for teaching. The hypotheses sought to determine if there was a significant difference between three (3) sets of variables. Hypothesis number one (1) addressed the dependent variable of 'Integration of ICTs' and its correlation to the independent variable which is 'The ICT knowledge of Teachers' to the integration process. Hypothesis number two (2) addressed the dependent variable of 'Integration of ICTs' and the independent variable of 'Teachers Confidence and Comfortability in using ICTs in the Classroom'. The tests for significance between the dependent and independent variables in the questionnaire were calculated using the ANOVA statistical test in the Microsoft Excel programme.

The data were collected from primary sources such as the teachers and students' questionnaires first, followed by interviews of educational leaders, observations of classroom practices and the examination of core curricula documents. The data from the different tools were then triangulated to determine complementarity or divergence of the findings. The triangulation process was based on the premise of using multiple data sources in an investigation to arrive at an understanding of a phenomenon which results in increasing the credibility and

validity of the findings of the research (Odiri, 2019). The findings for the research were addressed using the methodological triangulation design (Denzin, 1978; Patton, 2002) which employs the use of quantitative and qualitative data to elucidate complementary aspects of the phenomenon under review. According to Heale and Forbes (2013), triangulation is used when mixed methods are utilized in research and may produce results that converge and lead to the same conclusions; or the results may relate to different phenomena but may be complementary to each other and supplement the individual results; or may be contradictory to the results. Depending on the findings, converging results may increase the validity of the findings through verification while complementary results may highlight aspects of the phenomenon under review and divergent findings may lead to new and better understanding of the phenomenon under investigation (Tashakkori et al., 2003). Heale and Forbes (2013) are of the view that triangulation promotes a very comprehensive understanding of the problem being researched and enhances the rigour of a research study. Odiri (2019) further promulgates the benefits of triangulation by indicating that it minimizes inadequacies found in one data source when multiple sources confirm the same data, and it also verifies that multiple sources provide validity and verification while complementing similar data.

Limitations of the Study

The research sought to understand the ICT integration process in public secondary schools since they were the recipients of ICTs provided by international benefactors and the government to improve learning in Antigua and Barbuda. While assessing ICT integration at all levels in all secondary schools would have made the findings of the research even more generalizable, it was not feasible within the time frame given, especially with the rigor that was used to arrive at the findings of the study. Consequently, the research was delimited to specific

forms/grades and subject areas. It was felt that assessing ICT integration with forms two (2) to four (4) students and teachers would provide adequate data since the students and teachers in those classes would have been recipients of at least one (1) ICT initiative. Although conducting the assessment with all subject areas would have provided more data for analysis, it was felt that the core subject areas were enough to provide data that were also generalizable since those subjects were either mandatory for all students or pursued by most students in public secondary schools. Further, the research was also limited to public secondary schools since the assessment could only be done with schools that have been the recipients of ICTs on a whole school basis and would have had opportunities to integrate ICTs in teaching and learning.

One shortcoming of the methodology was the limited time span that was available to collect the qualitative data especially with the observation of practice since the timetables for the classes did not allow for more than one (1) observation on a given day. Additionally, schools experienced several interruptions over the data collection period due to factors such as lack of water which required cessation of classes and early closure due to school events. As a result, more time was spent in the field collecting data for the qualitative aspect of the research. To overcome this challenge, the researcher doubled efforts and spent numerous days collecting the data for the observation of practice and to a lesser extent with the interviews of educational leaders.

Summary

The major aim of this research was to assess the integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda bearing in mind the number of ICT initiatives that have been implemented in the public secondary schools over the years with the intention of improving teaching and learning, but with lack of evidence of the extent of their

integration and effectiveness. To guide the research process and create the focus of the research, five (5) research questions were formulated which the researcher sought to answer. The research employed the mixed method approach based on the paradigm of pragmatism which sought to determine what works by using multiple methods to assist in answering the research questions (Dawadi et al., 2021). A combination of quantitative and qualitative data collection methods was used to collect data for the research to include questionnaires for teachers and students, interviews for educational leaders, observation of classroom practices and document reviews which according to Creswell and Plano Clark (2011) provide the width and depth required to understand the phenomenon being researched.

The research required a population comprising users of ICTs at the school level to ensure that the data collected were applicable and pertinent to the phenomenon being studied. The population comprised randomly selected teachers and students of forms two (2) to four (4) for core curricula subjects and educational leaders who were selected using purposive sampling. The sample of teachers who responded to the questionnaire was 115 and the number of students registered at 163 from 10 public secondary schools. The researcher felt that the samples were representative of the populations since they were sourced from 10 of the 13 public secondary schools in Antigua and Barbuda. The sample for the classroom observation of practice was 18 core curricula lessons from six (6) secondary schools with three (3) classes per school, each at a different level. The six (6) schools for observation of practice represented 60 percent of the schools in the research and three (3) classes per school represented the average number of classes at each form level in public secondary schools which were representative of the core curricula classes. The sample of educational leaders comprised eight (8) educational leaders out of the 10 participating schools due to data saturation.

The research tools employed in the research included teacher and students' questionnaires, interviews, observation of classroom practices and document reviews. The questionnaires were adapted from an existing tool and the observation schedule, interview schedule and document review protocol were designed by the researcher in keeping with the purposes they were expected to serve. The questionnaire for the teachers was adapted from an existing questionnaire by Hogarty et al. (2003b) with the main purpose of determining the extent of ICT integration in core curricula. The questionnaire sought to find out the qualifications of teachers, the pedagogical knowledge of teachers in using ICTs, the confidence and comfortability of teachers in using ICTs in the classroom, the ICT support given at school and the ways in which ICTs are integrated in the classroom. The students' questionnaire which was also adapted from the existing tool by Hogarty et al. (2003b), examined the use of ICTs by students for learning in the core curricula of schools. The two (2) questionnaires were piloted with teachers and students from private secondary schools to assist with reliability and validity. Interviews were conducted with educational leaders using a self-designed interview schedule to determine their perceptions of ICT use at their schools, their roles in the integration process and the environmental and other challenges faced by schools in the ICT integration process. The interview schedule was piloted with a principal of a private secondary school. Observations of classroom practice were conducted at the specified form levels in the core subject areas using a self-designed observation tool to ascertain the use of ICTs for instruction in practice. Further, to complement the data collection tools used for this research, document reviews of the core curricula used in public secondary schools were conducted to determine the extent to which ICT components have been embedded in the documents. Worthy of note is that the chapter outlined the alignment of all research tools to the research questions to ensure that the data obtained were

relevant to the phenomenon being researched. Further, although the research tools were mainly aligned to specific research questions, it is imported to note that they provided data to address other research questions to some extent.

One aspect of the data collection process involved the trustworthiness of data for the qualitative aspect of the research to ensure that the data collection was reliable and valid so that the research may be easily replicated. The trustworthiness of data was presented using the element of credibility where the data collected from the interviews with educational leaders were checked for accuracy, and the observation of practice report was checked for accuracy in reporting and completeness by the teachers at the end of the sessions. The reports from the document reviews were also checked by curriculum officers for the core areas under review to ensure that the data captured was accurate. In addition, the researcher gave thick description of all aspects of the research detailing the checks for reliability and validity of the tools used in the research. Transferability was another aspect used in presenting the report to ensure that it was easy to follow by anyone desirous of replicating the research. Dependability was also employed to describe the methodology used in great details so that every aspect of the methodology may be repeated if required. Confirmability of the research in which the researcher stated her beliefs regarding the research and the methodological shortcomings was also provided.

The reliability and validity of the quantitative research tools were also described in detail. The teacher and student questionnaires were adapted from an existing questionnaire from Hogarty et al. (2003b) which were tested for reliability using teachers and students with similar demographics from private secondary schools who were not part of the sample for the research. Cronbach alpha was also used to test the reliability of the teacher and student questionnaires and Pearson's correlation was used to determine the correlation between the dependent and

independent variables in the teacher questionnaire. The dependent variable was ‘Integration of ICTs in the classroom’ and the independent variables were ‘ICT Knowledge of Teachers’ and ‘Confidence and Comfortability in using ICTs in the classroom’.

The significant constructs for the research were identified as information and communication technologies (ICTs), core curricula and technology integration. Slife et al. (2016) indicated that operational definitions are critical in the rationalization process of the research and to provide guidance for analysing the data in the research. The questionnaires for teachers and students were tested for reliability using Cronbach Alpha, and correlation was tested using Pearson correlation test using Microsoft Excel. The research employed two hypotheses to determine if there is a significant difference between the dependent and independent variables identified for the research. The dependent variable for the research was identified as ‘Integration of ICTs in the Classroom’ and the independent variables were identified as ‘ICT Knowledge of Teachers’ and ‘Confidence and Comfortability of Teachers in using ICTs’. The variables in the hypotheses were tested for significant differences using the ANOVA statistical test using Microsoft Excel. The data collected were analysed to arrive at the findings of the research.

To conduct the research, permission was sought and received from Unicaf Ethics Committee (UREC), the Antigua and Barbuda Institutional Review Board (ABIRB) and the Director of Education. The study participants are the main users of ICTs at public secondary schools and included educational leaders, teachers, and students under the age of 18 years. A letter of intent was issued to the Education Officer for secondary schools and gatekeeper letters were issued to educational leaders of the participating schools. Informed consent forms and guardian informed consent forms were issued to participants for confirmation of their involvement in the study. Verbal consents were also acquired from participants in the research.

According to the ethical guidelines for research, participants were apprised of the confidentiality, anonymity, and the ability to withdraw from the research at any time. Once the relevant consent forms were returned, the questionnaires were administered online via the participants' government issued emails and hard copy questionnaires were administered face to face by the researcher for those who did not complete the online tool. Interviews with educational leaders were done online using the Zoom platform. In keeping with the sequential explanatory design of the research, the interviews were conducted following the questionnaires to provide the opportunity to gather more data on areas that required further clarity or were not completely covered by the questionnaires. Observations of classroom practice and document analyses were done to complete the data collection process. The data collected were then analysed and the results triangulated to arrive at the findings of the research. Oppermann (2000) sums up the value of the triangulation process by stating that it is more of a verification of results process with the identification and elimination of methodological shortcomings, data, and bias of the researcher. It must be noted that although the ideal situation would have been to conduct the research with all classes and all subject areas in all public secondary schools, the research was limited to some extent with the class levels used (forms two to four) as well as the use of only the core subject areas. Future research would entail the use of all public secondary schools with all subject areas at all levels.

CHAPTER 4: FINDINGS

Introduction

The research sought to assess the integration of Information and Communication Technologies (ICTs) into the core curricula of public secondary schools in Antigua and Barbuda. Considering the number of ICT initiatives that have been implemented in public schools, the research sought to determine the extent of use of ICTs for teaching and learning and to ascertain their effectiveness. The information gleaned from the research may influence curriculum reform and may assist in providing guidance for future ICT related initiatives.

This chapter provides a description of the steps taken to arrive at the findings of this research. The research questions formed the basis of the research, and the results and evaluation of the findings are presented in alignment with each research question. The research employed five (5) research tools, namely, a teacher questionnaire administered to teachers, student questionnaire for students, interview schedule for educational leaders, observation schedule for classroom practices and data analysis tool for the review of the core curricula used in schools. Importantly, although each tool was aligned to a specific research question, they also captured data that was used to respond to aspects of other research questions.

One of the theoretical frameworks of the study focused on the Theory of Change which is an approach whereby underlying assumptions about a particular project involving change are made explicit and the desired outcomes are used to direct the planning, implementation, and evaluation of the programme (Reinholz & Andrews, 2020). The integration of ICTs in the core curricula of schools required stakeholders to acknowledge that change is necessary, and the outcome of the change is dependent upon their acceptance of that change. Additionally, acceptance of the change will direct the way a project is planned, implemented, and evaluated.

Another theory which guided the assessment of the ICT integration process was the Unified Theory of Acceptance and Use of Technology (UTAUT) which uses the variables of expectancy of performance, expectancy of effort, social influence by important people, and enabling conditions to determine acceptance and adoption of technology (Venkatesh et al., 2003). Based on the UTAUT theory, once change is introduced, and it is anticipated that it will be positive change, acceptance would most likely follow once the right amount of effort is exerted by the individuals involved, and there is use by significant people once the enabling conditions for the change are provided. Further, the TPACK theoretical framework advocated by Koehler et al. (2013) signals the need for teachers to have content knowledge, technological knowledge, and pedagogical knowledge for ICT integration to be effective.

The mixed method approach was used to obtain data to address the five research questions which guided the study. The research adopted a pragmatic approach based on the nature of the research and followed the sequential explanatory design. The research employed five (5) tools to gather data and in keeping with the sequential explanatory design, the quantitative data were collected first followed by the collection of the qualitative data. It is important to note that rigor was a significant aspect of the research since it is purported to play an important role in distinguishing scientific research from ordinary research and ensuring consistency on a scientific basis as the research questions are answered and conclusions are derived (Eryilmaz, 2022).

Results

This research collected data by means of both qualitative and quantitative sources using several research tools to include teacher and student questionnaires, document reviews, interviews, and observation of practice. The data from each tool were analysed and subsequently

triangulated to determine if the results converged and arrived at the same conclusions or diverged to arrive at different conclusions. Convergence of the results would increase the validity of the data while divergence of the results with contradictory findings would question the validity of the data to some extent. Additionally, the findings may relate to different areas of the phenomenon and complement the results from individual tools (Heale & Forbes, 2013). It must be noted that each research tool was specific to a group of participants and or aspects of the research but the responses to the research questions were not limited to any one research tool and to any one set of participants. To clearly address the research questions and triangulate the responses for each tool, this section will report the findings using the research questions to which they are aligned as guides.

Research Question 1

To what extent does the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflect ICT components?

This research question focussed on the core curricula of Mathematics, English, Biology and Social Studies to determine the extent to which they reflected ICT components. This research question was mainly answered through the document reviews of the syllabuses used in Forms two (2) to four (4) for the core subject areas in public secondary schools in Antigua and Barbuda and to some extent, observation of practice and teacher and student questionnaires. Interviews with educational leaders also contributed to answering the research question.

Document Reviews of Syllabuses

A document is any written or recorded material that is not specifically prepared for research or evaluation purposes (Lincoln & Guba, 1985), and to acquire the data required for this research, a document analysis guide was used to capture the data from the documents. According

to Denscombe (2017), any document to be used as a source of data for research should be authentic, representative of the nature of the document, clear in meaning and valid. The syllabuses for the core subjects are public documents which were crafted by the Caribbean Examinations Council (CXC) for use by teachers in secondary schools to prepare students with the skills and competencies needed for life which culminates with their school exit exams when they progress to form five (5). The syllabuses are readily accessible from the Caribbean Examinations Council's (CXC) website which vouches for a level of authenticity and representativeness of the documents. The contents of the syllabuses are clear and valid having gone through quality assessment checks for content accuracy and relevance by subject panels comprising subject specialists who represent the Caribbean territories as mandated by the organization. It is important to note that students have been engaged in using the syllabuses from Form one (1) which is the lowest level of secondary schools, where the foundation of each syllabus is taught. This is then followed with a natural progression to the more difficult concepts as they advance to higher levels of secondary schools with culmination of use at Form 5.

Research question number one (1) sought to find out the extent to which the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflect ICT components, and a document review guide was used to answer this question. The core curricula for Forms two (2) to four (4) were analysed for the presence of ICT components and the information logged using a document review tool comprising of four (4) statements reflecting the number of ICT components found in the English, Mathematics, Biology and Social Studies syllabuses. The information was recorded using a 5-point Likert-type scale ranging from one (1) to five (5) with one (1) representing 'Not at all', two (2) representing 'Small extent', three (3) representing 'Moderate extent', four (4) representing 'Great extent' and five (5) representing

‘Entirely’. The document review protocol also comprised four (4) statements which required documentation of evidence of the actual ICT components identified in each core syllabus reviewed.

The document review process entailed reading and rereading each document to ascertain the presence of ICT components which were then recorded. The process was then followed by coding of the information to ensure that all the ICT components were noted. The documents were then read and reread to certify that all codes were noted which were then placed into themes by the researcher. It is important to note that each of the syllabuses reviewed did not have specific mention of ICT components in the content of the documents but there was evidence of learning objectives that required the use of ICTs to complete tasks. The documents encouraged teachers to include 21st Century skills in their teaching which required the utilization of technology for learning in classes. The ICT components found in each syllabus were noted to determine the extent to which they are embedded in the documents.

English Syllabus

A review of the English Language syllabus revealed several specific learning objectives that required the use of ICT devices, for example, ‘listening to recordings to critique a narrative’, ‘watching videos and completing specific tasks’, ‘use of multimedia to project aspects of lessons’, ‘web searches’ and ‘audio clips of speakers for students to determine speaker’s purpose’ (CXC CSEC English Syllabus, 2022). The syllabus itself did not specify the types of ICT resources to be used to teach the learning objectives but it was implied in the requirements of the learning outcomes required at the various levels. The English Language syllabus required the use of several ICT devices to include computers, projectors, computer laboratories in some cases, internet, mobile phones, and digital recorders among others to adequately address various aspects

of the syllabus. According to the syllabus, a teacher of English is required to know how to use technology to increase and improve learning.

Social Studies Syllabus

The CXC Social Studies syllabus contains learning outcomes that once achieved will ensure that the students would have acquired adequate knowledge to negotiate the school exit examinations at form five (5) level and to navigate the world as global citizens. The syllabus presented suggested learning activities which the students are required to follow to negotiate several research projects requiring the use of ICT devices and the internet. In addition, the syllabus has learning objectives which required students to 'design a census', 'analyse the data', 'present data' and 'reporting of data' which also entailed the use of ICTs (CXC CSEC Social Studies Syllabus, 2019). Although the syllabus did not specify the ICT tools required to complete tasks, the nature of the learning outcomes necessitated the use of ICT tools to effectively negotiate the syllabus content at the various levels.

Biology Syllabus

A review of the Science (Biology) syllabus for CXC revealed the use of ICT components in the suggested teaching and learning activities given at the end of each section. The section on 'Living Organisms in the Environment' required the use of ICTs to 'record and report' during observations and 'collect, organize and present data' as well as 'create graphs and other charts' as needed throughout the syllabus. Other areas requiring the use of ICT components included 'video presentations' and the 'creation of movies or posters.' The biology syllabus is mainly designed for teachers to use various teaching and learning strategies incorporating the use of technology to inculcate skills such as problem-solving, critical thinking, innovation, and

communication in the students (CXC CSEC Biology Syllabus, 2021). Further, the syllabus indicates that a teacher of Biology is required to know how to use technology to improve learning.

Mathematics Syllabus

An examination of the Mathematics Syllabus revealed in its rationale that in keeping with the pledge made by the CARICOM Heads of Government, it should contribute to the formation of the Ideal Caribbean Citizen thus "demonstrate multiple literacies, independent and critical thinking and innovative application of science and technology to problem solving…." (CARICOM Heads of Government cited in CXC CSEC Mathematics Syllabus, 2016 p. 1). The syllabus contains a multiplicity of topics, but the topic entitled 'Statistics' requires the use of ICT components in several specific learning objectives to include 'construct a frequency table for a given set of data'; 'construct statistical diagrams'; or 'draw cumulative frequency curve' among others. Scientific calculators were also recommended for use with specific topics which is an indication of the embracing of technology. Though there were other specific objectives which required the use of ICT components, they were not explicit in the document. Teachers are expected to use technology to teach various aspects of the syllabus to inculcate critical thinking and problem-solving skills in the students (CXC CSEC Mathematics Syllabus, 2010-17)). Additionally, teachers are required to have technological and pedagogical knowledge in addition to content knowledge which is a major requirement for Mathematics.

The document review process revealed that the syllabuses comprised specific learning objectives throughout each unit that required the use of ICT components for student tasks to be completed. Additionally, the syllabuses did not name specific ICT components to be used in any section of the documents, learning objectives or specific contents, but the teaching strategies recommended for use to deliver the content suggested the employment of 21st Century skills

inclusive of the use of ICTs. This is commensurate with the cadre of skills which the 'ideal Caribbean citizen' is expected to obtain within schools from the region so that they can fit seamlessly into the global community where technology is rapidly developing (CARICOM, 2019).

The observation of practice also revealed to some extent that ICT components are reflected in the curricula of schools by their use by teachers in their practice. All classes observed used laptops for teaching and learning by teachers and students. Multimedia projectors, eBooks and internet were also used. It must be noted that teachers and students were issued with new laptops at the beginning of the school year 2021 to replace outdated devices issued in 2016, and the eBooks content for the subjects being pursued were loaded on each laptop. Further, more than 70% of the teachers observed in practice used ICTs to teach concepts. Fifty percent of the teachers also used ICTs to solve problems while teaching and 56 percent used ICTs to assign homework to the students.

The teacher questionnaire also revealed some evidence that ICTs are reflected in the curricula by 58 percent of the teachers who used them for student-centred learning and 67 percent who used them to teach new concepts. Further, many teachers (82%) indicated that they used ICTs for communication in class, while 67 percent used them as presentation tools, 82 percent use them for research purposes and 85 percent used them as problem-solving tools. In reference to the students' questionnaire, evidence of ICTs in the curricula could be seen in the students' use of ICTs for classwork ranging from a moderate extent to entirely. Students' use of ICTs for research showed as 84 percent while usage in core curricula classes ranged from 33 percent to 54 percent. The interviews with educational leaders also revealed that ICTs are present in curricula content to some extent with 50 percent of them indicating that ICTs are used by

teachers at their schools. Additionally, 100 percent of the educational leaders indicated the need for teachers to be pedagogically trained in ICT use to make the integration process more effective.

In summary, the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflected ICT components to a moderate extent as revealed by the data collected. While the syllabuses of the core areas do not specifically state the ICT components or devices that are to be used for the teaching and learning process, teachers and students engaged in their use in and out of school to include teaching new concepts, as research and productivity tools, for communication purposes and for other curricula activities as the need arose. Additionally, students reported use of ICTs for some class activities while educational leaders indicated the presence of ICTs in the curricula of schools to some extent by noting the number of ICT related class activities that take place at their schools.

Research Question 2 and Hypothesis 2

To what extent does the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools in Antigua and Barbuda?

Integral to answering this research question is the need to determine the extent to which the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public schools. Tools used to collect data in response to this question included the teachers' questionnaire, students' questionnaire, and observation of practice. The interviews with educational leaders also provided data which answered the research question to some extent. Hypothesis two (2) was used to address Research Question two (2) which sought to find out if there is a correlation between the Confidence and

Comfortability of teachers in using ICTs and the Integration of ICTs in the classroom. Teacher confidence and comfortability may play a major role in the extent of integrating ICTs components contained in the curricula of schools since confidence and comfortability are key indicators of knowledge which usually spurs use. Confidence in teachers suggests knowledge of what is to be taught and how it is to be taught, and teachers tend to show comfortability in teaching when those attributes are acquired.

The teacher questionnaire received responses from 115 teachers of public secondary schools. Eighty (80) percent of the participants were females and most of the participants had between 11 to 15 years of teaching experience. An equal number of participants taught English and Social Studies while the others taught Mathematics and Biology. Worthy of note is that most of the respondents have attained a bachelor's degree even though a teacher may qualify to teach in Antigua and Barbuda with minimum qualifications of five (5) CSEC subjects with Mathematics and English as mandatory subjects in addition to three (3) other subjects. It must be noted that a bachelor's degree or a certificate in teacher education are preferred qualifications for teaching.

Table 8 presents the demographics of the teacher sample.

Table 8

Demographics of Teacher Participants for Teacher Questionnaire

Demographics	Frequency N	Percent %
Gender		
Male	23	20
Female	92	80
Level of Education		
Doctorate	0	0
Masters	15	13
Bachelor	72	63
College	20	17
Diploma	8	07
Certificate	0	0
Other		
Number of years Teaching		
<5 years	12	10
5-10 years	25	22
11-15 years	36	31
16-20 years	24	21
>20 years	18	16
Core Subjects		
English	34	30
Mathematics	21	18
Science	34	29
Social Sciences	26	23

N=115

The teacher questionnaire was designed to solicit information about the integration of ICTs in schools by focusing mainly on teachers of core curricula. It was designed with five (5)

sections. The first section collected demographics on the respondents such as gender, qualifications, number of years as a teacher, school taught, and the core subject area taught. The second section of the questionnaire solicited responses on teacher preparation for use of ICTs in class by noting the ways in which they were prepared for teaching ICTs such as the training in the pedagogical use of ICTs received. The third section focused on the confidence and comfortability of teachers in using ICTs in the classroom which comprised eight (8) 5-point Likert-type scale statements ranging from one (1) to five (5) with one (1) representing 'Strongly Disagree', two (2) representing 'Disagree', three (3) representing 'Neutral', four (4) representing 'Agree' and five (5) representing 'Strongly Agree'. The fourth section related to school or administrative support comprising of seven (7) statements which required respondents to select a response in each row that best represented their level of agreement. The section supported a 5-point Likert-type scale with statements ranging from one (1) to five (5) with one (1) representing 'Strongly Disagree', two (2) representing 'Disagree', three (3) representing 'Neutral', four (4) representing 'Agree' and five (5) representing 'Strongly Agree'. Section five (5) consisted of 12 statements related to the integration of ICTs in the classroom which required the respondents to indicate the frequency with which they used ICTs in various teaching modes. This section supported a 6-point Likert-type scale with responses ranging from zero (0) to six (6) with zero (0) representing 'Not applicable', one (1) representing 'Not at all', two (2) representing 'Once per month or less', three (3) representing 'Once per week', four (4) representing 'Several times per week', and five (5) representing 'Every day'.

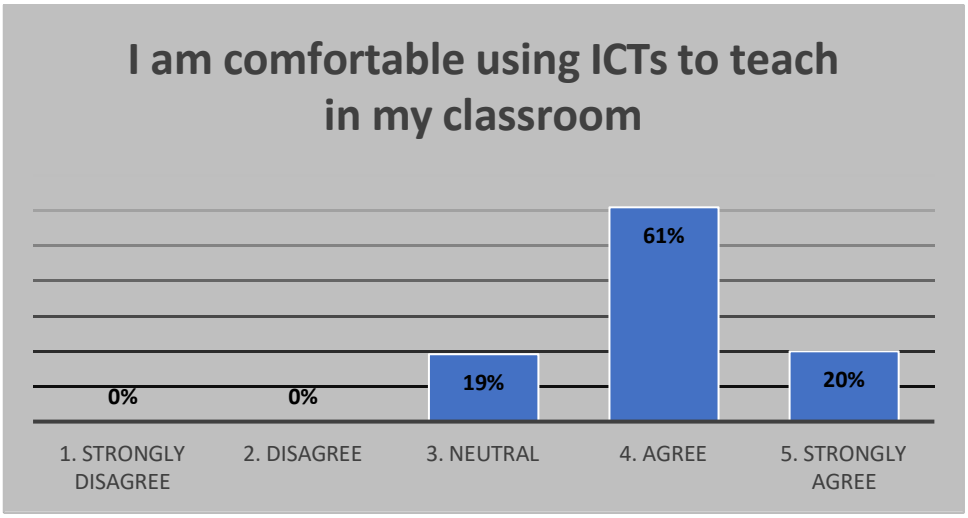
Section three (3) of the questionnaire related to teachers' confidence and comfortability in using ICTs in the classroom which is significant in answering Research Question two (2) which questions the extent to which the confidence and comfortability of teachers in using ICTs

contribute to the integration of ICT components contained in the core curricula of public secondary schools. Teachers' confidence and comfortability in using ICTs in the classroom play a significant role in the implementation of ICT components in the curricula that they teach since the extent of their use is likely to depend upon how confident they are with their ICT knowledge and how comfortable they feel in using them. Eight (8) statements using the 5-point Likert-type scale configuration addressed how teachers felt about using ICTs in their classes. It must be noted that for the purpose of this research, the responses 'agree' and 'strongly agree' denoted agreement while the responses 'disagree' and 'strongly disagree' denoted disagreement.

The first question relates to the extent of implementation of ICT components in class by addressing the adequacy of training of the teachers in using ICTs for which 59 percent of the respondents agreed that they have had adequate training. In response to their use of ICTs effectively in their classrooms, 61 percent of the teachers agreed with the statement. Twenty-nine (29) percent of the respondents remained neutral in response to their use of ICTs and ten (10) percent disagreed with the statement altogether. In response to the statement relating to comfortability while using ICTs to teach in their classrooms, 81 percent of the teachers agreed altogether. The remaining 19 percent of the teachers remained neutral on the matter as seen in Figure 4.

Figure 4

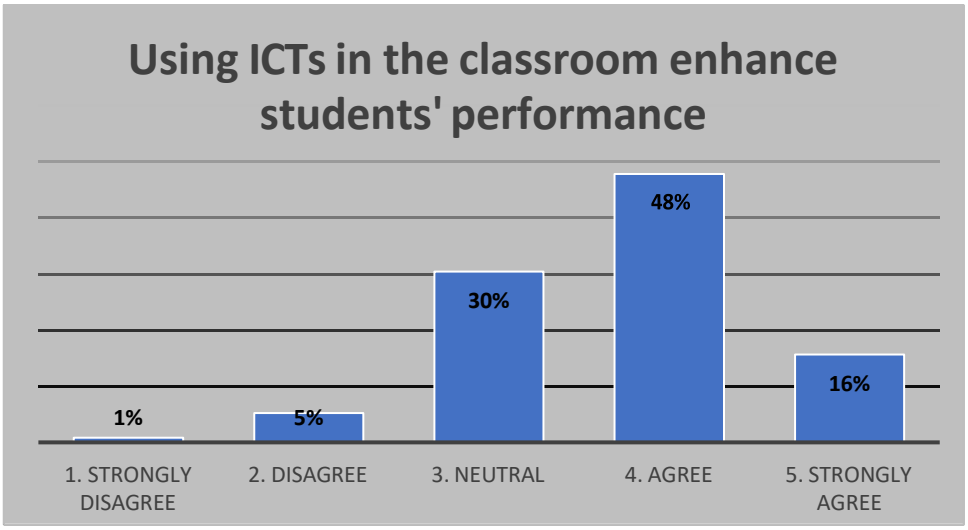
Teachers' responses to their confidence and comfortability levels in using ICTs to teach



The theme of teachers' comfortability playing a significant role in the extent of ICT integration in core curricula was evidenced by 80 percent agreeing that they are comfortable in giving students assignments using ICTs. Nineteen percent (19) of the teachers remained neutral while one (1) percent strongly disagreed. Worthy of note is that 78 percent of the respondents agreed that they are comfortable using ICT tools in the classroom, 17 percent of the respondents remained neutral while the remaining five (5) percent disagreed. Teachers who believed that their use of ICTs enhanced students' performance was represented by 64 percent who agreed with the statement while 30 percent of the teachers remained neutral while six (6) percent disagreed with the statement as can be seen in Figure 5.

Figure 5

Teachers' responses to use of ICTs in the classroom to enhance students' performance



In keeping with the theme of the extent of integration of ICT components in core curricula in schools because of teachers' confidence and comfortability was the need to note the views of those teachers who claimed that they were developing expertise when they used technology in the classroom. Fifty-seven (57) percent of the teachers agreed with the statement while 31 percent of them remained neutral and 12 percent disagreed. Additionally, teachers who were of the view that incorporating multi-media into lessons enhanced teaching was represented in 84 percent of the respondents agreeing to the statement which is likely to stimulate their interests in integrating ICTs in core curricula. Ten (10) percent of the teachers remained neutral while the remaining six (6) percent of the teachers disagreed.

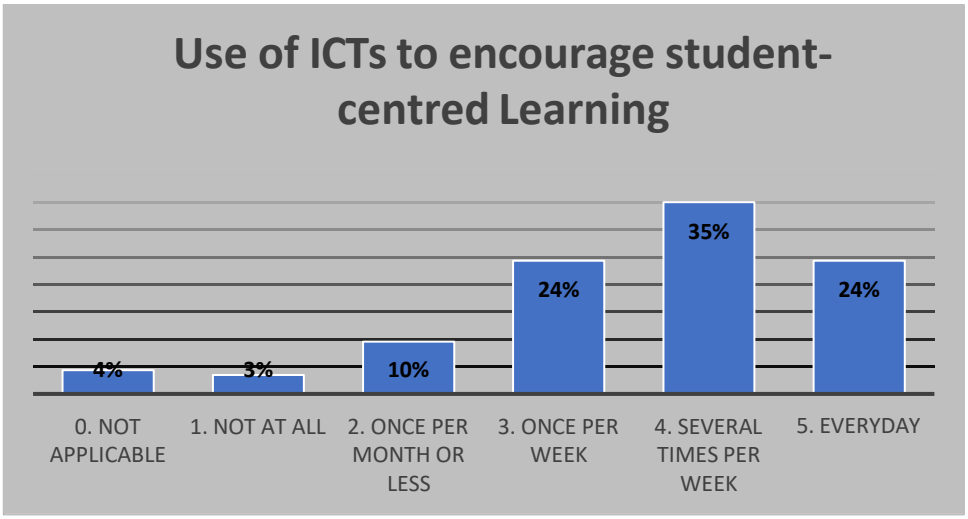
Assessing the integration of ICTs in the classroom is critical to this research and the fifth section of the teacher questionnaire entitled 'Integration of ICTs in the Classroom' addressed the extent of ICT integration in relation to teachers' confidence and comfortability as required by Research Question two (2). The section consisted of 12 statements to which the participants responded using a 6-point Likert type scale ranging from zero (0) to five (5) with zero (0)

representing ‘Not applicable’, one (1) representing ‘Not at all’, two (2) representing ‘Once per month or less’, three (3) representing ‘Once per week’, four (4) representing ‘Several times per week’ and five (5) representing ‘Everyday’. The statements relate to the frequency with which teachers engaged in varying teaching modes using ICTs at school which were directly aligned to the extent of integration of ICT components in core curricula of schools. The greater the use of ICTs for different modes of teaching, the more likely they will impact the extent of implementation or use. It must be noted that for the purpose of this research, the frequencies ranging from ‘once per week’ to ‘everyday’ are considered frequent which is described as moderate, while the responses relating to ‘once per month or less’ are considered negligible.

The engagement of teachers in using ICTs in individualized instruction and student-centred learning may be indicative of the teachers’ confidence and comfortability in using ICTs in schools since using them for those modes of teaching suggested some level of integration by teachers. In response to the statement requesting the frequency of use of ICTs for individualized instruction, five (5) percent of the teachers did not find it applicable, but three (3) percent indicated not at all, 32 percent said once per month or less, 17 percent indicated once per week, 32 percent said several times per week and nine (9) percent used ICTs for individualized instruction every day. In response to the use of ICTs encouraging student-centred learning, 24 percent indicated use once per week, 35 percent used them several times per week and another 24 percent used them every day as can be seen in Figure 6.

Figure 6

Teachers' use of ICTs in the classroom to encourage student-centred learning



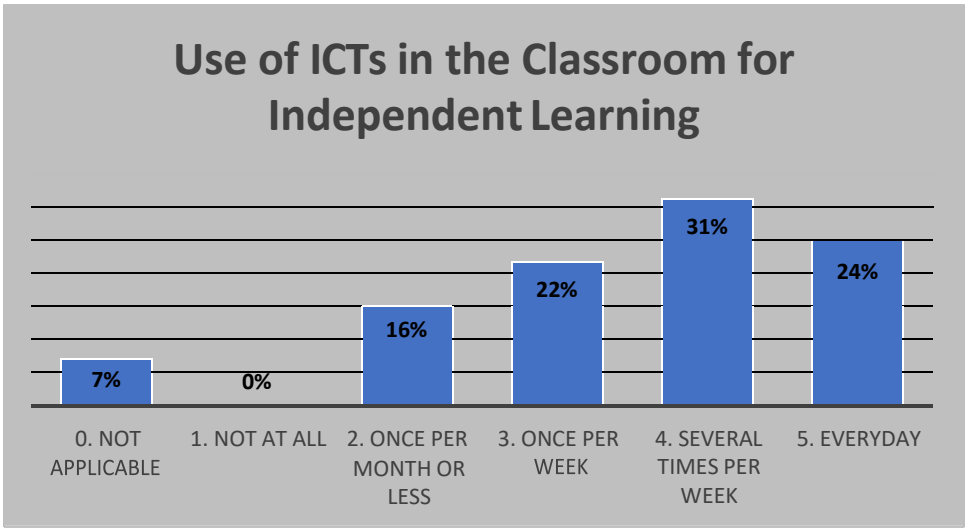
The extent to which the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools was also addressed by the responses of teachers on their use of ICTs for small group instruction which resulted in five (5) percent of the teachers to whom it was not applicable, four (4) percent who indicated not at all, 39 percent who indicated once per month or less, 24 percent once per week, 22 percent several times per week and six (6) percent every day. In reference to ICTs being used for cooperative group work, nine (9) percent of the participants were of the view that it was not applicable to their situation and 10 percent indicated that they did not use ICTs for cooperative group work. The remaining respondents were divided with 30 percent indicating once per month or less, 20 percent once per week, 23 percent several times per week and eight (8) percent every day. The statement which related to the use of ICTs as a reward revealed 25 percent of the respondents who said it was not applicable, 38 percent said not at all, 15 percent indicated once per month or less, 12 percent said once per week while ten (10) percent indicated several times per week. The large percentage of teachers who found the use of

ICTs as a reward either not applicable or do not use them at all for that purpose is indicative that implementation of ICTs for that purpose is quite negligible by many respondents and may not be considered a priority in the teaching and learning process.

One area that shows a high percentage of integration of ICTs in the core curricula is in independent learning. In response to the statement, over 50 percent of the respondents selected either once a week or several times per week and 24 percent said every day as seen in Figure 7.

Figure 7

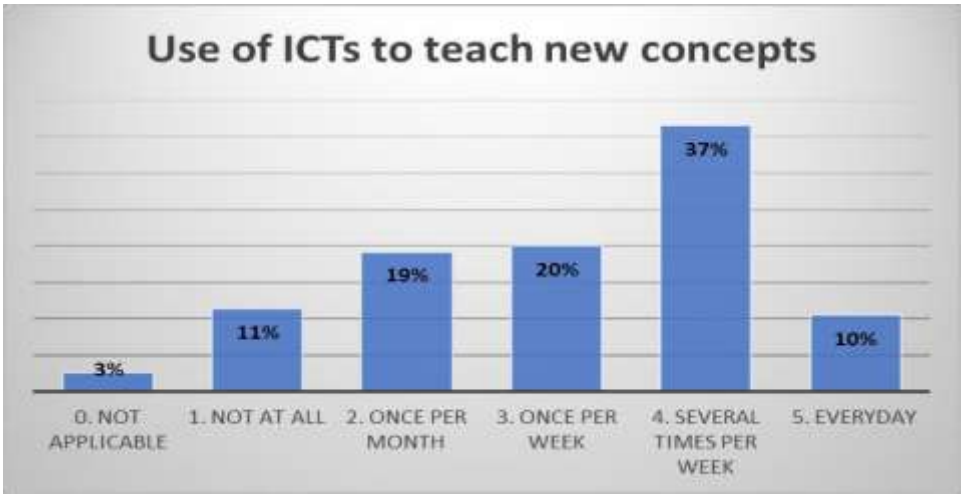
Teachers' use of ICTs in the classroom for Independent Learning



Another area related to the extent of ICT integration in core curricula that may be linked to teachers' confidence and comfortability was their use in teaching new concepts. In relation to ICTs being used in the classroom to teach new concepts, three (3) percent of the respondents claimed it was not applicable and 11 percent indicated that they did not use it at all. Nineteen percent of the participants used ICTs to teach new concepts once per month or less while 20 percent used them at least once per week. The highest percentage recorded for using ICTs to teach new concepts was a total of 47 percent of the remaining respondents using them several times per week or every day as can be seen in Figure 8.

Figure 8

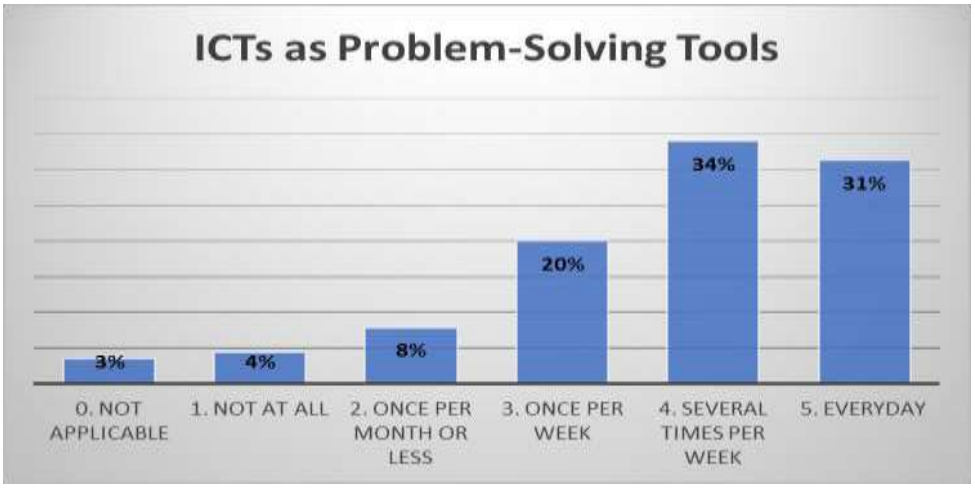
Teachers' use of ICTs to teach new concepts



The use of ICTs as a research tool in the classroom was suggested by teachers as a frequently used mode of teaching with high frequencies recorded for use once per week or higher. Twelve (12) percent used ICTs as a research tool once per month or less, 13 percent used them once per week, 69 percent used them several times per week or every day. Only three (3) percent of the respondents indicated that it was not applicable to their situation while three (3) percent said not at all. In response to the use of ICTs as a problem-solving tool, three (3) percent of the respondents claimed that it is not applicable for their situation and another four (4) percent indicated not at all. Eight (8) percent of the respondents indicated that they were used once per month or less while 20 percent used them once per week. High frequencies were recorded for the use of ICTs as problem solving tools which was selected by 65 percent of the respondents as used several times per week or every day. Figure 9 shows the breakdown of responses by teachers for the use of ICTs for problem solving by students.

Figure 9

Teachers' responses to the use of ICTs as problem solving tools for students



In responding to the statement of ICTs being used as a productivity tool to create charts, letters and other activities, 12 percent indicated that it was not applicable while seven (7) percent specified not at all. The remaining responses were presented as 28 percent for once per month or less, 23 percent once per week, 30 percent as several times per week or every day. The next statement in the section of the questionnaire relating to integration of ICTs in the classroom surrounds their use as a classroom presentation tool. In response to that statement, six (6) percent of the respondents claimed that it was not applicable to their situation and 10 percent said that ICTs were not used in their classes for that purpose at all. Seventeen (17) percent of the participants indicated that they were used once per month or less while 15 percent of them used ICTs for classroom presentation purposes once per week. Further, 39 percent of the respondents used ICTs for presentation several times per week while the remaining 13 percent indicated use every day. The final statement for that section of the questionnaire related to ICTs being used as a communication tool. Three (3) percent of the respondents indicated that it was not applicable to their situation, while three (3) percent stated that they did not use it for that purpose. Twelve

percent indicated use for communication once per month or less, 19 percent indicate use once per week while 63 percent indicated use several times per week or every day.

Of significance is that the teacher sample for the teacher questionnaire comprised teachers of core curricula who were all given laptops for teaching. Eighty-three (83) percent of the teachers surveyed used ICTs in their classes for student-centred learning which suggest a relatively high level of implementation. Additionally, 67 percent of them used ICTs to teach new concepts while 54 percent of the students on the students' questionnaire indicated that they used ICTs for classwork from a moderate extent to entirely.

Observation of practice revealed that 70 percent of the teachers observed used ICTs specifically to teach new concepts from a moderate to great extent while 28 percent did so to a small extent, while there were no classes observed where ICTs were not part of the delivery. In response to the statement which referenced the observance of the use of ICTs for consolidation of concepts by teachers, it was noted that 56% of the classes used them for that purpose to a small extent while 39 percent used them to a greater extent.

In response to the extent to which the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools, the students' questionnaire revealed less than 50 percent of the students engaged in ICT usage in Mathematics, English, and Science classes while 54 percent of them used ICTs in Social Studies classes. The less than 50 percent use of ICTs in core subjects indicated by students is corroborated by 63 percent of the educational leaders who indicated the need for more training in ICT integration for their teachers. Worthy of note is that 84 percent of the students used ICTs for research in class even though usage in class for core subjects were significantly lower.

Hypothesis 2

H_0 There is no significant difference between the Confidence and Comfortability of teachers in using ICTs and the Integration of ICTs in the classroom.

H_1 There is a significant difference between the Confidence and Comfortability of teachers in using ICTs and the Integration of ICTs in the classroom.

This hypothesis was used to reveal the relationship between one set of dependent and independent variables to better understand the ICT integration process. It is aligned to Research Question two (2) since the extent of integration of ICT components in the core curricula of schools may be influenced by the degrees of confidence and comfortability teachers have when using ICTs. This hypothesis was used to determine if the confidence and comfortability that the teachers have in using ICTs influenced their use of ICT components in the classroom. This hypothesis was tested using the ANOVA p-value test which rejected the null hypothesis. The results of the test revealed a p-value of 1.10E-13 < 0.05, and F-statistic 62.57771 > F-Critical Value 3.882568, which resulted in the rejection of the null hypothesis and the acceptance of the alternative hypothesis. See Table 9 for the results for hypothesis two (2). That suggests that there is a significant difference between the Confidence and Comfortability of teachers using ICTs in the classroom and the Integration of ICTs in the classroom.

Table 9

Summary of ANOVA Test for Hypothesis 2

Groups	*Count*	*Sum*	*Average*	*Variance*
AVERAGE 27-38	115	350.3333	3.046377	0.835671
AVERAGE 12-19	115	437.25	3.802174	0.214085

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	32.84568	1	32.84568	62.57771	1.10E-13	3.882568
Within Groups	119.6723	228	0.524878			
Total	152.5179	229				

In summary, it was revealed that the confidence and comfortability of teachers in using ICTs contributed to some extent to the integration of ICT components contained in the core curricula of public secondary schools. Eighty-one (81) percent of the teachers feel comfortable in using ICTs to teach and 61 percent claim that they use ICTs effectively in the classroom. ICTs were implemented to some extent in the core curricula of public secondary schools with over 50 percent of the teachers having had adequate training in ICTs even though it was revealed that 57 percent were developing competencies. The remaining teachers were limited in their use of ICTs which was corroborated by 63 percent of the education leaders who indicated that some teachers at their schools required more training in using ICTs to teach. Teachers showed confidence and comfortability in using ICTs for teaching to a moderate extent while students used ICTs to learn to a lesser extent in their core curricula classes, when it is noted that less than 50 percent of the students indicated that they used ICTs in at least three (3) of their core classes. The data received from teachers, students, educational leaders, and observation of practice showed a degree of

convergence of the data as it relates to research question two (2) which focused on the extent to which the confidence and comfortability of teachers in using ICTs contributed to the integration of ICT components contained in the core curricula of public secondary schools. Further, the results revealed that hypothesis two (2) which was tested to determine if there is a significant difference between the independent variable of the Confidence and Comfortability of teachers in using ICTs and the dependent variable of Integration of ICTs in the classroom has proven to be significant which has great significance for the extent of implementing ICT components contained in core curricula of public secondary schools in Antigua and Barbuda.

Research Question 3/ Hypothesis 1

How does the ICT knowledge of teachers affect their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda?

This research question sought to determine the relationship between the teachers' knowledge of ICTs and their use for teaching core subjects in public secondary schools. It was addressed primarily by the findings of the teachers' questionnaire followed by the results from the students' questionnaire, observation of practice and the results from the interviews with educational leaders. This research question was aligned with Hypothesis one (1) which sought to determine if there was a significant difference between the ICT Knowledge of Teachers and the Integration of ICTs in the classroom.

The correlation between teachers' knowledge and their use of ICTs in the classroom was captured in the teacher questionnaire in the sections entitled 'Teacher Preparation for the use of ICTs in the classroom' and 'Integration of ICTs in the classroom'. Seventy-six (76) percent of the teachers have attained master's or bachelor's degrees but may not have had training specifically in ICTs. To determine teachers' training in ICTs, the next question in the

questionnaire required the teachers to indicate if they had training specifically in ICTs. In response to the teachers receiving training in ICTs, 54 percent of the teachers received moderate to full training as part of their undergraduate programmes, 57 percent received training as part of an in-service programme, 69 percent learnt ICTs on their own through online tutorials or books and 54 percent learnt through distant learning. On the other hand, 70 percent of the teachers were not exposed to ICTs as part of their graduate programme but may have been exposed to ICTs at another level, and 50 percent did not receive training from interacting with or receiving instruction from other staff members.

Teacher preparation is an essential part of integrating ICTs in the curricula of schools and that section of the teacher questionnaire is pertinent in answering Research Question three (3) which sought to determine if teachers' knowledge of ICTs influenced their use for pedagogical activities in public secondary schools. Thirty-seven (37) percent of the respondents acquired ICT skills to a moderate extent through in-service courses or workshops while 43 percent were trained to a small extent through independent learning, with another 43 percent being trained largely by interacting with or learning from other staff members. Fifty-seven (57) percent of the respondents did not receive training through their graduate programmes and 26 percent of them did not receive any training as part of their undergraduate coursework. Worthy of note is the 69 percent of the respondents who received training from a moderate to high extent through independent learning as can be seen in Table 10.

Table 10

Teacher Preparation for ICT use in classroom

Teacher Preparation for ICT Use	Percentage Responses (%)				
	Not at all	**Small Extent**	**Moderate Extent**	**Great Extent**	**Entirely**
A course as part of undergraduate programme	26	20	22	25	7
Part of a Graduate programme	57	13	17	10	3
In-Service Workshop or Professional Development	10	32	37	18	1
Instructions from other staff	7	42	30	19	2
Independent Learning	3	28	23	43	3
Distance Learning Courses	26	20	16	28	10

To determine whether the ICT knowledge of teachers affected their use of ICTs for pedagogical activities, the teachers were required to indicate how often they used ICTs for specific teaching modes by selecting an option ranging from ‘not at all’ to ‘everyday’ and in cases when the situation does not apply to them, they were given the option to select ‘not applicable’. The report on the use of ICTs focused on all modes of teaching to which responses ranged from ‘once per week’ to ‘entirely’. Bearing in mind that most of the teachers received some form of training in the use of ICTs for teaching, 58 percent of the teachers indicated that they used ICTs for individualized teaching, 83 percent used them for student-centred learning and 52 percent used them for small group instruction. Worthy of note is that most of the teachers

who have been trained in using ICTs to teach are those who have been teaching for less than 15 years which is represented by 63% of the teachers. Other modes of teaching using ICTs showed usage by teachers to include 51 percent for cooperative group work, 77 percent for independent learning, 67 percent for teaching new concepts and 82 percent as a research tool. Eighty-seven (87) percent of the teachers also used ICTs as problem-solving tools while 67 percent used them as presentation tools and 82 percent as communication tools. Based on the data received, one mode of teaching using ICTs that was not used by a large percentage of teachers was its use as a reward which is recorded as 78 percent (25 percent indicated not applicable, 38 percent claiming not at all and 15 percent only once per month). The combined percentage of 63 percent representing the 'not applicable' group and the 'not at all' group is indicative of the lack of appeal for its use as a reward.

Research question three (3) was also addressed in the student questionnaire when the students were asked to respond to statements about their use of ICTs for the core subjects of English, Mathematics, Social Studies, and Biology. Students' use of ICTs in core classes for classroom activities ranged from 33 percent to 54 percent when calculated based on the options ranging from a moderate extent to entirely. It must be borne in mind that students' use of ICTs in class is greatly dependent on use by teachers and may be considered a good indicator of the extent of the ICT knowledge of teachers and their use for pedagogical activities. The students' responses regarding use of ICTs in the core curricula areas were somewhat below the level of use in classes indicated by the teachers. Table 11 shows the extent of ICT use for the core subjects as indicated by students.

Table 11

Extent of ICT use for Core Subjects by Students

Statements	Extent of ICT usage (%)				
	Not applicable	**Small Extent**	**Moderate Extent**	**Great Enti Extent**	**rely**
I use ICTs in my English Classes	30	21	29	13	7
I use ICTs in my Mathematics Classes	23	44	11	15	7
I use ICTs in my Social Studies Classes	36	10	34	13	7
I use ICTs in my Biology Classes	29	28	23	15	5

Fifty (50) percent of the educational leaders (coded as A, B, D, G) also responded to Research Question number three (3) when they indicated that some teachers 'shy away from using ICTs' which happens because of the 'limited knowledge of teachers' in using ICTs. Additionally, 50 percent of the educational leaders claimed that ICTs were 'present on some levels' at their schools which suggested some knowledge of ICTs by some teachers.

Observation of practice also revealed use of ICTs by teachers for several activities that are pedagogical in nature including the teaching of new concepts (72 percent), the solving of problems (50 percent) and assignment of homework using ICTs (56 percent). As part of the observation of practice, the teachers were asked to indicate how they incorporated ICTs in the

teaching of their core curricula of their respective subjects and their responses were captured in their own words as follows:

English Teacher 1

> I use ICTs to teach English, but only when I am able. I have problems with the internet, but I try to work with it when it is available. I often have my laptop and the students have their phones and laptops and I use them to teach listening and comprehension skills. On an average, I use ICTs to each listening skills in about 60 percent of my classes and for comprehension, it's about 40 percent. The students love when I use ICTs.

English Teacher 2

> To be honest, I am not very comfortable using technology. My colleagues use the laptops to teach, and I do so sometimes. I mainly use the traditional method where I ask the students to read, or I read to them. I am still learning.

English Teacher 3

> I am trained in using ICTs, so it is a natural part of my lessons. I use them for many of my classes especially when teaching storytelling and comprehension and sometimes I record the students when they make presentations in class and play them back for discussions. Most of my lessons include using ICTs for learning.

English Teacher 4

> I just graduated from university and a major part of my training was using ICTs to teach. I consider myself competent in using technology and it is a major part of my classes. My students like it when I use technology as part of instruction. Technology brings the class alive.

English Teacher 5

My principal encourages us to use technology for teaching especially since we received laptops from the government for that purpose. I use it in my classes as much as I can, but I have to call my colleague to assist me with technical issues. I attend all technology workshops with the hope that I will get better.

Mathematics Teacher 1

I use technology to teach Maths especially for those concepts that lend themselves to the use of technology. I use it to teach linear equations, geometry, and algebra. I know how to use it in my lesson, and I would say that I use it in about 50% of my classes. I get frustrated when I plan a lesson and I cannot get the internet to do it.

Mathematics Teacher 2

I have been teaching for 5 years and I enjoy using ICTs to teach. I got training in using technology to teach and I use it in my classes once it applies to what I am teaching.

Mathematics Teacher 3

I do not use technology to teach as I should. I know that technology is good, and it helps with learning, but the preparation needed is too much.

Mathematics Teacher 4

ICT use is advocated at my school for teaching Mathematics, and we have the resources needed to do so. The mathematics textbook is in the form of an eBook and some of the activities relate to technology to teach mathematical concepts. I like teaching using technology and it is good to see students learn using ICTs.

Biology Teacher 1

I have limited knowledge in using ICTs and my classes are not rich in ICT use. I would love to do more but I need to make the time to learn. My school has professional development sessions in using ICTs and during Covid, we had Google classroom training. I use the laptop only when I must present work in class using the projector and I call a coworker to set up for me.

Biology Teacher 2

I use technology only when I must because most of the times, there is no internet and some students do not have their laptops. I use technology when I am teaching new topics such as the digestive system when it is easy to find videos to show the stages. It makes teaching and learning easier.

Biology Teacher 3

Technology is key to learning. It is the way we should teach. I am comfortable using technology to teach and my students perform better. Most of my classes are taught using ICTs.

Biology Teacher 4

I use technology to teach many areas in Biology. It is easy because the eBook in biology is interactive, and it engages the students. I encourage the students to use their laptops and if needed they share devices so that they could follow in the class. Technology is used to teach at least 70 percent of my classes.

Social Studies Teacher 1

I use technology to start a new topic in Social Studies classes. I do not use them all the time, but I use them to explain difficult concepts and reinforce of those concepts already taught. I ask my students to make presentations based on their research in classes using ICTs.

Social Studies Teacher 2

Socials Studies is a subject that covers aspects of history, geography, government, politics and other social science topics and there are many technological resources that may be used to teach the subject. I use technology to teach as many aspects as possible of Social Studies that I can to engage the students. The students love it.

Social Studies Teacher 3

I did a course using technology to create charts, documents etc., basically the use of technological tools. I am not sure that I am using it to improve learning. I would like someone to show me some ways in which I can use technology to increase the students' knowledge. I guess I need to attend mote professional development sessions.

Social Studies Teacher 4

At least 50 percent of my classes use technology for learning. My students work independently to discover ideas for themselves, and they are encouraged to work in groups to learn. I often have presentations by students in my classes and this is because I set tasks using technology for in class activities and for homework.

Social Studies Teacher 5

I am fully trained to use technology for teaching. I incorporate technology for teaching. I use technology in almost all my classes. My students relish using technology to learn. The only drawback is that internet connectivity leaves a lot to be desired.

Research Question three (3) was aligned with Hypothesis one (1) which addressed the ICT knowledge of teachers and its effect on their integration of ICTs for in the classroom.

Hypothesis 1

H_0 There is no significant difference between the ICT Knowledge of Teachers and the Integration of ICTs in the classroom.

H_1 There is a significant difference between the ICT Knowledge of Teachers and the Integration of ICTs in the classroom.

Hypothesis one (1) which relates to Research Question three (3) shows a null hypothesis which indicates that there is no significant difference between the independent variable of the ICT knowledge of teachers in the classroom and the dependent variable of Integration of ICTs in the classroom. This hypothesis was used to determine if the knowledge of teachers in using ICTs increased their use of ICTs in the classroom. This hypothesis was tested using the ANOVA p-value test which rejected the null hypothesis. The results of the test revealed a p-value of 0.000154 < 0.05, and F-statistic 14.81239 > F-Critical value 3.882568, which showed a rejection of the null hypothesis and accepted the alternative hypothesis. This suggests that there is a significant difference between the ICT knowledge of teachers for use of ICTs in the classroom and the Integration of ICTs in the classroom. See Table 12 for the results for hypothesis 1.

Table 12

Summary of ANOVA Test for Hypothesis 1

Groups	*Count*	*Sum*	*Average*	*Variance*
AVERAGE 6-11	115	304.5	2.647826	0.397546
AVERAGE 27-38	115	350.3333	3.046377	0.835671

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	9.133454	1	9.133454	14.81239	0.000154	3.882568
Within Groups	140.5868	228	0.616609			
Total	149.7203	229				

In summary, the findings for research question 3 revealed that the ICT knowledge of teachers influenced their use for pedagogical activities to some extent. It was noted that over 50 percent of the teachers received some form of ICT training as part of their degree programmes or with assistance from staff members or independently via online courses. It was also revealed that most of the teachers who were trained in using ICTs to teach were those who have been teaching for 15 years or less. This suggests that the 37 percent of teachers who have been teaching for over 15 years may not be current in the use of technology to improve teaching. The frequency with which teachers used various modes of teaching was also reflective of their knowledge of ICTs which was noted as 86 percent for student-centred learning, 82 percent for their use of ICTs as research tools as well as communication tools. According to Ishaq et al. (2020), integrating ICTs using different modes of teaching could influence the relationship between teachers teaching and students learning which will encourage students to learn and motivate them in attaining optimal academic performance. The findings of the students' questionnaire relating to the ICT knowledge of teachers was reflected in the students' responses to the teachers' use of ICTs for teaching the core areas which was equal to or less than 54 percent for each core subject area. Although the results showed convergence in teachers' knowledge affecting their use of ICTs for pedagogical purposes, there was some divergence as it related to the extent to which they were used for pedagogical purposes by all teachers especially in relation to their lower-than-average use in the core subjects based on responses from students in the students' questionnaire.

Observation of practice revealed teachers use of ICTs to a moderate extent which related significantly to the teachers' knowledge of ICTs. Teachers who had limited knowledge of ICTs were very restricted in their use in the classroom and this was expressed by those teachers in

their own words. It was noted that those teachers who were trained specifically in using ICTs pedagogically were more inclined to use them for most of their classes.

In addition, the results revealed that hypothesis one (1) which was tested to determine if there is a significant difference between the independent variable of the ICT knowledge of teachers and the dependent variable of Integration of ICTs in the classroom has proven to be significant which has great implication for the way in which the ICT knowledge of teachers affect their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda.

Research Question 4

To what extent do students use ICT components for core curricula learning activities in public secondary schools in Antigua and Barbuda?

This research question focused on the use of ICTs by students for core curricula learning and it was addressed primarily in the students' questionnaire and to some extent in the teachers' questionnaire and the observation of practice. The students' questionnaire sought the views of the students on their use of ICTs in school by asking them to respond to several statements in a 5-point Likert-type scale configuration to which they responded in a range starting from 'Not at all' to 'Entirely'. The responses that ranged from 'Moderate extent' to 'Entirely' in this research were considered as reasonable or moderate evidence of use of ICTs for learning by the students in core curricula areas.

Student Questionnaire

The student questionnaire was designed to assess the integration of ICTs into the core curricula of public secondary schools with a focus on students' use of ICTs for learning. The questionnaire sought to provide answers to research question four (4) by examining use of ICTs

by students in school. The questionnaire comprised two sections, the first section focused on the demographics of the participants to include gender, age, school, and grade level. The second section focused on the students' knowledge and use of ICTs in school with 14 statements using a 5-point Likert-type scale configuration with responses including 'Not at all', 'To a small extent', 'To a moderate extent', 'To a great extent', and 'Entirely'.

The student questionnaire was administered to 163 participants with 66 percent being females. The participants were selected using the simple random sampling technique from 10 public secondary schools spanning three (3) grade levels, and their ages range from 13 years to 20 years. Table 13 shows the demographics of the student participants in the research.

Table 13

Demographics of Student Participants

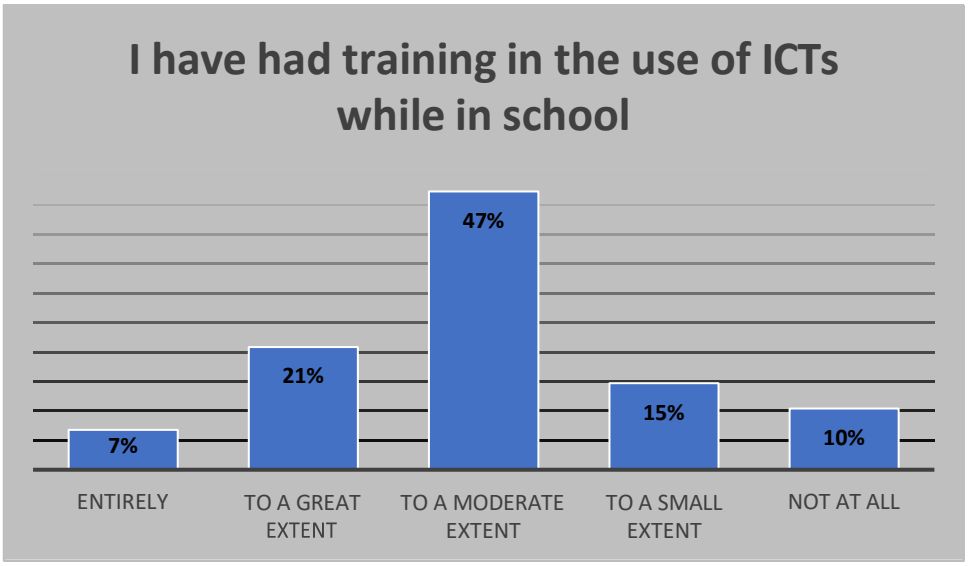
Demographics		Frequency N	Percent %
	Gender		
	Male	55	34
	Female	108	66
Age of Students			
	13 years	28	17
	14 years	45	28
	15 years	40	25
	16 years	44	27
	17 years	04	2
	17+ years	02	1
Secondary Schools			
	School 1	15	9
	School 2	18	11
	School 3	19	12
	School 4	24	15
	School 5	13	8
	School 6	20	12
	School 7	5	3
	School 8	14	9
	School 9	17	10
	School 10	18	11
Grade Levels			
	Form 2	14	9
	Form 3	80	49
	Form 4	69	42

N=163

Effective use of ICTs by students is likely to be dependent on their knowledge and use of ICTs. The first statement in section two (2) of the questionnaire is related to training in ICTs that the students would have attained before enrolling in secondary school. Eight (8) percent of the respondents claimed that they have been trained entirely while two (2) percent indicated that they were primarily trained, 18 percent to a moderate extent, 40 percent to a small extent and 32 percent have not been trained before enrolling in secondary school. In response to the statement related to receiving training in the use of ICTs in school, 75 percent of the respondents indicated being trained ranging from primarily moderate to great extent, while the other respondents received training to a small extent or not at all as can be seen in Figure 10.

Figure 10

Students' responses to training in the use of ICTs in school

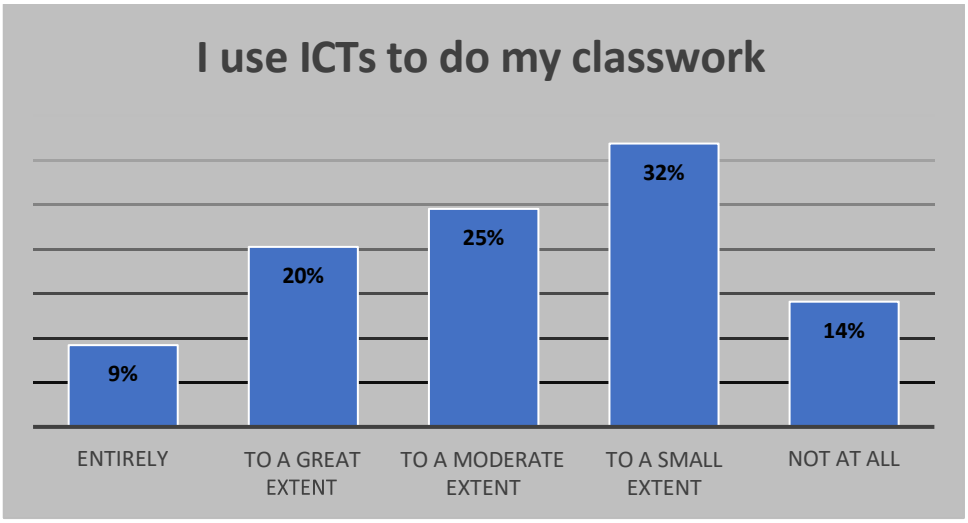


In response to the statement on students having access to ICTs at school to do schoolwork, 20 percent of the participants indicated that they have access entirely, 39 percent primarily have access, 23 percent to a moderate extent, nine (9) percent to a small extent and the remaining nine (9) percent claimed that they have no access whatsoever. In relation to the

statement requiring the respondents to indicate their use of ICTs to do classwork, nine (9) percent claimed that they used it entirely, 20 percent primarily indicated use, 25 percent used them to a moderate extent, 32 percent to a small extent and 14 percent did not use them at all for classwork as can be seen in Figure 11.

Figure 11

Students' responses to use of ICTs to do Homework



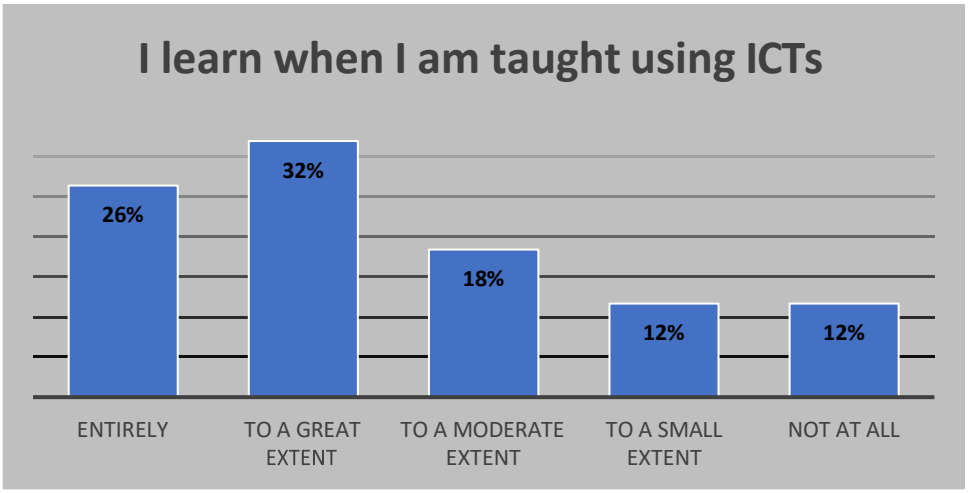
In response to the use of ICTs to do homework, nine (9) percent indicated that they used them entirely, 35 percent primarily used them, 12 percent used them to a moderate extent, 34 percent to a small extent and 10 percent do not use them at all to do homework. In reference to the statement related to use of ICTs to do research, 47 percent used them entirely, 21 percent primarily used them, 16 percent to a moderate extent, 11 percent to a small extent and five (5) percent did not use them at all to do research.

In reference to the statement related to use of ICTs in English classes, seven (7) percent of the respondents claimed to have used them entirely, 13 percent primarily used them, 29 percent used them to a moderate extent, 21 percent used them to a small extent and the remaining 30 percent of the respondents did not use them for their English classes at all. Regarding the next

statement which asked about the use of ICTs in Mathematics classes, seven (7) percent responded that they used them entirely, 15 percent primarily used them, 11 percent to a moderate extent, 44 percent to a small extent and 23 percent did not use them in Mathematics classes at all. The next statement was related to the use of ICTs in Social Studies classes, to which seven (7) percent of the respondents claimed to use them entirely, 13 percent primarily used them, 34 percent to a moderate extent, 10 percent to a small extent and 36 percent indicated no use at all. As far as the Science classes were concerned, five (5) percent of the respondents used ICTs for Science classes entirely, 15 percent primarily used them, 23 percent to a moderate extent, 28 percent to a small extent and 29 percent did not use them at all. In reference to learning when taught using ICTs, 26 percent of the respondents claimed that they learned entirely when ICTs are used to teach them and 50 percent of them claimed use either to a great or moderate extent. The remaining 24 percent represented those students who indicated learning to a small extent or not at all when using ICTs, as can be seen in Figure 12.

Figure 12

Students' responses on learning when taught using ICTs



In response to the statement which asked the respondents' opinions on whether ICTs should be used for teaching all subjects in school, 27 percent of the respondents said entirely, 15 percent said primarily, 33 percent said to a moderate extent, 19 percent indicated to a small extent and six (6) percent were of the view that ICTs should not be used for teaching all subjects in school. The next statement in the questionnaire required the respondents to give their opinions on whether they think that the school principal encouraged the use of ICTs for learning at school. This statement addressed the support given to students by principals to encourage learning using ICTs as well as created a link to research question five (5) which sought to find out if the schools environments promoted effective integration of ICT components in core curricula. In response to the statement, 11 percent of the students claimed to have the principals' support entirely, 37 percent indicated primarily, 29 percent to a moderate extent, 10 percent to a small extent and 13 percent said not at all. The final statement in the questionnaire addressed whether the respondents believed that the teachers were knowledgeable about the use of ICTs for teaching which will impact to some extent the use by students for core curricula learning activities. Twenty-six percent of the respondents believed entirely that the teachers are knowledgeable about the use of ICTs for teaching, 36 percent primarily indicated their agreement, 28 percent to a moderate extent, seven (7) percent to a small extent while three (3) percent indicated not at all.

Observation of Practice

Observation of classes in practice also provided data to answer research question number four (4). The observation of practice was a data collection activity where classes were selected using simple random sampling from any three (3) core content classes from forms two (2) to four (4) in any six (6) of the 10 public secondary schools taking part in the research. The observation of practice was done over the period of six (6) weeks. Eighteen classes were observed during the

observation period. Observations were unannounced but were only done with those teachers who have consented to be part of the research process and have signed and returned the informed consent forms. Observation of practice is a natural function of the monitoring process of the Ministry of Education officials and being one such official, the researcher seamlessly completed the process with the selected classes having received permission from the educational leaders of the respective schools. The observed classes were not video recorded for ethical reasons.

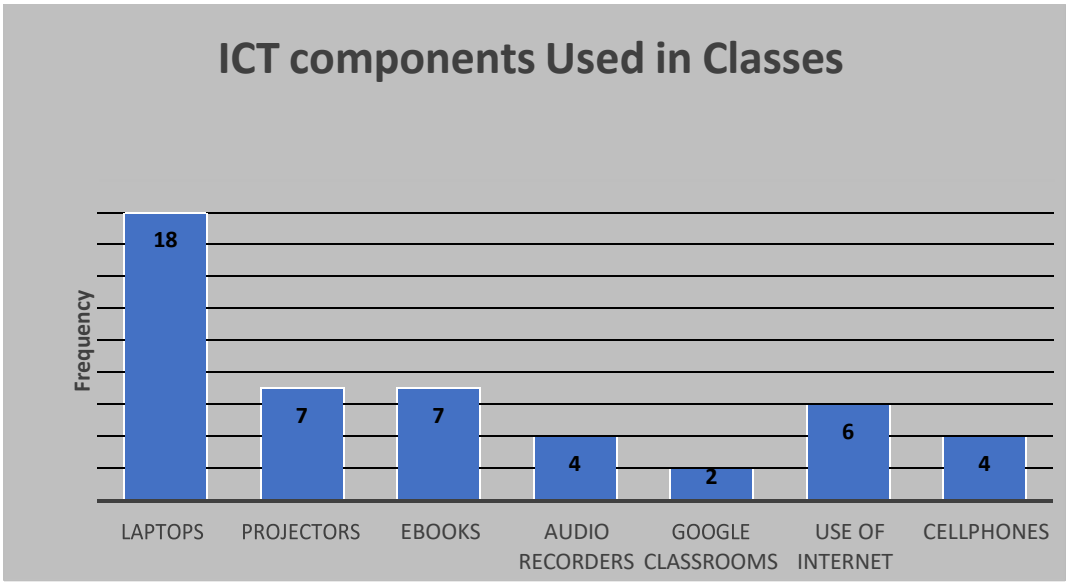
Observations were used to ascertain whether teachers and students used ICT components for core curricula learning activities in public secondary schools and to what extent (Research Question 4). The researcher used an observation protocol to record ICT related components used for the lessons observed. The observation protocol comprised a preliminary section with the name of the school, the subject and the class level being observed. That section was followed with five (5) statements specific to the use of ICTs in class by the teacher and students and to the use of ICTs for homework as set by the teachers for the students. The final section of the observation scheduled required the teachers to indicate how they use ICTs to teach in their subject areas. This aspect was recorded verbatim to be used as a 'rich description' for data processing. The observations of ICT use were recorded by the researcher using a 5-point Likert-type scale ranging from one (1) to five (5) with one (1) representing 'Not at all', two (2) representing 'Small extent', three (3) representing 'Moderate extent', four (4) representing 'Great extent' and five (5) representing 'Entirely'. Being aware that the Likert scale may be considered subjective for this activity, the report on section two (2) of the observation schedule which required the identification of the ICT components in each class was shared with each teacher for feedback on its accuracy which provided a measure of credibility for the data.

In response to Research Question number 4 which related to students' use of ICT components for core curricula learning activities in public secondary schools in Antigua and Barbuda, 66 percent of the classes observed had students using ICTs for independent learning and 50 percent had students using ICTs to solve problems. In response to the observation regarding the assignment of homework to students by teachers involving the use of ICTs, a total of 56 percent did so from a moderate to high extent and some teachers did not do so at all.

In response to the section that required the identification of ICT components that were observed in the lessons, the 18 classes observed had laptops being used to some extent in all classes. It was observed that in some classes, students did not have their laptops, but the teachers allowed them to share with other students to complete the activities. It must be noted that laptops in all classes observed referred to those used by teachers as well as students. Multimedia projectors and electronic books were among the most frequently used components observed as seen in Figure 13. Cell phones were mainly used by students to perform web searches for learning activities especially when they did not have their laptops.

Figure 13

Frequency of ICT Components used in Classes



In response to their use of ICTs in their respective subject areas, the teachers that had limited knowledge of ICTs were very restricted in their use in the classroom and those teachers who were trained in the pedagogical use of ICTs were motivated to use them for most of their classes.

To ensure credibility of the data collected, the teachers were shown a record of the ICT components identified in their lessons and were required to indicate any inaccuracies or omissions. The records were validated by the teachers, and it must be noted that one teacher claimed that an ICT component used in class was not reflected in the record. The teacher recounted the use of a cell phone in an English class to play a recording since the file on her laptop was corrupted. The researcher recalled the class situation and made the necessary change to the records.

The extent to which students were engaged in using ICTs for core curricula learning activities was also captured in the responses from the teacher questionnaire to some extent. Of

significance to research question number four (4) is that 83 percent of the teachers claimed use of ICTs for student-centred learning, 67 percent to teach new concepts, 85 percent used them for problem solving followed by 67 percent for presentations and 58 percent for individualized instruction. Use of ICTs by teachers for various modes of teaching suggest some use by students for learning since students are usually the beneficiaries of any teaching and learning exercise.

In summary, students use of ICTs for core curricula learning was relatively frequent as it was revealed that 75 percent of the students had training in the use of ICTs at school. Although 28 percent of the students had training before joining their schools, 82 percent of the respondents claimed that they have access to ICTs at their schools for learning. Students use of ICTs was also reflected in the 54 percent of them who used ICTs for classwork but when asked for use in the core subjects under review, the responses showed an average use of 45 percent in those subjects which is less than moderate. Additionally, during the observation process, teachers indicated that use of ICTs for their specific subjects is based on their knowledge of ICTs for teaching. Teachers' use of ICTs impacts to some extent the use by the students since students' use is usually dependent on the pedagogical activities planned by the teachers for instruction. This suggests use by teachers which signals the use of ICTs by students for learning activities to some extent.

Research Question 5

How does the school environment promote effective integration of ICT components in core curricula content of public secondary schools in Antigua and Barbuda?

This research question focused on the schools' environments and their conduciveness to the promotion of effective integration of ICTs in the core curricula of schools. This question was aligned to the data collected from interviews with educational leaders as well as from section

four (4) of the teachers' questionnaire which related to the general school or administrative support available at the school and sought the respondents' levels of agreement using a 5- point Likert type scale. Additionally, some responses given by the students in the student questionnaire also addressed the school environment and ICT integration to some extent.

Interviews of Educational Leaders

To gather data on Research Question number five (5), eight (8) educational leaders of public secondary schools were interviewed. The researcher began the interview preparation process with the intention of interviewing the 13 educational leaders responsible for the 13 public secondary schools in Antigua and Barbuda, but upon conducting eight (8) interviews, the responses were repetitive, and it was determined that a point of saturation had been acquired. The eight (8) interviews comprised more than 50 percent of the educational leaders representing public secondary schools in Antigua and Barbuda and was representative of the population.

To conduct the interviews, an interview protocol document was used to capture the data. The document comprised an introductory preamble outlining the nature and purpose of the study and the assurance of confidentiality and anonymity of the responses, followed by questions related to the number of years the individual has been an educational leader, whether or not they have received training in the use of ICTs, their perceptions of ICT integration in the school, their roles in the integration process, the support that they offered to teachers at their schools and barriers or challenges to effective integration at their schools. The interviews were conducted via Zoom and were recorded with permission from the educational leaders. All educational leaders interviewed had no objection to being recorded. The information was then transcribed and shared with the leaders to check for accuracy and to obtain feedback.

The educational leaders comprised two (2) females and six (6) males with years as educational leaders ranging from two (2) years to 16 years. One hundred percent of the principals had some form of training in ICT use ranging from certificates to masters' degrees. In the interest of anonymity, the educational leaders were coded with the letters A to H. Table 14 presents the demographics of the educational leaders.

Table 14

Demographics of Educational Leaders

Principals IDs	**Gender**	**Number of Years as a Principal**	**Education/Training in ICT**
A	Female	4	Bachelor of Computer Science
B	Male	2	Bachelor of Computing and Information science
C	Male	7	Master of Computer Science; Certificate in ICT
D	Female	5	Master of Educational Leadership, Certificate in ICT Integration
E	Male	16	Bachelor of Education; ICT Certificate
F	Male	2	Bachelor of Education; Training in Technology
G	Male	5	Bachelor of Education; Training in Technology
H	Male	15	Master of Computer Science

N= 8

Prior to conducting the interviews, a priori codes were developed using ideas relating to the theories engaged in the research (Boyatzis, 1998). A priori codes were developed based on the theoretical framework of the Unified Theory of Acceptance and Use of Technology

(UTAUT) to include performance, effort, technology, expectations, infrastructure, knowledge, acceptance, and change (Al-zboon et al., 2021). The interviews were conducted with educational leaders and the information gleaned from the interviews was transcribed, read, and re-read then shared with educational leaders to ascertain the accuracy of the information. The information was then coded based on relevancy to the a priori codes and the research question which resulted in codes such as training in ICT, lack of devices, teacher support, connectivity, poorly equipped classroom, motivation of teachers, teacher technical skills, administration, environment for ICTs, mentality of teachers, modes of delivery, eBooks, tools for teaching, buy-in from teachers, ICT devices, best practices, access to devices, infrastructure, misuse of technology and improper use of devices. The next step involved the conceptualization of the data by combining and recombining the codes to arrive at themes (Lofgren, 2013). Table 15 shows the themes, codes and frequencies of the information developed from the interviews.

Table 15

Themes, Codes and Frequency from Interviews with Educational Leaders

Themes	Codes	Frequency
Teacher Capacity	Training of teachers	8
	Teacher technological skills needed.	7
	Teacher mentality about use of ICTs needs to change.	2
	Improper use of devices	1
	Best practices	1
	Teacher support needed.	1
	Teacher motivation	6
	Variety in modes of delivery needed.	5
	Google classroom	4
	Increased engagement of students	2
	Teacher uncomfortable using technology	4
Infrastructure	Poor connectivity	8
	Poorly equipped classes	6
	Lack of access to devices	5
	Insufficient outlets/charging stations	6
	ICT ready environment needed	4
Resources	Insufficient ICT devices	4
	eBook content inaccessible	3
	Inadequate tools for teaching	6
	Theft of resources	1
	Inadequate space to house resources	4
	Software paucity	3

The themes identified based on the codes developed consisted of teacher capacity which focused on the ability of teachers to teach using ICTs; the infrastructure which encompassed the environment and the challenges faced by schools to teach using ICTs; and resources which

included the tools needed to teach classes using ICTs. Worthy of note is that the data collected from the interviews showed high frequencies regarding the necessity for training of teachers, the challenge of poor internet connectivity, poorly equipped classes, and inadequate tools for teaching. The data gleaned from the interviews were used to triangulate with results from the other research tools to arrive at the findings.

Feedback from educational leaders were recorded in rich details in their own words. It must be noted that educational leaders were identified by the letter codes A to H for reporting purposes in the interest of anonymity for this research. In response to the interview question which asked for the leaders' perceptions of ICT integration in their schools, responses included:

"It has revolutionized education" (A)

"We are not fully integrated. Some teachers use it. It is advocated for at school" (E supported by G)

"Training of teachers and students is needed" (A supported by B, C, D, E, F, G, H)

"Last two years we have been dependent on devices due to covid" (A supported by B, D, H)

"ICT is present on some levels. Not enough. Teachers shy away from the technology" (A supported by B, D, G)

"Students are more responsive to different modes of delivery using ICTs" (A, E, H, C, D)

"Teachers have limited knowledge of how to integrate ICTs" (A supported by B, D, E)

"Those teachers who are comfortable with ICTs use them" (F supported by E)

"We are not equipped appropriately" (A, B, H)

In response to the roles of the educational leaders in the ICT integration process at their schools, it was noted that most educators indicated facilitating training for their teachers and

creating an environment for ICT use. In the words of the educational leaders, they perceived their roles to include:

"Give training and support to teachers" (A supported by B, C, E and H)

"Foster an environment and encourage the use of ICTs (B supported by C, E, F, G and H)

"An instructional leader and chief exemplar" (D supported by G)

"Motivate teachers" (C supported by A, D, E, F)

"I am an advocate for ICT integration and pushing for a state-of-the-art IT room" (F)

In relation to the question of the support offered to teachers at their schools, the educational leaders mentioned several support initiatives that they have instituted at their schools. In their words, they indicated the following:

"Provide professional development sessions on ICT use" (A supported by B, C, D, E, G, H)

"Encourage the sharing of best practices" (C supported by F)

"Research and provide appropriate software for use by teachers" (A supported by C)

"I encourage Math and Integrated science to use ICTs especially since they have the government issued laptops" (F)

"Help with problems that teachers face" (B supported by C)

"I include parents in the children's education" (C)

"Purchase ICT devices that were not readily available for use by teachers" (E supported by A, F)

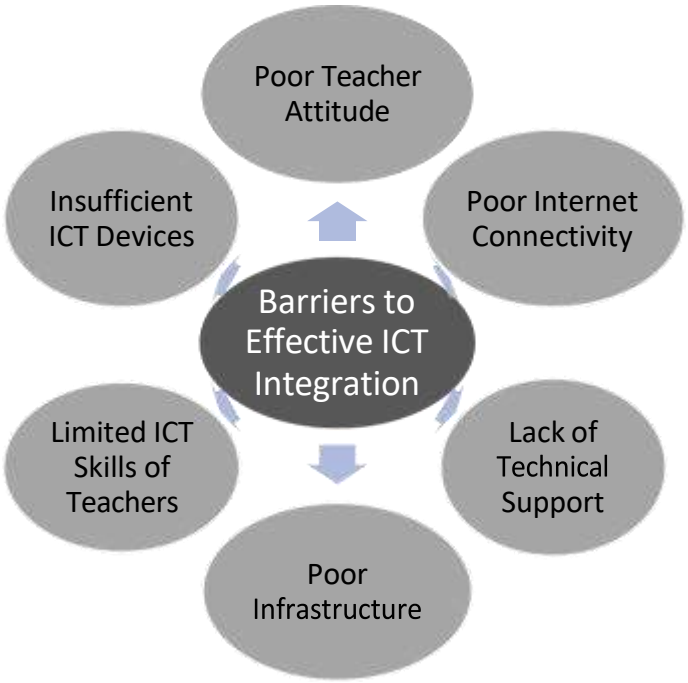
"Encourage the use of ICTs as part of administration" (A supported by B)

In response to what educational leaders perceived as environmental factors that impeded ICT integration or barriers to effective ICT integration in their schools, several barriers and

environmental factors were identified to include the need for policy advocating for ICT integration, larceny of equipment and the need for the Ministry of Education to play a greater role in enforcing ICT integration. Figure 14 identifies the most common barriers or environmental factors identified by educational leaders that prevented effective ICT integration in their schools.

Figure 14

Barriers to Effective ICT Integration identified by Educational Leaders



Educational leaders (25 percent) suggested that ICT integration at their schools was not fully implemented but are advocating for it to change how teaching and learning take place. All educational leaders (100 percent) were of the view that more training for teachers in ICT integration was necessary for ICT integration to be effective. Twenty-five percent of the leaders indicated that only teachers who felt comfortable about using ICTs used them in their classes and this was verified by Lim (2022) who claims that not all teachers would embrace ICTs for several

reasons including fear of the unknown or not wishing to change established teaching habits or routines which could affect the quality of education.

Twenty-five (25) percent of the educational leaders viewed their roles in the ICT integration process as instructional leaders but 100 percent of them indicated that they provided ICT training and support for their teachers on a regular basis through professional development sessions. Seventy-five (75) percent of the leaders saw themselves fostering environments at their schools that are ICT ready and encouraging ICT use for teaching and learning. Educational leaders (63 percent) also saw themselves as motivating factors to help their teachers engage in integrating ICTs in all subjects.

According to the educational leaders, the support given to their teachers to promote ICT integration included sharing of best practices (25 percent), providing additional devices (38 percent) and sourcing software (25 percent) that may be used in the instructional process. One leader indicated the inclusion of parents as part of the integration process by encouraging them to support their children's education by assisting them while at home. Educational leaders also indicated that they encouraged the use of ICTs as part of the administrative work of the schools (25 percent). Educational leaders also noted that apart from motivation, they addressed poor teacher attitudes with the promotion of best practices (25 percent) to improve the effectiveness of ICT integration. It must be noted that educational leaders responded to the role of the school environment in promoting effective integration of ICTs in core curricula by stating that they have been promoting ICT ready environments (75 percent) and supported teachers by providing opportunities for training (63 percent).

Section four (4) of the teacher questionnaire relating to the support given by the school or administration of the school was also instrumental in addressing research question five (5). One

of the key areas to be aware of in relation to ICT integration at a school is the need for individuals to have access to ICTs at school. In response to the statement on access to computers, 71 percent of the teachers indicated that they had access while 11 percent remained neutral, and 18 percent did not have access. Time to learn computer skills is also critical in the ICT integration process and in response to this statement, 33 percent of the teachers agreed that they had adequate time while 33 percent did not have adequate time and 34 percent remained neutral. Participants were also asked for their opinions regarding a sufficient level of computer related support available at their schools and 52 percent indicated that they received support, 27 percent remained neutral, and 21 percent did not receive technological support. The encouragement given by staff members in the ICT integration process had agreement of less than fifty percent of the respondents. Forty-two (42) percent of the respondents agreed to being encouraged by staff to use computers while support from school administration in computer-related training had agreement from 55 percent of the respondents. Importantly, while 55 percent of the teacher respondents agreed that the school administration supported ICT training, 36 percent remained neutral and only nine (9) percent disagreed. Research question five (5) which questions whether the school environment promotes effective ICT integration in core curricula of schools was also addressed by the statement which states 'The administration encourages the use of computers in the classroom' to which respondents gave their levels of agreement. Sixty-four percent of the respondents agreed with the statement while 30 percent remained neutral, and six (6) percent disagreed. The other statement that addressed research question five (5) relates to the administration encouraging the use of computers outside of the classroom. Forty-three (43) percent of the respondents agreed with the statement while 46 percent remained neutral, and 11 percent disagreed.

The student questionnaire also provided data related to research question five (5) to some extent. The questionnaire asked the students to state the extent to which they received training in ICTs at school and 75 percent of them indicated that they received training spanning from a moderate extent to entirely. As it relates to access to ICTs in school, 82 percent of the students had access while 18 percent had access only to a small extent or not at all. Students receiving training in ICTs at school as well as having access to ICTs while at school related quite significantly to the role of the school environment in promoting ICT integration since access and training are key factors in the process.

The statement in the student questionnaire requiring the students to give their opinions on whether they thought that the school principals encouraged the use of ICTs for learning at schools also had significance in answering research question five (5). In response to the statement of the encouragement of principals in the use of ICTs for learning, 11 percent of the students claimed entirely, 37 percent primarily indicated, 29 percent to a moderate extent, 10 percent to a small extent while 13 percent said not at all.

In summarizing the data collected for research question five (5) which sought to determine if the school environment promoted effective integration of ICTs in core curriculum content, educational leaders identified issues relating to the capacity of teachers, infrastructure, and resources as factors to be addressed. They indicated that they advocate for ICT integration and provide training and support for their teachers in the use of ICTs. The interview process also revealed that educational leaders play the roles of motivators, instructional leaders, and chief exemplars in ICT use at their schools.

The school environment promoted ICT integration in the core curricula of schools to some extent as was reported by 71 percent of the teachers who indicated that they have access to

ICTs for teaching but may lack connectivity in some cases. In addition, 33 percent of the teachers reported to having adequate time to learn ICT skills but on the other hand, the same number of teachers reported that they did not have adequate time. The 34 percent of the teachers who remained neutral provided a level of uncertainty as it relates to teachers having adequate time at school to learn ICT skills. The findings also revealed that computer related support at school, encouragement of staff members in the use of ICTs and the support of school administration in computer-related training for teachers accounted for over 50 percent of the responses by teachers. Students were of the view that school principals encouraged the use of ICTs at school while the educational leaders were of the view that they provided ICT ready environments and the necessary support for teachers through training opportunities.

Evaluation of Findings

The research sought to assess the integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda. ICT integration in school is commensurate with the use of technology which denotes the process of incorporating technological tools and services like the use of computers and the internet into the learning environment which according to Koretsky and Magana, (2019) will impact the curriculum and its delivery and the educational infrastructure of a school. Ratheeswari (2018) purports that ICTs refer to any technology that provides access to information through telecommunication which is a key element for instruction in schools and the reason why the workplace expects its workforce to be ICT competent.

Data for this research was collected in reference to the five research questions used to guide the process as well as from the testing of two (2) hypotheses. The research was based on the theoretical frameworks of the Theory of Change, the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technological Pedagogical and Content Knowledge (TPACK).

The Technological Pedagogical and Content Knowledge (TPACK) was used to answer the research questions especially in relation to the knowledge of content, pedagogy, and technology of teachers. The research employed a sequential explanatory design, and a mixed method approach was used to collect the data using qualitative tools to include interviews, observations and document reviews and quantitative research tools to include teachers and students' questionnaires to arrive at the results. The triangulated design for the mixed method was used for the data collected from the research tools and the findings converged significantly. The findings for each research question were evaluated based on the review of the literature and the theoretical frameworks of the study after which conclusions were drawn.

Research Question 1

To what extent does the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflect ICT components?

This research question sought to determine the extent to which the core curricula of public secondary schools reflected ICT components. Bearing in mind that the content of any programme in school is usually dictated by a curriculum or syllabus, it was determined that the question would best be addressed by conducting document reviews of the syllabuses of the core areas. Observation of practice and teacher and student questionnaires were also key data sources for this research question.

According to Al-zboon et al. (2021), the introduction of ICTs into the education system requires proper planning and implementation for it to be successful. Additionally, the Unified Theory of Acceptance and Use of Technology (UTAUT) framework purported by Al-zboon et al. (2021) relies on teachers and students accepting the change and willing to work with it for it to be effective. The idea of integrating ICTs into the education system is usually reflected in the

curricula of schools and according to Livingstone (2019), the curriculum refers to all educational experiences to which the students are exposed, the types of learning resources with which they interact, how they tackle their learning and how well they internalize what they learn. Some researchers are of the view that including ICTs in the curricula content of schools creates opportunities for broad-based learning to take place using a large variety of resources (Livingstone, 2019; Raturi et al., 2011).

The examination of the curricula documents revealed learning objectives that required the use of ICTs for them to be achieved. In that regard, teachers were required to use ICTs for pedagogical activities as dictated by the learning objectives of the syllabuses, and students would use them for learning. The syllabuses require teachers to use a combination of teaching methods and strategies and integrate technology in the process to develop a diverse set of 21st Century skills in students inclusive of critical thinking, problem solving, innovativeness and communication skills (Cetin & Solmaz, 2017). The findings revealed ICT components implied in the syllabuses to a moderate extent which are used to teach new concepts, to facilitate research, to utilize as a productivity tool as well as for communication purposes and other activities. The extent of ICT usage varies from teacher to teacher based on their interpretations of the syllabuses, but the findings of this research suggest some usage by several teachers in the classroom.

The findings from the observation of practice revealed the use of ICTs by all teachers observed and students which was not surprising since all teachers and students were issued with laptops for that purpose. Curricula related tasks involving the use of ICTs for pedagogical purposes revealed moderate frequencies such as teaching new concepts as shown by 70 percent of the teachers observed, solving problems as shown by 50 percent of the teachers and assigning

homework involving the use of ICTs by 56 percent of the teachers. Those activities indicated that teachers have incorporated the use of ICTs which were either explicit or inferred in the learning objectives of the curricula for those subjects observed. One significant observation made during the observation of practice was the use of ICTs mainly for pedagogical purposes such as to teach new concepts and web searches to solve problems and not just for general purpose uses like creating word documents, creating tables or charts. Boukhechba and Bouhania (2019) emphasized the need for ICTs to serve specific educational purposes in the classroom and underscored the necessity for teachers to plan their use of ICTs in class so that they enhance learning. The observation of practice also revealed the teachers' oral accounts of their use of ICTs in their specific subject areas. Of the five (5) English teachers observed, four (4) indicated moderate use of ICTs for teaching which is sometimes hampered by internet connectivity, and one (1) teacher expressed lack of ICT knowledge for proper integration. Of the four (4) Biology teachers, two (2) indicated use of ICTs for pedagogical activities while the other two (2) teachers confessed that they have limited knowledge of ICTs for teaching. When asked about their use of technology in their subject, three (3) of the four Mathematics teachers observed indicated that they use ICTs to teach, but one (1) indicated that she had limited knowledge of ICTs and does not use them pedagogically. The Social Studies teachers observed were five (5) in number and three (3) indicated use of ICTs in their classes to a moderate extent, but two (2) teachers professed limited knowledge of ICTs.

The findings from the teacher questionnaire also revealed evidence of ICT components embedded in the core curricula of public secondary schools. It was noted that 67 percent of the teachers used ICTs to teach new concepts while 58 percent of them used ICTs for student-centred learning. Employing ICTs to teach new concepts and engaging in student-centred

learning suggested guidance from the curricula which provides the blueprint for what is taught in class (Livingstone, 2019). Additionally, some teachers have accepted the emerging technology as integral to the teaching and learning process and like Persaud and Persaud (2019), they may be of the view that the use of ICTs to teach curricula content increases students' interactivity and promotes cooperative learning among them. Conversely, according to Palak and Walls (2009) and Tezci (2011), teachers may use ICTs to support their existing teaching methods but not for student-centred learning and this distinction must be borne in mind when addressing learning using ICTs. The findings also revealed 85 percent of the teachers using ICTs to solve problems in class while 82 percent used them for research. Problem-solving and research activities are usually created by the teacher and are solved based on students' involvement in the learning which according to Ramesh and Dibaba (2017) increases motivation, thinking and engagement in the learning process. They further assert that once the process is planned, students are kept engaged as they work individually or in teams to create knowledge and make it more meaningful for them. The educational leaders through the interview process also revealed that ICTs are present in core curricula content to some extent with 50 percent of them indicating that ICTs are used by teachers at their schools. Moreover, all the educational leaders indicated the need for teachers to be pedagogically trained in ICT use to make the integration process more effective.

Gomathi (2020) sums up the value of ICTs in the curricula of schools by stating that the curricula for all subject disciplines should be replete with digital components which should be infused in all pedagogical activities for learning to be effective. Significantly, although the findings revealed that teachers used ICTs pedagogically during instruction and students used them for learning, the CSEC syllabuses or the curricula used in schools need to be more explicit in guiding the use of ICT components for specific teaching and learning activities rather than for

teachers to determine what should be used. This will encourage more use by some teachers, and those teachers who are knowledgeable about ICTs could find more creative ways to use them for instruction.

In conclusion, the content of the core curricula for public secondary schools reflects ICT components to a moderate extent which is indicated in use by teachers and students for teaching and learning. Further, the findings revealed that the presence of ICTs for delivering the content of the syllabuses is inferred in some cases in the learning objectives of the syllabuses and would require interpretation by teachers in determining the components to use for specific lessons. Additionally, the presence of ICTs in the core curricula was mainly reflected in the use by teachers for instruction which hinges primarily on their knowledge and acceptance of ICTs. This finding is also reflective of the Theory of Change purported by Reinholtz (2020) which shows some acceptance of the emergent technology by the teachers by their use of the components listed in the syllabuses for instruction which will translate into use by students for their learning. The extent to which ICT components are reflected in the core curricula of public secondary schools in Antigua and Barbuda is moderate and is dependent upon the configuration of the syllabuses based on curriculum reform. Additionally, the extent of use is determined by teachers for classroom activities since teachers determine what is taught and how it is delivered. Significant in the findings from the observation of practice is the revelation that some teachers who were trained to teach are not comfortable in using ICTs to teach. This suggests that the Department of Teacher Education which is the department responsible for the training of teachers may need to focus more on the pedagogical training of teachers in using ICTs in addition to the other skills and strategies that are part of the training regimen.

Research Question 2

To what extent does the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools in Antigua and Barbuda?

This research question focused on the extent to which the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components in the core curricula of public secondary schools in Antigua and Barbuda. The tools used to respond to this question included the teachers' questionnaire, students' questionnaire, observation of practice and interviews with educational leaders. This research question was also addressed by research hypothesis two (2) which was tested using the ANOVA statistical test to determine if there is a significant difference between the confidence and comfortability of teachers in using ICTs and the Integration of ICTs in the classroom.

One of the sections of the teachers' questionnaire directly aligned to the research question was the section entitled 'Confidence and comfortability of teachers in using ICTs' which suggests some correlation between the comfortability and confidence of teachers in using ICTs and the extent to which they use them in the classroom. It is believed that teachers who feel confident in using ICTs usually have more comfortability in using ICTs and would most likely use them for teaching. According to Ammade et al. (2020), teachers play a critical role in effectively integrating ICTs into instruction once they are confident about their use which is often linked to having sound knowledge of pedagogy and content. Further, Palagolla et al. (2019) are of the view that successful and effective ICT integration in schools requires teachers with ICT knowledge which according to TPACK Org (2012) should include Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK). The results of the teacher

questionnaire revealed that 59 percent of the teachers believed that they have had adequate training in ICTs and 61 percent believe that they use ICTs effectively in their classrooms. This suggests that more than half the number of teachers surveyed had TCK and TPK which most likely contributed to the extent to which ICTs are integrated in their classrooms. Winzenried et al. (2010) expounded on the value of teachers having ICT knowledge by stating that teachers who are trained in ICTs are more effective in teaching using ICTs than those who have not been trained.

The findings also revealed 81 percent of the teachers who are comfortable and confident in using ICTs to teach in their classrooms, 78 percent who are just comfortable using ICTs tools in the classroom and another 80 percent who claimed that they are comfortable giving their students homework using ICTs. Those findings suggest measures of integration of ICTs by teachers which translates into some level of comfortability and confidence in using the technology. This situation is supported by UNESCO (2011) which identifies technology literacy of teachers as a developmental stage for teachers to enable them to guide their students into using ICTs for learning. Further, the results of the study revealed that almost 70 percent of the teachers believed that their use of ICTs enhances students' performance which is reinforced by UNESCO (2011) which states that ICTs in the classroom create the deepening of knowledge in students and encourage them to apply their knowledge in real life situations.

Another section of the teachers' questionnaire directly linked to the confidence and comfortability of teachers in using ICTs and their integration of ICTs in the curricula of public secondary schools relates to 'Integration of ICTs in the Classroom'. The statements in that section addressed the frequency with which teachers used different modes of teaching in instruction which may be linked to how they feel about using ICTs since the greater the use of

ICTs for the various teaching modes, the greater the extent of integration (Amuko et al., 2015). The results showed 58 percent of the teachers using ICTs for individualized instruction while 83 percent used ICTs to encourage student-centred learning, and more than 50 percent used them for small group instruction. The teachers use of those modes of teaching involving ICTs suggested cognizance of the value of ICTs in facilitating and motivating students' learning and their use of the information gleaned (Cleaves & Toplis, 2012), which has positive implications for the level of ICT integration.

Other modes of teaching which relate to the confidence and comfortability of teachers and the extent to which ICT components are integrated into classrooms included 51 percent of the teachers using ICTs for cooperative group work, 77 percent using them for independent learning, 67 percent to teach new concepts, 82 percent as a research tool, 85 percent as a problem-solving tool and 67 percent as a presentation tool. Most of these modes of teaching show an average of 65 percent usage by teachers in the classroom which is indicative of integration of ICT components to a moderate extent.

Observation of practice also revealed evidence of teachers' comfortability and confidence in the implementation of ICTs in the core curricula of schools. Worthy of note was the 72 percent of the teachers who were observed using ICTs to teach new concepts was close in usage to the 67 percent of teachers in the teacher questionnaire who indicated their use of ICTs for teaching new concepts. This comparison also showed a moderate degree of integration of ICTs in the curricula of schools by teachers which may be linked to their confidence in using the technology, but the students' questionnaire revealed an average of 45 percent usage of ICTs in their core classes of Mathematics, English, Biology and Social Studies which reflected slightly below moderate use as defined in the operational definitions of this research. Of significance is

the high use of ICTs by students for research purposes even though use for core subjects had an average of 45 percent. This shows some divergence in the findings concerning the level of use of ICTs by teachers for core subjects and the level of use identified by the students.

Additionally, observation of practice revealed moderate use of ICTs by teachers to teach new concepts and assigning homework involving ICTs but showed less than moderate use of ICTs for consolidation and independent learning which may account for the divergence in the findings. The interviews with educational leaders also revealed that some teachers show confidence and comfortability in using ICTs to teach with 50 percent of the leaders indicating that ICTs are used by teachers at their schools for instruction. Worthy of note is that the educational leaders indicated the need for teachers to be pedagogically trained in ICT use which suggests that optimum use of ICTs is not realized in their schools.

The findings for this research question showed that ICT components have been integrated into the core curricula of public secondary schools to a moderate extent with the confidence and comfortability of teachers in using ICTs playing a major role in the process. There is evidence to indicate average use of ICTs by teachers with support by school administrators, but if ICT integration is to be considered effective, there should be high frequency use in all classroom and other school activities, once the variables for effectiveness are in place. One such variable encompasses the confidence and comfortability of teachers in ICT use which is supported by the UTAUT conceptual framework advocated by Al-zboon et al. (2021) which indicates that while the variables such as performance expectancy, effort expectancy, social influence and facilitating conditions are present, ICTs will most likely be used by teachers for instruction.

Hypothesis 2

This hypothesis was used to assist in answering research question two (2) to determine the extent to which the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools in Antigua and Barbuda. The null hypothesis stated that there is no significant difference between the confidence and comfortability of teachers in using ICTs in the classroom and the Integration of ICTs in the classroom. The ANOVA statistical test was used to test the null hypothesis and it revealed a p-value of $1.10E\text{-}13<0.05$ which rejected the null hypothesis and accepted the alternative hypothesis which suggests that there is a significant difference between the dependent variable of 'ICT integration in the classroom' and the independent variable of the 'Confidence and Comfortability of teachers' in using ICTs. It is therefore conclusive that the confidence and comfortability of teachers in using ICTs in the classroom affects the level of Integration of ICTs done by teachers in the classroom. According to Uslu (2017), the ICT knowledge of teachers increases their confidence and comfortability levels in teaching when using ICTs which will affect the level of ICT integration in schools. The findings of research question two (2) revealed that use of ICTs by teachers is boosted when the teachers feel confident and comfortable in using technology to teach, and according to Kafyulilo et al. (2015), it is usually linked to specific training in the use of ICTs for instruction. The research revealed moderate use of ICTs by teachers for instruction but would require more training for teachers in the pedagogical use of ICTs to build greater confidence and comfortability to improve the level of ICT integration in schools.

Research Question 3

How does the ICT knowledge of teachers affect their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda?

This research question sought to determine the degree to which the ICT knowledge of teachers affected their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda. The research question was answered by the teachers' and students' questionnaires, observation of practice and by the educational leaders through interviews. This research question was also addressed by research hypothesis one (1) which was tested to determine if there is a significant difference between ICT knowledge of teachers and the Integration of ICTs in the classroom.

The ICT knowledge of teachers was addressed to some degree by the section of the teachers' questionnaire captioned 'Teacher preparation for the use of ICTs in the classroom'. While it was revealed that 76 percent of the teachers have attained either a bachelor's or master's degree in their areas of expertise, it was necessary to ascertain their training in the use of ICTs for pedagogical activities. It was revealed that an average of 59 percent of the teachers have received ICT training in one form or another and have used that knowledge to teach using ICTs. This suggested that for full and effective implementation of ICTs in the classroom, the remaining 41 percent of the teachers would need to be pedagogically trained in the use of ICTs. Of significance in the findings is that most of the teachers who have received training in using ICTs to teach have been teaching for 15 years or less. This suggests that teachers who have been teaching for over 15 years may need to be retrained in the use of ICTs for teaching to enable greater use of ICTs in the classroom. Mutisya, (2020) is of the view that once ICTs are used pedagogically by teachers, the learning barriers that formed part of the traditional classroom will

be broken and abstract concepts for the students will be made simple, leading to improved learning.

The findings revealed that with the average of 59 percent of the teachers having had ICT training, teaching using various modes of teaching involving the use of ICTs ranged from 51 percent to 82 percent with the highest percentages aligning with use for student-centred learning at 83 percent, teaching new concepts at 67 percent, use for communication at 82 percent and use for independent learning at 77 percent. The high frequency of use for teaching modes such as student-centred learning, teaching new concepts and independent learning suggested some degree of pedagogical knowledge of ICTs by teachers. Limited knowledge of pedagogical use of ICTs by teachers would likely result in them using the technology to prepare learning resources and assessments rather than using them to create opportunities for students to think critically (Yildirim, 2007). According to Livingstone (2019), teachers using technology by itself in the classroom without careful planning for how it will be used to improve learning will not be successful in transforming teaching and learning. Livingstone further claims that it is the way in which the technological tools are used in the classroom that will determine how effective they are in teaching and learning.

The students' questionnaire also addressed teachers' ICT knowledge and the extent to which it affected their use for pedagogical activities. It is important to note that students' use of ICTs in class is dependent significantly on the teachers and the plans that they formulate to use ICTs for teaching and learning. Students indicated that their use of ICTs for core classes using the frequencies of 'moderate extent', 'great extent' and 'entirely' ranged from 33 percent to 54 percent with the highest frequency recorded for Biology classes and the lowest frequency for Mathematics. If consideration were given to uses of ICTs for core classes by teachers as

indicated by students inclusive of the frequency tally of ‘to a small extent’, the overall frequency for each core area would be higher to include English as 70 percent, Mathematics as 77 percent, Social Studies as 64 percent and Science as 71 percent. It is important to note that the frequency ‘to a small extent’ is considered a low frequency for use of ICTs by teachers in the core areas as indicated by the Likert scale and is considered as a limited extent for this research. The overall findings of pedagogical use of ICTs by teachers in the teacher questionnaire with the frequencies ranging from a ‘moderate extent’ to ‘entirely’ suggest use of ICTs in core classes by teachers to a moderate extent which according to Palagolla and Wickramarachchi (2019) is dependent on the ICT knowledge and capabilities of those teachers.

In reference to the ICT knowledge of teachers affecting their use for pedagogical activities in school, 50 percent of the educational leaders revealed that some teachers ‘shy away from using ICTs’ due to the ‘limited knowledge of teachers’. It is important to note that some respondents in the students’ questionnaire indicated that ICTs were not used in their core classes which was recorded as 30 percent for English, 23 percent for Mathematics, 36 percent for Social Studies and 29 percent for Biology. These recorded frequencies for non-use of ICTs in core curricula classes with students would suggest total lack of use or very limited use by some teachers to teach those subjects. In the observation of practice, teachers expressed that their use of ICTs was dependent upon their knowledge of ICTs. Four (4) of the five (5) English teachers, two (2) of the four (4) Biology teachers, three (3) out of the four (4) Mathematics teachers and three (3) of the five (5) Social Studies teachers used ICTs in their classes because of their knowledge of ICTs for teaching. The other teachers indicated that they had limited knowledge of ICTs, hence their limited use in the classroom.

In conclusion, the ICT knowledge of teachers affect their use of ICTs for pedagogical activities in schools to a moderate extent. This was evidenced by the findings of the teachers and students' questionnaires, the teachers who were observed in practice as well as the educational leaders who were interviewed. The results showed over 50 percent of the teachers received training in ICT and the findings indicated that those teachers who are ICT trained tend to use them more so for student-centred learning, communication, independent learning and for teaching new concepts. These findings are in keeping with existing research which shows that teachers are moving away from the traditional face-to-face teacher-centred methods of teaching to those that are more student-centred with the teachers in those cases acting as facilitators rather than sages on a stage (Livingstone, 2019). The TPACK theoretical framework advocated by Koehler et al. (2013) signals the need for the content knowledge, technological knowledge, and pedagogical knowledge of teachers as critical for effective ICT integration in schools. Non-use or little use of ICTs for pedagogical activities represented by 41 percent of the teachers who have not been trained in the use of ICTs signified the need for more training in the area for those teachers. To address the issue of lack of training, teachers who have been teaching for over 15 years should be considered for ICT pedagogical training or re-training in the use of ICTs to enable greater compliance in using ICTs in the classroom to improve learning. Additionally, teachers should be continuously kept current with learning technologies because teachers' and students' perceptions of technology and its use are key to its acceptance in educational contexts (Livingstone, 2019).

Hypothesis 1

This hypothesis was used to assist in answering research question three (3) to determine the extent to which the ICT knowledge of teachers contribute to the Integration of ICTs in the

classroom. The null hypothesis stated that there is no significant difference between the ICT knowledge of teachers and the Integration of ICTs in the classroom. ANOVA statistical test was used to test the null hypothesis and it revealed a p-value of $0.000154 < 0.05$ which rejected the null hypothesis and accepted the alternative hypothesis which indicates that there is a significant difference between the dependent variable of Integration of ICTs in the classroom and the independent variable of ICT knowledge of teachers. It is therefore conclusive that the ICT knowledge of teachers affects the level of Integration of ICTs in the classroom. According to Uslu (2017), as the ICT knowledge of teachers increases, the comfortability level will increase, and they are likely to use ICTs in student-centred teaching in schools.

Research Question 4

To what extent do students use ICT components for core curricula learning activities in public secondary schools in Antigua and Barbuda?

This research question examined the extent to which students were engaged in using ICTs for core curricula learning activities in public secondary schools, and it was answered by the findings from the students' questionnaire, the teachers' questionnaire, and the observation of practice to some degree.

One area that affects use of ICTs by students for learning activities is their knowledge of ICTs based on the level of training received. Students benefit from ICT integration from hands-on activities in a technology-based environment where they are not bounded to the limitations of the curriculum and resources (Ghavifekr & Rosdy, 2015). Ghavifekr and his team further stated that students also benefit from coursework which is designed to stimulate their understanding about the subjects they are pursuing. The results of the students' questionnaire revealed that while 32 percent of the students were not trained in ICTs before enrolling in school, 75 percent

of them received training while in school and as a result it can be deduced that at least 75 percent of the students have had training in ICT use. It must be borne in mind that even with students being trained in ICT use, it does not mean that all the students have the same level of knowledge when using ICTs for learning. This suggests that the way in which students handle the learning activity using ICTs in school may vary from student to student. In addition, the students' levels of ICT use are usually based on the learning activities set by the teacher. Sahin (2014) advances that teaching students to use ICTs to learn will provide access to resources online, enhance their learning and empower them with critical thinking skills. Another factor to bear in mind when assessing students use of ICT components for core curricula learning is their access to ICT resources at school. Eighty-two (82) percent of the students revealed that they had access to ICTs at school to do schoolwork and 54 percent claimed that they used ICTs to do classwork which has positive implications for students performing learning tasks using ICTs at school. The presence of ICTs at school and use by the students suggest classrooms that are more contemporary in nature with the focus on the competency and performance of the students, and with teachers more concerned with how the knowledge is used by students (Singh, 2017). Students using ICTs to make use of knowledge, and the way they interact with the content to make meaning is referred to as radical constructivism (Stabile & Ershler, 2016). Constructivism underpins the use of ICTs for learning where knowledge and understanding are viewed as socially constructed by students in a learner-centred environment (Xu & Shi, 2018). Students use of ICT components for core curricula learning activities was also revealed in their utilization of them to do research with 84 percent using them primarily. According to Xu and Shi (2018), a student-centred environment is created when students are asked to conduct research in class and are given the opportunity to manipulate the knowledge to gain meaning.

Another aspect of the students' questionnaire relating to the extent of ICT use by students was addressed by the frequency with which ICTs were used in core curricula classes. According to the students, ICT use in core classes with frequencies ranging from a 'moderate extent' to 'entirely' revealed 49 percent use in English, 33 percent use in Mathematics, 54 percent use for Social Studies and 43 percent use for Biology classes. Interestingly, the percentage of use selected for the option 'small extent' for Mathematics was 44 percent which was significantly higher than the same option for the other subjects. Another noteworthy aspect of the findings from students related to their limited or apparent lack of use of ICTs for learning in their core classes. This suggests less use of ICTs by teachers in Mathematics classes. As part of the background for this research, it was clear that the in-country performance in Mathematics for the Caribbean Secondary Education Certificate (CSEC) for the years 2021 and 2022 were 29.5 and 23.7 percent respectively which were below average performance. The findings of this research revealed 44 percent of the students using ICTs for learning to a small extent which is indicative of a significant number of students who are not fully engaged in using ICTs for learning which must be addressed if integration is to be more effective.

The students' responses for their use of ICTs in their core subjects for the option 'not applicable' were significant with a 30 percent for English, 23 percent for Mathematics, 36 percent for Social Studies and a 29 percent for Biology. The response of 'not applicable' in ICT use for the core subjects suggests that those students do not use ICTs in their core classes at any time. These findings from the students are significant in that they revealed slightly diverse results showing limited use of ICTs for core curriculum classes compared to the more moderate use of ICTs stated by teachers in their questionnaire. When students were asked for their opinions about the adequacy of knowledge of ICTs by their teachers, 90 percent of the students responded

affirmatively. The students' assessment of the ICT knowledge of their teachers would most likely be dependent upon the teachers' frequency and depth of use, and the students understanding of the ICT related learning activities given in the classroom. While the accounts of ICT use by the teachers and students slightly differ, the situation may be attributed to the teachers' use of ICTs as teaching tools rather than using them for pedagogical purposes. Further, Ojo (2005) is of the view that based on the pace of development of ICTs globally, teachers just using words alone to communicate ideas, skills and attitudes is fast becoming obsolete.

The research revealed that students use of ICTs for learning is greatly dependent upon the teachers and their integration of technology into their lessons. In response to the question in the teacher's questionnaire regarding use of ICTs by teachers, 83 percent claimed use for student-centred learning, 85 percent claimed use for problem-solving for students, 67 percent revealed use of ICTs for presentations and 58 percent claimed use for individualized instruction. The pedagogical uses of ICTs by teachers in classes may be linked to use by students for learning since students are usually the beneficiaries of ICT use by teachers.

Observation of practice data on students' use of ICTs for learning revealed that 66 percent of the classes observed had students using ICTs for independent learning, 56 percent of the teachers assigned homework involving ICTs and 50 percent used them to solve problems. The use of ICTs by students in schools in ways that promote constructivism is endorsed by UNESCO (2011) who advocates for teachers to encourage students to use ICTs to stimulate problem solving and innovative skills in the classroom. While the percentages relating to uses of ICTs by teachers for various activities in the observation of practice revealed a range of 50 percent and above, they suggested use of ICTs by students to some extent since they were the beneficiaries of their use. Interestingly, the 18 classes observed revealed 100 percent use of

laptops by teacher and students for various learning activities which were aligned with the lessons planned by the teachers. This situation was not considered an anomaly since teachers and students of public secondary schools in Antigua and Barbuda were issued with laptops loaded with the digitized content for textbooks (eBooks) used in schools which could account for the presence of laptops in all the classes observed. Observation of practice, however, revealed teachers use of ICTs for pedagogical purposes and by the students for learning.

In conclusion, the evidence reviewed from students' questionnaire, teachers' questionnaire and through observation of practice showed definite use of ICT components by students for core curricula learning activities to a moderate extent. Chien et al. (2014) is of the view that students would embrace the technology for learning since they are the new generation who were born in the world of technology and as a result have been referred to as digital natives. Teachers are responsible for determining the extent of use of ICTs in class based on the content being taught and the roles that ICTs play in the instruction process to generate learning. Relevant in the discourse are the knowledge and skills of students in using ICTs to improve learning. This finding is also supported by the role that radical constructivism plays in learning where it was indicated that students worked independently using ICTs and were responsible for their own learning by making meaning of the world around them (Xu & Shi, 2018).

Research Question 5

How does the school environment promote effective integration of ICT components in core curricula content of public secondary schools in Antigua and Barbuda?

This research question addressed the effectiveness of the school environment in promoting the integration of ICTs in the core curricula of public secondary schools in Antigua

and Barbuda. The data was gathered from interviews with educational leaders and some sections of the teacher questionnaire and student questionnaire.

One key area of interest relating to the environments of schools in promoting effective ICT integration was the educational leaders' perceptions of ICT integration in their schools and whether they considered them to be adequate and effective. The results revealed that the educational leaders were generally not satisfied with the integration process at their schools although there was evidence of ICT use. Fifty percent of the leaders have indicated some measure of ICT use present in their schools by claiming that 'ICTs are present on some levels' but 'they are not enough', whereas other leaders (25 percent) have indicated that 'they are not fully integrated' and another 50 percent have stated that 'teachers have limited knowledge of how to integrate ICTs'. Further, 100 percent of the educational leaders were of the view that the 'training of teachers and students is needed' if ICT integration is to be effective. Padmavathi (2016) purports that teachers' technical skills and knowledge of ICTs are not enough for teaching using ICTs to be effective. Padmavathi further indicated that it is important that they use teaching strategies involving a combination of technology, content knowledge and pedagogy to improve learning.

A school environment that promotes ICT integration also involves educational leaders playing integral roles in the process (IG Global, 2018). Educational leaders were cognizant of the roles they must play if ICT integration is to be effective and have indicated that they 'give training and support to teachers' (63 percent), they 'foster an ICT environment and encourage the use of ICTs' (75 percent), and they 'motivate teachers' (63 percent). According to IG Global (2018), ICT integration in schools is dependent upon the school environment which includes the relevant infrastructure, acceptance and motivation by educational leaders and teachers and the

pedagogical knowledge of the teachers. This suggest that apart from ownership by teachers and educational leaders, the school environment must be conducive to ICT integration if the process is to be effective. The results revealed that educational leaders offered support to their teachers and provided resources to facilitate ICT integration to some extent. Some areas of support offered by educational leaders as stated in their own words included ‘professional development sessions on ICT use’ (88 percent), ‘sharing of best practices’ (25 percent), ‘purchasing ICT devices that were not readily available’ (38 percent) and ‘encouraging the use of ICTs as part of administration’ (25 percent).

Another area of note for assessing a school’s environment in promoting effective ICT integration was the identification of hindrances or barriers that have impeded the integration process. Some educational leaders were of the view that there should be a current ICT integration policy to guide the integration process with the Ministry of Education playing a greater role in ensuring that ICTs were fully integrated in schools. This suggests that some educational leaders are not aware of the existing 2013 ICT policy which indicates that they did not follow the guiding document for the integration process. Educational leaders also identified several barriers impeding the ICT integration process to include poor teacher attitudes, little or no internet connectivity, lack of technical support, poor infrastructure, limited ICT skills of teachers and insufficient ICT devices in some cases. Twenty-five (25) percent of the educational leaders have indicated that they have advocated for teaching and learning at their schools to be ICT ready, and all educational leaders have indicated that their teachers need to be trained in ICT integration.

There are some barriers that may be addressed by the Ministry of Education which is the entity responsible for the management of public schools in Antigua and Barbuda but some of the issues would need the intervention of other ministries to adequately alleviate them. In Antigua

and Barbuda, public schools are not autonomous entities in terms of resources and infrastructure and as a result, they are not able to address some of the challenges that they face without the intervention of the Ministry of Education. Further, it must be noted that although the Ministry of Education is responsible for managing public schools, there are other Ministries that are responsible for addressing specific aspects of schools. One such ministry is the Ministry of Public Works which is responsible for the structure of buildings. The challenge related to infrastructure would be addressed either by the Ministry of Public Works or the Maintenance Unit at the Board of Education which deals with issues on a priority basis. Any challenge encountered in public secondary schools which requires the intervention of another ministry would first be reported to the Ministry of Education which would then contact the relevant Ministry for its assistance.

The challenge related to the lack of ICT technical support at school rests with the Ministry of Information, and the connectivity issues would be addressed by the government through the Antigua and Barbuda Public Utilities Authority (APUA) or through private digital entities such as Digicel or Flow. Teacher attitudes and knowledge are critical areas that would be addressed by the Ministry of Education through professional development sessions and target-specific courses. According to Saxena, (2017), teacher attitudes towards ICT integration in schools may impact students' attitudes which could negatively affect the integration process. This suggest the need for teachers to be trained in the use of ICTs for learning which may quell fears of technology and lead to ownership and meaningful use in the classroom.

The teachers' questionnaire also addressed the school environment in the section relating to support given by the school administration. It was revealed that 71 percent of the teachers had access to ICTs at school, 18 percent claimed that they did not have access and 11 percent

remained neutral. While most teachers claimed to have access, the reason for the 18 percent who did not have access is unknown. The lack of access indicated by those teachers was unexpected since all public secondary schools have Information Technology labs and all teachers in public secondary schools were issued with laptops which is an integral resource for teaching using ICTs. Ghavifekr and Rosdy (2015) and Fu (2013), cautioned that the lack of access to ICTs by some teachers is a sign of insufficient technology and lack of ICT labs, and have indicated that such a situation will hinder the integration of ICTs in schools. It must be noted that all public secondary schools involved in this research have computer labs that are mainly used by students pursuing the subject called Information Technology which is offered as a CSEC exit examination at the end of secondary school. The computer labs are also available for use by students of other subjects who do not have their laptop devices at school (Ministry of Education Curriculum Policy, Antigua and Barbuda, 2015).

Another area of support for ICT integration revealed by the teachers' questionnaire was the adequacy of time given at school to learn computer skills. Only 33 percent of the teachers indicated that they have adequate time while 33 percent were of the view that they do not have enough time to learn those skills and 34 percent remained neutral. Although one third of the teachers indicated that they had adequate time to learn computer skills, it is quite likely that the teachers who indicated that the time was inadequate may have had conflicting issues such as other curricula activities or packed teaching schedules during the workday which would not leave time for other activities. The 34 percent of teachers who remained neutral was quite unexpected and significant since teachers would most likely know if their teaching schedules allowed for training to take place.

In the areas of computer related support at school, staff encouragement and the support of administration for ICT integration, the results showed moderate support. Palagolla and Wickramarachchi (2019) referred to the need for support at school for ICT integration to be effective by purporting that in addition to teachers being skilled in the use of ICTs, they must engage in proper planning, have access to proper ICT infrastructure, and obtain the support of educational leaders. In addition, most of the teachers indicated receipt of support for the integration of ICTs by educational leaders who advocated for use of computers in the classroom.

The results obtained from the students' questionnaire revealed that the schools' environment promoted ICT integration to a moderate extent. This was verified by the percentage of respondents who claimed that schools provided students with access to ICTs and provided training in ICTs to a great extent. Additionally, over 70 percent of the student respondents revealed that school leaders encouraged the use of ICTs for learning at schools which corresponded with 75 percent of the educational leaders who claimed that they promoted ICT ready environments at their schools. Ghavifekr and Rosdy (2015) added to the role of school support in the integration process by purporting that the efficacy of teachers is dependent on school leadership and their development of a culture to implement change in their schools in the use of ICTs. In such a culture, the educational leaders will provide opportunities for teachers to be trained and in so doing will enhance the integration of ICTs in the classroom. The Unified Theory of Acceptance and Use of Technology (UTAUT) as elucidated by Al-zboon et al. (2021) is the main theoretical framework which relates to research question five (5) of this research. The framework focuses on the dimensions that must be examined to determine acceptance of change to include the school environment and the challenges faced to integrate ICTs in schools. The overall findings for research question five (5) which sought to determine how the school

environment promoted effective integration of ICT components in core curricula content of public secondary schools revealed that the environment assisted to a moderate extent even though student use was relatively high in some cases.

Summary

This chapter sought to discuss the findings of the research with guidance from five (5) research questions. The research followed a sequential explanatory design and used a mixed method approach to conduct the research to facilitate a comprehensive data collection process. The research adopted a pragmatic approach and used several tools to collect data. Five (5) research tools were used to include a teacher questionnaire administered to teachers of core subjects, a student questionnaire which was administered to students pursuing core subjects in forms two (2) to four (4), a document review schedule which was used to analyse the core syllabuses used in the selected forms, an interview schedule used with educational leaders to garner their perspectives on the phenomenon under review and an observation schedule of teaching practice conducted with teachers during instruction of core subjects. It must be noted that each research tool was aligned to a specific research question although some aspects of each tool provided data for other research questions to a limited extent. The administration of each research tool, how they were administered, and the length of time used to conduct that aspect of the research were also addressed. The research also tested two hypotheses to determine if there is a significant difference between the ICT Knowledge of Teachers and the Integration of ICTs in the classroom and if there is a significant difference between the Confidence and Comfortability of teachers in using ICTs and the Integration of ICTs in the classroom.

Another step in the process was the triangulation of data derived from the research tools. The data received from each research tool was discussed in relation to the responses given for

each of the research questions and the results were then compared to determine convergence or divergence of the findings. The results showed convergence of the data collected generally with a slight divergence in the extent to which ICTs were used for pedagogical purposes by teachers which was considered moderate versus the data collected from students which showed less than average use by students in the core areas.

The results of the research were evaluated based on findings for each research question. Research question number one (1) addressed the extent to which the content of core curricula reflected ICT components. The research tools used to produce the data for this question were document reviews, observation of practice, interviews, and teacher and student questionnaires. The findings for research question one (1) through the document review process reflected the presence of ICT components to a moderate extent in the learning objectives of the syllabuses though some of the components were inferred in the learning activities given rather than being expressed directly in the content. The presence of ICTs in the core curricula was also reflected in the use by teachers and students in the teaching and learning processes of schools which was evidenced by the responses received from the teachers and students through the questionnaires, the responses from educational leaders as well as what was observed in the observation of practice.

The findings for research question two (2) which addressed the extent to which the confidence and comfortability of teachers in using ICTs contributed to the integration of ICT components contained in the core curricula of public secondary schools in Antigua and Barbuda was found to be moderate. This was revealed by evidence of use of ICTs for a variety of purposes by a large percentage of the teachers and students who participated in the research through questionnaires, observation of practice, and the support for integration given by the

educational leaders of the schools. It was also noted that the extent of integration of ICTs in core curricula classes was dependent primarily on the confidence and comfortability of teachers which determined their use of ICTs for instruction. The tools used to procure the findings were the teachers' and students' questionnaires, interview of educational leaders and observation of practice. Also critical for this research question was hypothesis two (2) which was tested using the ANOVA statistical test which proved that there is a significant difference between the Confidence and Comfortability of teachers in using ICTs in the classroom and the Integration of ICTs in the classroom. This revealed that the more confident teachers are in using ICTs to teach, the more comfortability they will display be in using ICTs, and the more likely they will use them for instruction.

Research question three (3) addressed the extent to which the ICT knowledge of teachers affected their use of ICTs for pedagogical activities, and it was revealed that the ICT knowledge of teachers had an impact on their use of ICTs for pedagogical activities in schools to a moderate extent. It was also revealed that teachers who were teaching for less than 15 years were the ones most likely to use ICTs to teach. The evidence revealed a positive correlation between ICT knowledge of teachers and the degree of integration of ICTs in schools. The relationship between those variables were tested by hypothesis one (1) which proved that there was a significant difference between Teacher Preparation for Use of ICTs in the classroom and the Integration of ICTs in the classroom. This indicated that teacher knowledge for the use of ICTs in the classroom will impact ICT integration in the classroom. The results for this research question were captured by the teachers and students' questionnaires, observation of practice as well as the interviews with educational leaders.

Research question four (4) addressed the extent to which students used ICT components for core curricula learning activities in public secondary schools and the research tools used to collect the data were the students' questionnaire, the teachers' questionnaire, and the observation of practice. The findings revealed definite use of ICT components for core curricula by students to a less than moderate extent, even though there was a slight divergence in the results received from the teachers' questionnaire and the students' questionnaire. Teachers revealed moderate use of ICTs for instruction, but the students indicated less than moderate use for the core areas. Important in the findings is the use of ICTs by students for several ICT related learning activities that are considered moderate in use. It was also deduced that use by students is dependent primarily upon the instruction for use of ICTs by teachers based on the content to be taught and their plans for the execution of the lessons.

Research question five (5) examined the school environment in the promotion of effective integration of ICT components in the curricula content of public secondary schools. The data for this research question was gathered from interviews with educational leaders, the teacher questionnaire, and the student questionnaire. The findings for this question revealed that the schools' environment promoted ICT integration to a moderate extent which was evidenced by the views of the educational leaders with corroboration by the teachers and students who formed part of the research. The findings also revealed that there are many challenges in the schools' environment impeding the ICT integration in schools which need to be addressed before ICT integration can be successful.

The research was undertaken to assess ICT initiatives that were introduced in public secondary schools since there is no evidence that they have been successful in their effort to improve learning. Additionally, there was also a lack of evidence to show that the initiatives

were evaluated to determine their effectiveness in teaching and learning in schools. It was on this basis that the research was conducted to assess ICT integration into the core curricula of public secondary schools in Antigua and Barbuda, to find out the level of acceptance of the technology and the extent to which they are being used for instruction. The findings revealed moderate use of ICTs by teachers for instruction and students for learning and has also revealed evidence of use by school administration to a limited extent. The findings revealed acceptance and implementation by stakeholders at public secondary schools to some extent, but it was also revealed that there are issues that would need to be addressed to attain full and effective integration in schools. A key finding of the research is that teachers who have been teaching for 15 years or less are the ones who mainly use ICTs for teaching. This suggests the need for continuous professional development for teachers in schools in the pedagogical use of ICTs, and for ensuring that teachers who are being trained are not only taught how to use ICTs but how they are to be used to improve learning by students. It is also important to note that the training of teachers in the pedagogical use of ICTs would most likely increase the level of confidence and comfortability in teachers using ICTs for instruction which is likely to increase the integration of ICTs in schools.

CHAPTER 5: IMPLICATIONS, RECOMMENDATIONS, AND CONCLUSIONS

Introduction

The Ministry of Education in Antigua and Barbuda has been the recipient of Information and Communication Technology (ICT) initiatives in public secondary schools over the years to enhance teaching and learning. The status of the integration of ICTs in the curricula of public secondary schools was unknown and it was deemed important to determine the level of integration and to ascertain whether schools have benefitted from the various integration attempts over the years. The problem for this research is that there is a lack of evidence to show that past initiatives involving the integration of ICTs in the core curricula of public secondary schools in Antigua and Barbuda were effective and there was lack of evidence to show that they were evaluated to determine their effectiveness as they related to the way teaching and learning took place in schools. This research therefore sought to assess the Integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda, and the knowledge gleaned will be used to enable data driven planning for future ICT initiatives.

The study examined the integration of ICTs in 10 public secondary schools and collected data from educational leaders, teachers and students on a number of areas to include the content of curricula currently in use and their ICT components, the ICT knowledge of teachers and its use for pedagogical activities, the extent of ICT use by students for learning activities and the preparedness of school environments and the challenges they face for the integration of ICTs in the core curricula of schools. The research was conducted to determine if ICT integration in core curricula took place and the depth of integration in public secondary schools. The study followed a sequential explanatory design and employed a mixed method approach using a combination of qualitative and quantitative research tools to gather data on the integration of ICTs in schools.

The qualitative tools used were interviews conducted with educational leaders, observation of classroom practices and document analyses of core curricula documents. The quantitative tools used were questionnaires for teachers and students.

The research engaged participants 12 years and above and employed the necessary ethical principles to accord respect to the participants and protect them from danger, sorrow, disadvantage, and worry (Hope, 2015). In keeping with sound ethical principles, the researcher sought and was given permission by UREC (Unicaf Research Ethics Committee), the Antigua and Barbuda Institutional Review Board (ABIRB) and the Director of Education in the Ministry of Education, Antigua and Barbuda to engage in the research process. A letter of intent was issued to the Education Officer for secondary schools, and gatekeeper letters were issued to educational leaders of the 10 public secondary schools used for the research for the roles they were required to play in the research process. Additionally, the participants were fully apprised of the aims of the research and their roles in the research process which was confirmed by the informed consent forms signed by participants over 18 years old and by the guardian consent forms signed by parents or guardians for participants under 18 years. All participants gave verbal consents to participate in the process and were assured of confidentiality and anonymity and the assurance that they may withdraw at any time without consequences.

Data were collected from educational leaders using an interview schedule with open-ended questions which self-designed and piloted with the principal of a private secondary school. Document reviews were done to analyse the four (4) core syllabuses for evidence of ICT components, and observations of teaching practices in schools were conducted using a self-designed observation schedule. Data from teachers were collected using an adapted questionnaire from Hogarty et al. (2003b) which was piloted with five (5) teachers from a private secondary

school with similar demographics. A student questionnaire adapted from Hogarty et al. (2003b) was used to collect data from students after being piloted with ten (10) students from a private secondary school. The questionnaires for the participants of the research were completed online, and the data collected were coded for confidentiality and anonymity purposes and were entered into Microsoft Excel programme for analysis. Participants who did not complete the online questionnaires were issued with hard copies of the documents for completion. Those questionnaires that were completed manually were also coded for ethical purposes before inputting in Microsoft Excel for analysis. The data collected from the qualitative tools were transcribed, coded, and themed and inputted into Microsoft Excel programme for analysis. All physical files with data were secured with access only by the researcher and the online data were stored in a secure folder on the researcher's personal computer.

The data collected for each tool were then analysed, the findings noted, and the results methodologically triangulated. The triangulation process involved comparing the findings of each tool with each other to determine congruence or divergence. Triangulation revealed convergence of the findings of the results except for the aspect of the students' and teachers' questionnaire relating to the use of ICTs for core curricula classes. The use of ICTs by teachers for core classes was recorded with an average of over 60 percent while the students recorded an average of 45 percent. Worthy of note is that the findings for the use of ICTs for other modes of teachers were recorded as average or slightly above average. Further, the findings were also linked to the theoretical frameworks including the Theory of Change, UTAUT, and TPACK which provided the support that guided the research in addition to pertinent literature on technology and integration in schools. The Theory of Change according to Reinholz and Andrews (2020) is an approach whereby underlying assumptions about a particular initiative

involving change are made clear and the desired results are used to guide the planning, implementation, and evaluation of the programme. UTAUT which is the Unified Theory of Acceptance and Use of Technology was a key framework considered for the research on ICT integration since it advocates for the variables of performance expectancy, effort expectancy, social influence and facilitating conditions to be used when implementing such change. There was some measure of performance and effort expectancy noted from the standpoint that teachers were aware of the requirements of the government considering the issuance of a laptop per teacher and student. Additionally, the eBook initiative which was introduced into public secondary schools which featured electronic textbooks available on their laptops was indicative of the expected use by teachers and students. Social influence and facilitating conditions were also critical in the use of ICTs as teachers got assistance from their colleagues or the educational leaders to ensure that they used their laptops to some extent. The findings indicated that the facilitating conditions for the integration of ICTs were less than desirable with poor or limited internet connectivity, infrastructural shortcomings, and the need for training of teachers in the use of ICTs for instruction. The theory of Technological Pedagogical and Content Knowledge (TPACK) is another critical framework that added to the structure of the research by highlighting the connection between teachers' understanding of content, pedagogy and technology and the way they correlate with each other to create effective teaching (Koehler et al., 2013). The research revealed that teachers in the education system of Antigua and Barbuda have the requisite content knowledge to teach the core subjects as required by law, but according to TPACK, it is not enough for a teacher in a 21st Century classroom where students are expected to be engaged in critical thinking and problem solving to make sense of the world around them. The findings of the study showed teachers who are competent in the general use of ICTs but are not

skilled in the pedagogical use of ICTs in accordance with the requirements of TPACK. Lack of ICT knowledge by teachers, especially for pedagogical purposes, will negatively impact integration of ICTs in schools.

The focus of this chapter is to discuss the implications of the findings of the research as they relate to integrating ICTs into the core curricula of public secondary schools in Antigua and Barbuda. The implications for teaching practice in public secondary schools in Antigua and Barbuda are addressed with a view to regularising the practice of integrating ICTs in schools. It was reported that some teachers were not trained in the use of ICTs for pedagogical purposes, and this would need to be considered for future practice. This chapter makes recommendations for ICT integration in public secondary schools in Antigua and Barbuda especially as it relates to the evaluation and monitoring of initiatives to ensure that their goals are achieved so that issues requiring interventions may be identified and addressed on a timely basis to avoid unnecessary injection of resources. The findings are also important for the economy of Antigua and Barbuda since it revealed the pertinent areas of the integration process to be addressed if ICTs are to become essential components of the curricula. The findings also serve as references for developing states in the region and further afield who may be facing similar challenges in the ICT integration process in schools. Further, the findings add to existing literature on ICT integration in developing states both regionally and globally especially as it relates to the challenges faced and the ways in which they may be addressed. Additionally, the chapter addresses applications of the findings for future research to facilitate other ICT initiatives that may be considered necessary.

Implications

The research was conducted to assess the integration of ICT components into the core curricula of public secondary schools in Antigua and Barbuda and the findings used to change the way teaching and learning are done in schools. The research revealed the degree of incorporation and use of ICT initiatives in the content design of core curricula, and indicated to some extent, the factors that should be considered to improve the planning, creation, and delivery of core curricula in schools using ICTs. The findings of the research revealed the status of the existing ICT integration programmes in public secondary schools which will assist in charting the way forward with the goal of equipping students with the skills and competencies needed to fit seamlessly into the global society as competent 21st Century citizens. The implications of the findings for this research are addressed by focusing on the research questions which were used as guides for the research process.

Research Question 1

To what extent does the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflect ICT components?

The content of the core curricula for public secondary schools reflected ICTs to a moderate extent. The reviewed core curricula syllabuses showed learning outcomes which required teachers to teach using ICTs based on specific learning objectives such as 'design a census', 'analyse the data' and 'present data' but there were no indication of the actual ICT components or tools required to teach the lessons or to complete tasks by the students. Worthy of note is that students often conduct self-studies by using the syllabuses as guides and as part of their independent learning, they should be directed by explicit references to ICTs required to complete tasks identified in the syllabuses. Further, students using the syllabuses in class would

follow the dictates of the teachers and use ICTs accordingly based on the stipulated tasks given in class. The students would be expected to choose the appropriate ICTs for the tasks and complete them with guidance from the teacher as advocated for student-centred learning. Though the syllabuses revealed the presence of ICT components in the core curricula content to some extent, they were mostly inferred in the learning objectives of the syllabuses and not expressed directly. The presence of ICTs in the core curricula was also reflected in the way they were used by teachers for teaching and utilized by students in the learning process. This has implications for the ICT knowledge of the teachers and students since the tasks to be completed cannot be properly planned and executed if the knowledge of ICTs is not applied. The TPACK framework indicated that teachers are required to have technological and pedagogical knowledge in addition to knowledge of content for integration to be successful, so teachers would be required to be trained in all aspects of TPACK for successful ICT integration to be realized.

The results for the document reviews were based on the main subject areas of Mathematics, English, Social Studies, and Biology which were selected for the research since Mathematics and English are compulsory in all grade levels and Biology and Social Studies are pursued by most students in forms two (2) to four (4). It must be noted that the areas of Social Sciences and Science are sub-divided into related subject areas. Social Sciences is divided into Social Studies, Geography and History but Social Studies was selected as the area of focus for the research because it is an area that is pursued by over 75 percent of candidates for the CSEC exit examinations in any one year and would ensure a good sampling of students for the research. Science, on the other hand, comprises Biology, Chemistry, and Physics and the area of study that is most popular for the CSEC exit examinations is Biology which is the focus of this research.

The assessment of the core curricula of public secondary schools in Antigua and Barbuda required that the syllabuses for core subjects be examined for evidence of ICT components since they are the formal curricula used in schools. Dei (2018) agrees with this approach when he advocates for the use of syllabuses as sources of evidence for ICT components. Dei claimed that ICTs were revolutionizing school syllabuses in many ways including the type of teaching methods and strategies that teachers use to deliver their lessons. The results of this research revealed moderate ICT components embedded in the reviewed syllabuses as was expected since syllabuses usually provide content topics and learning objectives for teachers, with guidance on teaching methods and strategies involving the use of technology, rather than stating the actual technological components that should be used for specific topics. Gomathi (2020) confirms that for ICT integration to be maintainable, the curricula of schools should comprise digital components and ICTs should play a primary role in all subject disciplines in schools. This implies that for ICT use to be greater than moderate, the syllabuses used in schools should reflect more explicit ICT components than what presently exists to make them more student friendly, and the educators using the syllabuses should have sound content, technological and pedagogical knowledge in using ICTs to improve learning.

Research Question 2

To what extent does the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools in Antigua and Barbuda?

The findings for this research question showed that the confidence and comfortability of teachers in using ICTs contribute significantly to the integration of ICT components contained in the core curricula of public secondary schools. There is evidence to indicate use by teachers who

feel confident and as a result express comfortability in using ICTs to teach, especially having had ICT training. Moreover, educational leaders indicated moderate use of ICTs by teachers for teaching and learning at their schools especially by those teachers who are confident and comfortable in using them. The extent of integration of ICTs into the core curricula of schools is dependent upon the ICT knowledge of the teachers, and the findings revealed 59 percent of the teachers acknowledging that they have sound knowledge of ICTs while 61 percent believed that they use ICTs effectively in their classroom for learning to take place. This suggest integration of ICTs to a moderate extent with more than half the number of teachers in the sample being knowledgeable of ICTs and have displayed some skills in using them in the classroom. Additionally, the findings revealed 81 percent of the teachers who felt comfortable using ICTs in their classrooms, 78 percent of them who were comfortable using ICT tools to teach and 80 percent of the teachers who indicated comfort in giving their students homework involving the use of ICTs to complete tasks. The use of ICTs by more than half the number of teachers in the cited cases is indicative of some measure of confidence and comfortability in use and correlates to the level of integration in the core curricula of public secondary schools. The remaining 22 percent of teachers in the sample who did not feel comfortable using ICTs would most likely include those teachers who have been teaching for over 15 years who would require upgrades in their ICT training to become current to facilitate their use in the classroom for ICT integration to take place. If ICT integration is to be considered successful, teachers should be trained in the pedagogical use of ICTs so that they have confidence and comfortability in using the technology which would result in more ICT integration practices as proven by hypothesis number two (2). Successful ICT integration suggests high frequency use by teachers in all activities at school whether they are in the classroom or in other school related activities.

The findings revealed 70 percent of the teachers who believed that their use of ICTs in the classroom enhanced students' performance. This finding implies use by over 50 percent of teachers for teaching which relates to a moderate extent of ICT integration in the core curricula of public secondary schools which is the focus of the current research. Further, the use of ICTs by 83 percent of the teachers to encourage student-centred learning as well as their significant use of ICTs for other modes of teaching attest to their appreciation of the role of ICTs as a motivation for learning in the students (Cleaves & Toplis, 2012) which adds to the degree of ICT integration in core areas of the curricula of schools. The findings also revealed that teacher knowledge for use of ICTs in the classroom has a significant impact upon the level of integration of ICTs in the classroom. This implies that once teachers are prepared for the use of ICTs for instruction, they would be more confident and most likely comfortable in using them which would make them more inclined to integrate them into the teaching and learning process of schools. The moderate integration of ICTs in the curricula was also noted in the observation of practice with 72 percent of the teachers in practice using them as part of their instructional process when teaching new concepts. Observation of practice also chronicled teachers stating that they use ICTs to teach core classes because they are knowledgeable about them and feel comfortable doing so. Those teachers who had limited knowledge of ICTs used them to a limited extent or did not use them whatsoever in their classes.

Data from the students revealed 45 percent average use of ICTs in their core classes which is also an indication of the extent of integration of ICTs. Of significance to this research question is the use of ICTs by teachers which may also be translated into ICT integration into the curricula of schools which signals some adaptation to the change as promoted by the Theory of Change (Reinholz & Andrews, 2020). Teachers' acceptance of the change was manifested by the

extent to which they implemented the change (Reinholz & Andrews, 2020). The findings related to the conceptual framework of the Unified Theory of Acceptance and Use of Technology (UTAUT) which addresses the variable of expectancy of effort by teachers which is defined as what the teachers view as expectations from school leadership and other stakeholders on the use of the technology. Once teachers are aware of the expectations by others, they appear to conform to the expectations such as using ICTs for teaching (Venkatesh et al., 2003). The variable endorsed by UTAUT referencing enabling conditions, on the other hand, relates to fostering ICT ready school environments for implementation of the integrative process (Venkatesh et al., 2003). It is likely that those teachers who were trained in using ICTs would be more confident to use the technology for teaching to apply the knowledge gained especially with the provision of the right environment to encourage their use and increase the extent of ICT integration.

Research Question 3

How does the ICT knowledge of teachers affect their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda?

This research question had results indicating that the ICT knowledge of teachers impacts upon their use of ICTs for pedagogical activities in public secondary schools to a moderate extent. This was demonstrated by the findings of the teachers' questionnaire which was used to obtain data on their training in the use of ICTs generally as well as specific use of ICTs for pedagogical activities in schools. The educational leaders who were interviewed also provided data on teachers who have been ICT trained and the ways in which ICTs are used in their schools. Over 50 percent of the teachers surveyed received training in ICTs as part of their studies or were trained on the job with the assistance of their colleagues, or through self-help or through professional development activities. The results revealed that those teachers who were

ICT trained were most likely to use them for student-centred learning, communication, independent learning and for teaching new concepts. Further, it was discovered that teachers who have been teaching for over 15 years were the ones who did not readily use ICTs for teaching. To keep teachers updated on the use of ICTs for teaching, the education system would need to put measures in place for the professional development of teachers to focus on ICT strategies that are current and ensure that it becomes a continuous process in the professional development of teachers.

The findings of this research question revealed that the highest frequency for use of ICTs by teachers was for student-centred learning with 83 percent, while their use for teaching new concepts was revealed as 67 percent of the teachers. Use of ICTs for communication by teachers was 82 percent and their use for independent learning of students was 77 percent. ICTs used for the modes of teaching identified in the questionnaire indicated some pedagogical knowledge of ICTs by teachers. According to Heitink et al. (2017), pedagogical knowledge of teachers is critical for learning with ICTs since the highest level of ICT use in any classroom occurs with their use for pedagogical practices by teachers which often promotes the activation of student learning. Heitink et al. (2017) and Summer et al. (2021) are of the view that sound pedagogies used for teaching and learning should provide the foundation for the adoption of ICTs in classrooms. Saxena (2017) further expounded on the need for teachers to be prepared for ICT use by stating that effective ICT integration requires a combination of curricula content, technology and appropriate pedagogy as purported by the TPACK model. Teachers who present with limited pedagogical knowledge of ICTs would most likely result in them using the technology to prepare teaching resources and assessment tools rather than to create critical thinking opportunities for students in the classroom (Yildirim, 2007). Further, if teachers are not willing to integrate ICTs

in their classes, the students will not be afforded the opportunities to practice using them in the classroom (Hong, 2016). This reinforces the idea that if teachers are not equipped to use ICTs pedagogically in class, the students would not benefit from use to improve learning. Critical in the findings of the research is that teacher preparation for use of ICTs in the classroom has a significant impact on the integration of ICTs in the classroom. The finding implies that for ICT integration to be successful and effective, the teachers must be equipped with the content, pedagogical and technological knowledge and skills required to teach using ICTs (TPACK, 2012).

Worthy of note is that the findings of this question are positively correlated to radical constructivism in learning. Xu and Shi (2018) expounded on the nature of radical constructivism by stating that it is about learning that takes place in a student-centred environment where knowledge and understanding are constructed socially by the student. This suggests that teachers who engage in pedagogical activities using ICTs are providing the students with opportunities to learn independently and construct meaning to make sense of the world around them. Jamieson-Procter et al., (2013) also showed the significance of the ICT knowledge of teachers and the role it plays in radical constructivism when they claimed that the use of ICTs in teaching improves the learning process and capitalizes on the students' engagement in active learning. Further, it was statistically proven in this research through hypothesis number one (1) that the ICT knowledge of teachers positively impacts the integration of ICTs in the core curricula of schools. This suggests that the training of teachers in using ICTs to teach is critical if ICT integration in schools is to be successful.

Non-use of ICTs for pedagogical activities by some teachers as noted in the findings of the research signified the need for those teachers to be trained in the use of ICTs for teaching.

The findings of the research revealed adequate access to ICTs at school for teachers as well as training opportunities provided through professional development sessions which may be system-led or school-led or training by other teachers. In addition, the provision of a laptop for all teachers and students and the presence of at least one computer laboratory in each school suggests availability and access to ICTs which are critical for the pedagogical integration of ICTs at schools. Bearing in mind that several factors impact upon the utilization of ICTs for teaching and learning, it is advocated that the integration process includes the provision of all the necessary ICT hardware and software required for the process and most importantly, the improvement of the readiness and skills of teachers for ICTs to be successfully integrated into the pedagogical process (Agbatogun, 2012; Ghavifekr & Rosdy, 2015).

Research Question 4

To what extent do students use ICT components for core curricula learning activities in public secondary schools in Antigua and Barbuda?

The evidence reviewed from teachers and observation of practice showed above moderate use of ICTs for curricula learning, but evidence from the students revealed less than moderate use of ICT components for core curricula learning activities in public secondary schools. Chien et al. (2014) is of the view that students are more likely to embrace the technology for learning since they are part of the generation who were born in the world of technology and are digital natives. Students use of ICTs in class is dependent upon teachers who are responsible for planning and executing the lessons and determining the roles that ICTs will play in the class to generate learning. Relevant in the discourse are the pedagogical knowledge, skills and competencies of teachers and the skills of the students in using ICTs to improve learning.

Two major factors in students use of ICTs for core curricula learning activities are their skills in the use of ICTs and access to ICTs for learning activities. The findings of the research revealed that 75 percent of the students received training in the use of ICTs in schools even though some students received training in ICTs before enrolling in schools, and 82 percent indicated that they have access to ICTs at school to do schoolwork. Worthy of note is that most students are likely to have access to computers since they were all issued with laptops by the government in 2021 to support online modality of instruction. The 18 percent of students who indicated that they did not have access to ICTs was unexpected considering the laptop initiative in 2021 but may have occurred because of issues relating to non-functioning devices or non-adherence to scheduled collection of devices. Significant to note, however, is that students have access to computer labs that are available at all public secondary schools.

The skills of each student in the use of ICTs may vary based on the level of training received and this has implications for the ways in which the students address learning activities using ICTs. The findings showed 84 percent of the students using ICTs to do research which according to Xu and Shi (2018) creates a student-centred environment. Of significance to research question four (4) is the students' use of ICTs for learning in the core areas which is represented by frequencies ranging from a 'moderate extent' to 'entirely' and is revealed as 49 percent use in English, 33 percent use in Mathematics, 54 percent use for Social Studies and 43 percent use for Biology classes. Use of ICTs is considered less than moderate considering the options of 'moderate extent' to 'entirely', but if consideration were given to the inclusion of the option of 'small extent', the results would change significantly to reveal English as 70 percent, Mathematics as 77 percent, Social Studies as 64 percent and Biology as 71 percent. Worthy of note in the findings is the relatively high percentage of students who selected the option 'small

extent' to indicate use of ICTs in Mathematics. Forty-four (44) percent of the recorded 77 percent of the students selected the option 'small extent' which suggests almost 45 percent of students who used ICTs for Mathematics only used it to a small extent. This has implications for the teaching of Mathematics and the degree to which teachers of Mathematics opt to use ICTs to teach, especially considering the dismal national passes (less than 30 percent) in Mathematics for 2021 and 2022 CSEC examinations. Ghavifekr and Rosdy, (2015) are of the view that using ICTs when teaching a subject enables the learners to become more active and involved in the learning exercise leading to improved learning. The findings from this section of the research relating to the students' who indicated that the use of ICTs was not applicable for the core areas also has implications for the integration of ICTs. The students' responses stating 'not applicable' to the use of ICTs in the core areas ranged from 23 percent to 36 percent which translates into non-use by core teachers or non-use by the students for those classes. This implies that for ICT integration to be fully implemented and integrated into the curricula of schools to improve learning, all students would need to be engaged in the process.

The findings from the observation of practice in the 18 classes revealed 66 percent of the classes had students using ICTs for independent learning and 50 percent using them to solve problems. Use of ICTs by students for other learning activities reflected percentages over 50 percent. While the uses of ICTs by the students reflected 50 percent and above for all learning activities observed, the expectation is that their engagement in such ICT activities should have been higher especially since all teachers and students were issued with laptops to stimulate learning in schools. According to UNESCO (2011), in class use of ICTs will stimulate the problem solving and innovative skills of the students. The identified frequencies imply less than

moderate use of ICTs by students for the core areas and are also indicative of the pedagogical use of ICTs by teachers and access to ICT resources at school.

Research Question 5

How does the school environment promote effective integration of ICT components in core curricula content of public secondary schools in Antigua and Barbuda?

The findings of this research question revealed that the schools' environments promoted ICT integration in core curricula to a moderate extent. This was evidenced by the data received from the educational leaders, teachers, and students. The data from educational leaders revealed school environments that reflected ICT integration moderately but with different levels of readiness. All schools provide access to ICTs including computers, multimedia projectors, computer labs and white boards and different levels of connectivity to the internet. Educational leaders have indicated some measure of ICT use in the learning processes of their schools, but they are not satisfied that there is enough use for pedagogical and administrative purposes. In addition, some educational leaders have indicated that some of their teachers have limited knowledge of ICTs and all the leaders have specified the need for training of teachers as well as students. The school environment is a major factor in promoting integration of ICTs in schools and according to IG Global (2018), it is important that the relevant infrastructure as well as acceptance and motivation by educational leaders and teachers combined with the pedagogical knowledge of the teachers are available. The results revealed educational leaders who engaged their teachers in ICT training as part of their professional development activities, and some leaders who provided ICT ready environments to some extent at their schools to encourage integration. The support by educational leaders relates to the structure of one of the conceptual frameworks of this research which is the Unified Theory of Acceptance and Use of Technology

(UTAUT) which identifies the provision of enabling conditions as one of its variables to determine reception and adoption of the use of technological resources in schools (Venkatesh et al., 2003). This suggests that for ICT integration to be effective in schools, the necessary infrastructure should be in place to promote acceptance and utilization of the technology by the teachers, students, and educational leaders of schools.

The findings also revealed barriers which impeded the effective integration of ICTs in the core curricula areas. Educational leaders identified them as poor teacher attitudes, poor internet connectivity, lack of readily available technical support, poor infrastructure, limited ICT skills of teachers and insufficient ICT devices in some cases. Larceny of devices was also reported as a factor that has contributed to the lack of devices. Since the schools in the research are public secondary schools that depend on the government for their resources, the government is responsible for ensuring that schools are supplied with the resources needed for learning.

Technological support at school was revealed as lacking by educational leaders. Public secondary schools do not have technological support on site and would need to engage the Ministry of Information for support if teachers on staff are not able to troubleshoot the technological issues being faced. In situations when the issues cannot be addressed at the school level, technicians in the Ministry of Information are contacted and the schools are expected to wait until a technician becomes available for service which may not be immediate. This delay in technical service would provide an interruption to learning which may vary depending upon the availability of the technicians. It is the responsibility of the government of Antigua and Barbuda and specifically the Ministry of Education to reassess the lack of technical support at schools with a view to providing onsite support considering the move towards intensifying ICT integration in schools to improve learning.

The findings also revealed that over 75 percent of the students were trained at school and 82 percent indicated that they had access to ICTs at school. This suggest that training and access to ICTs are moderate to high for the students while at school and are indicative of the schools' environments which are conducive to ICTs playing a significant role in learning. Further, over 80 percent of the respondents indicated that their educational leaders encouraged the use of ICTs for learning at their schools which further confirms school environments that support ICTs to some extent.

Cetin and Solmaz (2017) have indicated that ICT integration has many sub-dimensions which may vary based on the education systems available, and they advocate for the conduct of comprehensive assessments to evaluate initiatives involving ICT integration in education. Further, ICT integration requires change and Reinholz and Andrews (2020) are of the view that change must be grounded in change theory to provide knowledge of existing information in the field to enable the initiatives to contribute to knowledge that can be generalized. Based on the Theory of Change which forms part of the theoretical framework of this research, initiatives that have been implemented are to be investigated and revised as they progress, and processes changed based on the findings of the evaluations to ensure the effectiveness of the initiatives (Reinholz & Andrews, 2020).

This research began with the need to assess the integration of ICTs in the core curricula of public secondary schools in Antigua and Barbuda to provide evidence of the efficacy of the implementation of ICT initiatives over the years. There was lack of evidence to indicate the status of the ICT integration process, hence the need for this research. The findings revealed moderate use of ICTs for teaching and learning in public secondary schools in Antigua and Barbuda, with a definite need for teachers to receive specific training in the pedagogical use of

ICTs in instruction. Key in the findings is that teachers who have been teaching for more than 15 years would need to be re-trained in the use of ICTs for them to be current in the ways in which ICTs may be used for teaching. It is also evident from the findings of the research especially from the interactions with teachers in observation of practice that teachers in Antigua and Barbuda can benefit from the development and implementation of a mandatory continuous professional development policy to encourage teachers who have been trained for over 5 years to become current and refocused in the use of technology to improve teaching and learning. This programme should be government led and would encourage the upgrading of ICT skills for existing teachers which could result in higher frequencies of ICT use. Additionally, if the recommendations made for this research are implemented, the status of ICT integration in the curricula of all schools in Antigua and Barbuda would most likely be improved.

Recommendations for Application

Over the last few years, instructional practices in secondary schools have seen a paradigm shift from the traditional approaches with the teacher in the middle of the instructional process to one that is more modern in nature and student-centred, with the teacher facilitating the process rather than being the main transmitter of knowledge (Livingstone, 2019). Further, Livingstone (2019) indicated that technology is rapidly becoming the platform used to promote learning, and educational leaders in public secondary schools in Antigua and Barbuda have shown that they are accepting the emerging technology to some extent which is evidenced by the number of teachers and learners in the schools who moderately use the technology. Persaud and Persaud (2019) also added to the literature for this research by indicating that incorporating ICTs in the curricula of schools increase the engagement of students and encourage learning through collaboration and cooperation. There is an abundance of literature on the value of ICTs in

improving learning, but the findings of this research will supplement the literature that presently exists especially in relation to integrating ICTs in the curricula of schools in a developing country like Antigua and Barbuda.

The research was geared towards assessing the integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda to determine if the ICT initiatives implemented over the years have been used to promote learning. The research sought data from educational leaders, teachers and students who interacted directly with ICTs in schools and were the primary sources of information used to arrive at the results. Another source of information included document reviews of the core syllabuses. The findings of the research revealed that ICTs are moderately used for instruction in public secondary schools, and it was also revealed that there were some areas which needed to be addressed if full and effective integration is to be realized in Antigua and Barbuda. Based on the findings, the areas for recommendations include updating present curricula, training of teachers in pedagogical use of ICTs, training of students in using ICTs as part of their learning, technological support on school compounds, comprehensive internet connections, provision of ICT ready infrastructures, continuous professional development of teachers and full implementation of the ICT policy to guide the integration process.

Updating Present Curricula

The research required the review of existing curricula for the presence of ICT components in the core curricula of public secondary schools. The review revealed that ICT components are present in the core curricula to a moderate extent but are not explicit in indicating the components to be used for teaching and learning (Research Question 1). The users of the curricula are required to determine the ICT components to be used to achieve the stated

objectives in the curricula, but it would be more instructive to teachers and students who practice independent learning, if ICTs are linked to specific learning outcomes. This research recommends a review of the existing core curricula to be more ICT specific to enable teachers to plan ICT integrated lessons and enable the learners to be guided by suggested ICTs that could enhance their learning if they wish to work independently. Worthy of note is that any syllabus revision is the mandate of the Caribbean Examinations Council (CXC) and any changes to be made would need to be done through specific subject specialists who are selected from throughout the region to form the review panel. This recommendation would need to be formally made to CXC, reviewed for consideration by countries in the region, accepted as feasible and applicable, documents reviewed and amended followed by ratification for use in the region.

Training of Teachers

The findings of the research revealed that there are teachers in public secondary schools who need training in using ICTs to enhance learning. Research question three (3) sought to determine if the ICT knowledge of teachers affected their use of ICTs for pedagogical activities in public secondary schools and it was revealed that some teachers are using ICTs for pedagogical activities, but some teachers need training in the use of ICTs for instruction. Further, it was noted that the ICT knowledge of teachers is critical for the ICT integration process since it was proven that it has a significant impact on the extent of ICT integration in schools. It is therefore the recommendation of this research that teachers in Antigua and Barbuda are trained in using ICTs pedagogically rather than just acquiring skills in computer use. The nature of this type of training is supported in the literature by Livingstone (2019), who indicated that technological tools alone are not enough for the transformation of teaching and learning to take place. He further claims that it is the utilization of ICT resources in the schools' environments

that will ascertain success in teaching and learning. Boukhechba and Bouhania (2019) also expounded on the need for the pedagogical training of teachers in using ICTs by stating that it is important for teachers to understand that there is a difference between the availability of technological equipment in the classroom for general classroom use and using the equipment to serve a specific pedagogical objective. UNESCO (2011) supports the training of teachers by stating that the development of teachers in technology literacy is critical to enable them to provide guidance to their students in using ICTs to improve learning. To ensure that all teachers are trained in pedagogical use of ICTs, it is recommended that the Department of Teacher Education, which is responsible for the training of novice teachers, be issued a new mandate for the training of teachers to involve training in the pedagogical use of ICTs in teaching all subject areas. In reference to active teachers who have not been trained in the pedagogical use of ICTs, or teachers who were ICT trained but have not been re-trained in under five (5) years, it is recommended that there be government led mandated training for all public-school teachers on a weekly, bi-weekly, or monthly basis to ensure that they are equipped with the requisite skills needed for full ICT integration. Additionally, teachers are to be encouraged to engage in self-motivated continuous professional development training to master the use of ICTs as part of their professional growth.

Training of Students in using ICTs for Learning

Another recommendation based on the findings of this research is that all students receive training in the use of ICTs so that they are fully engaged in the learning process when ICTs are used by teachers. This is in response to the findings of research question four (4) which examined the extent to which students used ICT components for core curricula learning. The research revealed less than moderate use of ICTs by students for learning in core curricula areas

which suggests that more training is required for learning to be maximized. According to Wedlock and Trahan (2019), students must be trained to effectively engage with the technologies to promote learning. Further, Sahin (2014) expounded on the value of students being trained in the use of ICTs by stating that it will enhance their learning, provide them with ready access to resources, and foster their use of skills for critical thinking. Based on the findings, the extent of ICT uses by students especially in core curricula classes should have reflected a higher percentage of frequency which means that a larger number of students need to be engaged in the use of ICTs for learning. This suggests that in addition to ready access to ICTs by all, the lessons planned by teachers should be ICT specific and student-centred bearing in mind that the use of ICTs by students is based on the knowledge of teachers which translates into the confidence and comfortability of teachers as proven by hypothesis number two (2). Ultimately, teachers' pedagogical use of ICTs will determine their frequency of use for teaching and by extension the use by students for learning (Ghavifekr & Rosdy, 2015).

Provision of Technological Support

It is also the recommendation of this research that technological support be available onsite for real time interventions in solving technical issues involving ICTs in the classroom. This will prevent the loss of learning that would normally be incurred if the technical support was in a different location. The onsite support would reduce the wait time for the problem to be addressed. The findings of research question five (5) revealed that public secondary schools are not provided with technical support to address technological issues faced by schools daily. Schools depend on staff members with technological knowledge to solve simple issues in real time but for more complicated issues, a team from the Ministry of Information would be deployed to address them. This situation relates to schools on the mainland of Antigua but the

single secondary school in Barbuda would most likely have longer wait times to fix technical problems due to transportation issues since it is separated from the mainland Antigua. Technicians from the Ministry of Information would need to travel to Barbuda via aeroplane or by ferry which requires booking reservations in advance. The speed of the intervention to solve technological issues at a school greatly depends on the queue of jobs that the technical team from the Ministry of Information would need to address, hence the strong recommendation for onsite technical support at all schools if ICT integration is to be successful.

Internet Connectivity

Another recommendation to be considered is the provision of high speed and widespread internet connectivity at all schools. In response to research question five (5), most of the educational leaders indicated poor internet connectivity and on some school plants, internet is only available at certain locations. The integration of ICTs depends heavily on internet connectivity which makes it a priority resource if ICT integration in schools is to be realised. Dinc (2017) purports that internet connections help to improve learning by providing students with an abundance of information for learning and creates an avenue for instant feedback and collaboration. Educational leaders are of the view that internet connectivity at schools must be optimised since teachers and students depend on access for learning to take place. Public secondary schools in Antigua and Barbuda are dependent on consistent internet to support the Information Technology Labs, the operation of the EMIS system for those schools who have acquired one, the wireless printing of materials, and the enabling of access to the content on the eBooks and the applications of the Onelern platform on which the eBooks are housed. It is therefore critical that whole school high speed internet connectivity be prioritized immediately to create an environment that is conducive to ICT integration as intimated by the UTAUT

framework that has enabling conditions as one of the variables required for integration to take place.

ICT Infrastructure

It is also recommended that the necessary ICT infrastructure be put in place to cater for the ICT needs of the schools. The research revealed that some schools require support in developing ICT ready environments to enable the integration process to progress and be more effective. This entails the provision of more computer labs for use by teachers and students whose devices are not functional or are unavailable. All public secondary schools have at least one computer lab which is accessible to all teachers and students, but they may become inaccessible when they are used for the teaching of subjects such as Information Technology and Electronic Document Preparation Management (EDPM) classes. It is also recommended that the government of Antigua and Barbuda considers the provision of backup electrical power to prevent interruption of the learning process when there is a power outage. It is important to note that power outages occur from time-to-time in Antigua and Barbuda which halts instruction that is dependent on electricity. It is also the recommendation of this research that the installation of more charging ports and workstations at various locations on the schools' compounds be considered for use by staff and students. In addition, it is recommended that the government addresses those challenges that require intervention by specific entities outside the remit of the Ministry of Education such as an entity to provide an effective Learning Management System (LMS) for the administration of all public secondary schools as well as for the procurement of solar powered generation of electricity to schools.

Professional Development of Teachers

Another area to be addressed is the engagement of teachers in continuous professional development activities to cater to their training needs, to motivate them and to create buy-in for the use of ICTs for teaching. The findings from research questions two (2), three (3) and five (5) revealed that there are teachers who need to be retooled or updated on pedagogical use of ICTs which may be done through professional development sessions. Rana et al. (2020) are of the view that support via professional development sessions is necessary especially when traditional teachers are resistant to change to the more contemporary student-centred teaching involving the use of ICTs. Teachers may be more accepting of change when they think that their colleagues believe that they should accept it. This situation is addressed by the Unified Theory of Acceptance and Use of Technology in its social influence variable which relates to the extent to which the user of the technology is of the view that key individuals within the institution think that the technology should be used (Venkatesh et al., 2003). Professional development sessions should be mandated for all teachers especially those who have been teaching for five (5) or more years without a refresher course. Professional development sessions should be facilitated by the Ministry of Education with the possibility of being school led at a later point. If professional development sessions on ICT integration are school-led, it is advocated that the educational leaders have a clear vision for ICT integration for their schools and seek buy-in from teachers and other stakeholders to enable the integration process to be considered effective (De Witte et al., 2015).

Mandatory Enforcement of ICT Policy

One of the findings of the research is that some education leaders are not aware of an ICT policy to guide the integration process. This suggests that the existing 2013 ICT Education

Policy for Antigua and Barbuda is not being used for the ICT implementation process in schools. The ICT Education Policy for Antigua and Barbuda (2013) was designed to enable a shift in paradigm from the traditional approach to teaching and learning to one that is more student-focused and constructivist in nature (ICT in Education Policy for Antigua and Barbuda, 2013). The research revealed that some educational leaders were of the view that the Ministry of Education should create a policy and enforce it by making it mandatory for schools to follow to ensure successful integration. It is therefore the recommendation of this research that the existing 2013 ICT in Education Policy be reviewed to ensure that current trends in technology are embedded, and the updated document used as a guide to address lingering ICT integration issues and to facilitate future initiatives. ICT integration studies have shown that successful ICT integration requires the involvement of stakeholders (Fu, 2013) who must work together to implement the process to achieve success. An updated policy on ICT integration which identifies the roles that all stakeholders in the education system in Antigua and Barbuda should play must be considered for that purpose.

This research on the integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda is relevant and timely as the government and benefactors continue to invest in ICTs in schools. There is significant literature on the value of integrating ICTs into the curricula of schools and many have promulgated the value of evaluation in determining their usefulness in the education system (Rehan et al., 2019). This research focused on the developing country of Antigua and Barbuda and has revealed that there is moderate integration of ICTs in the core curricula of public secondary schools. The research revealed the presence of some ICT components in the core curricula in schools, the use of ICTs in the classroom for instruction to some extent, varying technological infrastructures in schools, some

teachers with limited knowledge on the pedagogical use of ICTs, some students who have limited knowledge on the use of ICTs for learning and educational leaders who have embraced the use of ICTs for learning but wish that the environmental issues and barriers plaguing the integration process at their schools are addressed. It is generally agreed in several ICT research studies that for ICT integration to be effective in schools, it requires the involvement of policy makers, educational leaders, teachers, students, and parents to some extent. Innovative in the findings for the successful integration of ICTs in the curricula of schools, is the need for the process to be purpose-driven with the development of clear key indicators to guide the process. In addition, the process should be managed by a team of experts that will provide expertise at various levels of the public secondary education system in Antigua and Barbuda. This research acknowledges the named stakeholders as integral to the integration process (Fu, 2013) and the recommendations made are suggested for use to manage the existing ICT integration systems currently in place, and to facilitate further ICT integration in the education system of Antigua and Barbuda.

Recommendations for Future Research

This research study was considered necessary against the backdrop of ICT initiatives that have been introduced into the curricula of public secondary schools in Antigua and Barbuda. While it is widely known that ICTs have been proven to improve knowledge of students and decrease accessibility and equity gaps (Seiuli, 2020), there was lack of evidence to show that the ICT initiatives in Antigua and Barbuda have been effective. The introduction of such initiatives without evaluating their effectiveness is not recommended and is the reason for conducting this study. The research assessed the level of ICT integration in public secondary schools, and it revealed that there is moderate use in the different facets of schools which may be optimized if

several challenges were addressed. It is important to note, however, that while the findings of this research may be generalized for Antigua and Barbuda and for developing countries in the region facing similar challenges, there is the need for further studies to be done to make the findings more generalizable in a wider context. This chapter will make recommendations for future research to provide guidance for the introduction of other ICT initiatives in Antigua and Barbuda as well as for developing countries in the region as they strive to integrate ICTs into the curricula of their schools.

To determine the effectiveness of ICT integration, the study focused on public secondary schools and opted to use core curricula subjects to make it more manageable for the time frame given for the research. The study used a population comprising educational leaders, teachers, and students to gather data since they were the principal users of ICTs in secondary schools. Ten (10) of the thirteen (13) public secondary schools in Antigua and Barbuda were used for the research which made the findings generalizable for public secondary schools in Antigua and Barbuda as well as public secondary schools in other Caribbean territories facing similar situations. It is highly recommended that the research be extended to include private secondary schools which might have different dynamics to what occurs in public secondary schools but would provide comparative data on ICT integration for both sets of schools. Additionally, a comparison between public and private secondary schools may be done to provide data relating to ICT integration for all secondary schools in Antigua and Barbuda therefore providing a comprehensive picture of the process in the country to inform country wide initiatives that may occur in future.

Another recommendation that should be considered for future research is that similar research be conducted in all curricula areas offered in public secondary schools at all grade

levels to determine the scope of integration. While the present research focused on the core subject areas and specific classes in the interest of time, it may be more instructive to assess the integration across all curricula and at all levels so that generalizability of the findings would be greater. Widening the scope of the research will also provide an opportunity to determine the ICT use by teachers and students for each subject area and provide further insight into ICT use so that the necessary interventions that may be needed for learning to take place are integrated into the process.

Another proposal for future research is for the recommendations made in this research to be accepted and implemented and a follow-up study done to examine how schools perform with ICT integration after addressing the gaps and challenges outlined in this study. One of the major issues to be addressed is the training of teachers in using ICTs for teaching. This action could build the confidence and comfortability of teachers in using ICTs and dispel the inhibitions of those teachers who are afraid to use ICTs. Additionally, the recommendation was made for students to be trained in the use of ICTs so that they will be able to manipulate them when they are used by teachers in the classroom. Wedlock and Trahan (2019) are of the view that the learners must be united with the technology available for them to learn. According to Al-zboon et al. (2021), the use of ICTs should be validated, and the adoption verified by educational leaders, teachers and students who are the users of the technology for them to accept the change. Further, the research recommended strong internet connectivity at all schools which is necessary if ICTs are to be integrated in curricula to promote learning.

Ad hoc attempts at integrating ICTs into the curricula of schools can lead to integration being unsuccessful. The study recommends that future initiatives relating to integration be guided by an ICT policy which will ensure that all elements needed for the process are aligned

and implemented. The ICT Policy of Antigua and Barbuda (2013) was prepared by the Ministry of Education of Antigua and Barbuda in collaboration with UNESCO and the Commonwealth of Learning to facilitate education reform and shift the paradigm from teacher centred to learner centred teaching and learning. The ICT policy was ratified for use in 2013 and should have been used to guide all attempts at integration in all schools. It must be noted however, that there is lack of evidence to show that evaluations were done to determine the effect of the attempts at integration and there is also lack of evidence to show that the policy was used as part of the integration process. The research revealed moderate use of ICTs in public secondary schools in Antigua and Barbuda which suggest some attempts at integration using aspects of the ICT policy on a limited basis since some educational leaders asked for one to be activated. This research advocates that the ICT policy be updated to reflect current technological advancements and used for all future ICT initiatives in schools in Antigua and Barbuda.

It is also recommended that future research be conducted to assess the integration of ICTs into the curricula of schools by using a model designed specifically for that purpose. One such model is a Maturity Model specifically designed for assessing a whole school attempt at ICT integration. A popular model which may be considered is the ICTE-MM (ICT in School Education Maturity Model) which was designed based on international standards and best practices for the management of ICTs in education (Solar et al., 2013). The findings of this research provided data regarding the extent of use of ICTs in the core curricula of public secondary schools, but a further assessment using this model will provide greater details on the level of success per individual school level. According to Solar et al. (2013), the success of ICT implementation in a school is dependent upon the quality and maturity of its ICT plan which is formulated from the results of monitoring the integration process and using the results from

evaluations of the process to plan the ICT programmes. A maturity model would assist in diagnosing the ICT integration progress of a school and would enable the school to create a roadmap towards ongoing improvements (Solar et al., 2013). Further, the roadmap will augment the ICT investments and provide the opportunities for a higher level of maturity for the schools.

This research assessed the level of ICT integration for Antigua and Barbuda which is a twin island developing state with scarce resources but is desirous of integrating ICTs into the curricula of schools to equip its citizenry with the skills necessary to be technologically literate. It was the hope of the government that ICT integration would enable teachers and students to respond to the changes which technology would bring to the classroom and ultimately enable its citizens to be part of the 'Knowledge Revolution' in the workplace (ICT in Education Policy for Antigua and Barbuda, 2013). The issues or challenges faced by schools with the process of ICT integration and the suggested ways in which they may be overcome were chronicled in this research and may be added to existing literature especially for developing states as they integrate ICTs into the curricula of their secondary schools. While there might be much literature on ICT integration in the curricula of schools, there is a paucity of information on the challenges faced by schools in developing countries hence the reason for the findings of this research to be added to the existing literature.

An assessment of the integration of ICTs in the core curricula of schools required finding evidence of ICT components embedded in the curricula, determining the extent to which the confidence and comfortability of teachers impacted ICT integration in schools, examining teaching practice to ascertain the incorporation of ICTs, determining if there are appropriate and adequate technological infrastructures at schools to facilitate ICT integration, determining teachers' pedagogical knowledge of teaching using ICTs and determining the perceptions of

educational leaders on ICT integration at their schools (IG Global, 2018). This research provided information on the degree of ICT integration in the core curricula of public secondary schools in Antigua and Barbuda and concluded that while ICTs are integrated into the curricula to a moderate extent, specific focus should be placed on the need to evaluate ICT initiatives implemented in schools as part of the planning process.

Conclusions

The purpose of this study was to assess the integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda. This was deemed necessary to determine the status quo of ICT integration in schools due to the number of ICT initiatives that have been implemented in public secondary schools with the intention of improving teaching and learning as well as ensuring that students who leave school on a yearly basis are equipped with the necessary technological skills and competencies to fit seamlessly into the world. Of significance to the researcher was the lack of evidence from past ICT initiatives to indicate the effectiveness of the integrations as they relate to the use of ICTs in schools by teachers and students. In addition, there was lack of evidence to show that evaluations have been done to provide data that would assist policy makers in making data driven decisions when considering future ICT initiatives. Noting that the focus of the study was on an assessment of the integration of ICTs in public secondary schools, data was sourced from the actual users of ICTs at schools to include teachers, students and educational leaders with specific attention paid to the knowledge of ICTs by the users and the actual use of ICTs at school for teaching and learning as well as for administrative purposes. It must be noted that one of the main goals of the government of Antigua and Barbuda is for the country to become an ‘economic powerhouse’ in the next five (5) to ten (10) years, and to achieve that goal, the citizens of the country must be technologically

literate with the process starting in schools. Schools have received injections of ICT resources from the government and other benefactors to improve learning to create a cadre of students who have sound knowledge of technology and are able to contribute to the development of the country.

The research employed a pragmatic approach to conduct the study using mixed methods to obtain data with guidance from five (5) research questions. The study followed a sequential explanatory design with the quantitative tools used to inform the qualitative tools which followed. The quantitative and qualitative tools used to gather data included teacher and student questionnaires, interview schedules, documents reviews and observations of practice. It was felt that the combination of research tools would provide a balance between authentic data collected from the actual sources within the phenomenon (qualitative tools) and those that provided scientific data requiring numbers (quantitative tools) to ensure that the data collected complemented each other, making the findings more reliable and valid.

There are 13 public secondary schools in Antigua and Barbuda and the research gathered data from 10 of those schools with student populations ranging from approximately 250 students in the smallest school to approximately 550 students for the largest school in the research. The population for the research comprised teachers and students of forms two (2) to four (4) in the core areas of English, Mathematics, Biology and Social Studies for the main purpose of covering a wider range of students since most students in secondary schools pursue those subjects at the specified levels. English and Mathematics are compulsory at all levels of public secondary schools and the Caribbean Examination Council (CXC) report (2020) reflects many students who opt to pursue Social Studies and Biology. The samples for the research comprised 163 students

in Forms two (2) to four (4) with ages ranging from 12 years to 18 years, 115 teachers, 10 educational leaders and 18 classes for observation of practice.

To assess the degree of ICT integration into the core curricula of public schools, it was determined that a curricula review would be critical in providing data since the literature claims that ICT integration is usually reflected in the curricula of schools (Dei, 2018). The action was taken to answer research question one (1) of the research which asked for the extent to which the content of core curricula designed for public secondary schools reflected ICTs and it was revealed that the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflected ICT components to moderate extent. The results revealed that the actual presence of ICT components in the curricula are moderately reflected in the tasks that students are expected to do in relation to the learning objectives, rather than being incorporated as explicit components in the documents. It must be noted that the curricula documents revealed the incorporation of teaching strategies or methods which required the use of ICTs for teaching various aspects of the content and could prove useful for the less experienced teacher. The recommendations in the syllabuses regarding the use of ICTs are followed by teachers using the syllabuses, but if ICT components were reflected in the syllabuses to a greater extent, the lessons produced and implemented by teachers may be more ICT oriented and student-centred. This has implications for classroom practice since the pedagogical use of ICTs by teachers is dependent upon their knowledge of ICTs, and the use by students for learning is dependent upon their skills in using ICTs. This suggests that for ICT initiatives in public secondary schools in Antigua and Barbuda to be considered successfully integrated, the content of the core curricula should reflect more ICT components for teaching and learning and the ICT knowledge of the users of ICTs must be taken into consideration. As stated by Livingstone (2019), tasks given in class relating to

the use of ICTs cannot be properly planned and executed by teachers if their knowledge of ICTs is not applied.

In response to research question two (2) which addressed the extent to which the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools in Antigua and Barbuda, the findings revealed that there was good correlation between the confidence and comfortability of teachers and the integration of ICTs in the curricula of schools. The research found that there was moderate ICT integration which may be attributed to the ICT knowledge of teachers which translates into the confidence and comfortability that teachers displayed in their use of ICTs. The degree of integration of ICTs in the curricula of schools is dependent to a great degree on factors to include the knowledge of ICTs by teachers which helps to boost their confidence and engenders a degree of comfortability in ICT use, the ICT resources available and support by school administration. One major element that was borne in mind concerning the level of ICT integration relating to the confidence and comfortability of teachers was the fact that teachers and students at all public secondary schools were the recipients of laptops for teaching and learning which appeared to have contributed to use of ICTs by most teachers and students. Worthy of note is that many of the teachers in the research expressed comfortability in using ICTs in their classrooms for learning to take place, and they were also instrumental in encouraging ICT use by students by setting ICT related tasks in class and for homework. The research also revealed that there is a significant difference between the confidence and comfortability of teachers in using ICTs in the classroom and the Integration of ICTs in the classroom. This means that once teachers have confidence in their knowledge of ICTs, they will most likely feel comfortable in using them for instruction and would most likely increase the

degree of integration in schools. According to Uslu (2017), teachers' knowledge of ICTs will increase their confidence in using ICTs which will positively impact integration in the classroom. The results further showed that most of the teachers used ICTs for student-centred learning to enhance students understanding of concepts as purported by radical constructivism (Xu & Shi, 2018). This revelation suggests acceptance of ICTs by several of the teachers and students in schools which according to the structure of the theory of change, is evidence of accepting the change from the traditional to the contemporary approach to teaching.

The study also concluded that the ICT knowledge of teachers affected their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda. This was the focus of research question three (3) which sought to find out if there is a positive correlation between the ICT knowledge of teachers and their use for pedagogical activities in schools. The results regarding the level of ICT use by teachers for pedagogical activities showed use to a moderate extent which was corroborated when more than half the number of participating teachers indicated that they have had training in ICTs as part of their degree or certificate courses, or through assistance from their colleagues at schools. Evidence showing that the knowledge of teachers affected their use for learning activities in the classroom was also revealed by the significant number of teachers who used ICTs for student-centred learning as well as to teach new concepts (Venkatesh et al., 2003). Further, the ANOVA statistical test for this research proved that there is a significant difference between the ICT knowledge of teachers in using ICTs in the classroom and the Integration of ICTs in the classroom. This suggests that once teachers have knowledge of ICTs in addition to subject content, they are likely to integrate ICTs into the teaching and learning process at school. A less than average number of students indicated their use of ICTs for learning which signifies use by a limited number of teachers when

teaching. Based on existing literature, teachers only use ICTs for such activities when they are comfortable and confident about their knowledge of ICTs (Uslu, 2017; Rana et al., 2020). The literature also revealed that the highest use of ICTs in any classroom results with the pedagogical use of ICTs by teachers which engages students and motivates them to learn (Cleaves & Toplis, 2012). The research therefore concluded that moderate use of ICTs in the classroom indicates that teachers have satisfactory knowledge of the pedagogical use of ICTs for teaching, and as a result incorporated them into the process of instruction at their schools.

The degree to which students used ICT components for core curricula learning activities in public secondary schools in Antigua and Barbuda as referenced by research question four (4) was defined as less than moderate according to the responses from students but moderate according to responses by teachers. Worthy of note is that the students' use of ICTs for other activities was considered moderate and above. Major factors which led to the outcomes for this aspect of the research were the students' knowledge of ICTs, their access to devices and teachers' knowledge and use of ICTs for classes. The research revealed that most of the learners were trained in the use of ICTs either before they entered secondary schools or after they enrolled in schools. This means that most students had some knowledge of the use of ICTs to navigate learning. According to Chien et al. (2014), it is not surprising that the students used the technology since they were born in an era dominated by technology and are prone to embrace it. Further, since secondary schools are equipped with ICT laboratories and all students received laptops for use in schools, access did not prove to be a major issue for most of the students. It was also noted that the use of ICTs by students was significantly dependent upon use by teachers, hence the knowledge of teachers in the use of ICTs determined use by students and the effectiveness of ICT integration. This approach is endorsed by Ghavifekr and Rosdy (2015) who

claim that the knowledge and use of ICTs by teachers to teach subjects enables students to be more engaged in the lessons leading to improved learning.

The research also concluded that the schools' environments promoted integration of ICT components in core curricula content of public secondary schools in Antigua and Barbuda to a moderate extent. It was revealed that the environments at some schools supported ICT integration with some aspects of the necessary infrastructure in place and according to IG Global (2018), the proper infrastructure is a major factor in encouraging effective ICT integration in schools. It was also revealed that the educational leaders supported the integration process to some extent by providing ICT ready environments as far as the resources allowed in accordance with the Unified Theory of Acceptance and Use of Technology (UTAUT) which identifies enabling conditions as one of the variables for ICT integration technology (Venkatesh et al., 2003). It was also made clear that there is need for even greater infrastructural support such as strong and wide-spread internet connectivity and onsite technical support as well as for training of teachers in the pedagogical use of ICTs to provide more effective integration.

Based on the findings of this research, there are teachers in public secondary schools who moderately use the technology for teaching which may be considered as evidence that they have accepted technology to some degree as the platform to be used to promote learning (Livingstone, 2019). The literature is replete with information on the use of ICTs to improve learning but is somewhat deficient in the challenges which developing countries like Antigua and Barbuda face in the Caribbean as they attempt to integrate ICTs in their curricula. Integration of ICTs require in-depth planning, and schools must be completely ready for successful implementation to take place. This research has made several recommendations for integrating ICTs in public secondary schools where ICTs are expected to form an essential part of the teaching and learning

mechanisms. One of the major recommendations is for all teachers to be trained in the pedagogical use of ICTs to ensure that learning takes place. The recommended training would be more than just training in ICT skills and would incorporate teaching teachers how to use ICTs to improve learning. Of significance is the recommendation that the training of novice and existing teachers in the pedagogical use of ICTs should be a priority. Training of novice teachers should be the responsibility of the Department of Teacher Education since that is the department responsible for the training of teachers in Antigua and Barbuda, and the training of existing teachers should be the responsibility of the Ministry of Education especially through mandated professional development programmes. Additionally, it was recommended that students be taught ICT skills so that they may be comfortable in using ICTs which could translate in them being fully engaged in tasks that involve the use of ICTs. The findings also suggest the need for the continuous professional development of teachers in using ICTs for teaching to motivate them, develop their confidence and comfortability in using the technology and attain their acceptance of the technology as a pedagogical tool integral to instruction (Rana et al., 2020).

It was also the recommendation of this study that principals of schools formulate an ICT vision for their schools and work towards creating buy-ins from staff and take steps to achieve the vision. Antigua and Barbuda have an ICT Policy which was crafted to guide integration of ICTs in public secondary schools. The policy was ratified for use in 2013 and there is lack of evidence of its use for the integration process in schools. The lack of knowledge of the policy was noted when some educational leaders expressed the need for a policy to be developed and mandated for use by the Ministry of Education. This suggests that those principals were not aware of an existing policy, hence the recommendation by this research that the policy be

updated to include current technological advancements and reinforced for use in schools by the Ministry of Education.

The findings from the research also have implications for future research. This research focussed on an assessment of the integration of ICTs into the core curricula of public secondary schools and the findings are only relatable to public secondary schools. It was recommended that future research be conducted in private secondary schools to assess the ICT integration processes to be able to draw conclusions about the status of ICT integration in private secondary schools. The data from this research and from the proposed research in private secondary schools would provide the data to compare ICT integration in public and private secondary schools as well as to determine the status of ICT integration in all secondary schools in Antigua and Barbuda. It was also recommended that future research be conducted with ICT integration in all subjects at all levels in schools to be able to determine the level of use of ICTs by teachers and students in all subject disciplines and their impact on learning.

Another recommendation for future research is to address all the major challenges faced by schools when integrating ICTs as indicated in this research and conduct a follow-up study to determine the performance of students at schools with little or no barriers to ICT integration. It is predicted that such an environment would be more ICT compliant which may ensure full integration by teachers and optimal performance by students. Additionally, it was recommended that a Maturity Model be used as another method to assess the level of ICT use in schools. The suggested model is the ICTE-MM (ICT in School Education Maturity Model) which is a design grounded on international standards and best practices in relation to the management of ICTs in education (Solar et al., 2013). According to Soler et al. (2013), the degree of success in implementing ICT will depend significantly on the quality of the school's ICT plan which should

be embedded with constant evaluations of the plans. Zhihua and Zhaojun (2009) cited in Solar et.al. (2013) have indicated that the weakest component of ICT plans is the evaluation. This Model is a long-term approach to assess ICT integration and is conducted as a whole school model to capture data on integration at all levels in all subject areas. It is hoped that this Model will provide more detailed data on the extent of integration of ICTs and effectiveness in public secondary schools.

The findings of this research are significant for developing countries that are in the process of integrating ICTs into their schools' curricula. Many ICT integration attempts have been made in public secondary schools in Antigua and Barbuda and there was lack of evidence to show whether ICTs are being used for teaching and learning and to what extent. Additionally, it is important that any attempts at integration be based on the evaluations of previous initiatives so that issues that may negatively impact a new integration initiative may be identified and addressed before implementation of the initiative (Rehan et al., 2019). There was lack of evidence to show that evaluations were done for past ICT initiatives in Antigua and Barbuda hence the reason for the focus of this research.

The assessment of the integration of Information and Communication Technologies (ICTs) into the core-curricula of public secondary schools in Antigua and Barbuda has revealed the following:

1. ICT components are embedded in the core curricula of public secondary schools to a moderate extent and would require a higher number of components embedded more explicitly in the curricula to guide the users of the curricula in the teaching and learning process.

2. The extent to which the confidence and comfortability of teachers in using ICTs contribute to the integration of ICT components contained in the core curricula of public secondary schools in Antigua and Barbuda was moderate which was based on use by teachers for different modes of teaching and by the actual accounts (rich descriptions) given by teachers. The results also revealed that there is a significant difference between the Confidence and Comfortability of teachers in using ICTs and the Integration of ICTs in the classroom which impacted the extent of integration of ICTs in the core curricula of public secondary schools.
3. The research revealed that the ICT knowledge of teachers affect their use of ICTs for pedagogical activities in public secondary schools in Antigua and Barbuda to a moderate extent. The research revealed a significant difference between the ICT Knowledge of Teachers and the Integration of ICTs in the classroom which suggests that once teachers are trained in the pedagogical use of ICTs, it will positively impact the extent of ICT integration in class. The content knowledge of teachers, their technological knowledge, and their pedagogical knowledge of ICTs in preparation for teaching are critical for the integration of ICTs in schools. The research revealed teachers in the education system who are not current in the use of ICTs for learning, and this should be addressed as expeditiously as possible beginning with government led professional development engagements. Additionally, some teachers have indicated non-use or little use of ICTs for teaching, and these should be addressed if ICT integration is to be effective in schools.
4. The research revealed that students use ICT components for core curricula learning activities in public secondary schools in Antigua and Barbuda to a less than moderate

extent while teachers indicate moderate use for core curricula instruction. Significantly, the findings revealed that students use of ICTs for learning is dependent upon the teachers' use of ICTs in instruction. While it is important that students are knowledgeable about ICTs for learning, it is critical that teachers are pedagogically trained to provide the learning opportunities for the students to learn.

5. The school environment promotes effective integration of ICT components in core curricula content of public secondary schools in Antigua and Barbuda to a moderate extent even though it was revealed that integration is ad hoc in some schools since they are not guided by an ICT policy in the process. It is recommended that schools have an ICT plan and an updated ICT policy to guide the integration process. Additionally, it was revealed that the challenges that mitigate the ICT integration process in public secondary schools in Antigua and Barbuda include lack of pedagogical training of teachers in using ICTs for instruction, lack of onsite technical support, lack of internet connectivity and other infrastructural issues such as the need for more charging ports and the need for back-up power sources for schools.

Further, the implications of the findings, the recommendations for public secondary schools from this research and the recommendations for future research are critical for developing countries that plan to implement or integrate further ICT initiatives to improve student learning. ICT integration in secondary schools must be well planned, executed and evaluated if the integration process is to be successful.

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APPENDICES

Appendix A: Request Letters and Approvals to Conduct Research

Unicaf Provisional Approval to Conduct Research

UNIVERSITY

UNICAF UNIVERSITY
RESEARCH ETHICS APPLICATION FORM
DOCTORAL STUDIES PROVISIONAL APPROVAL

The Provisional Approval - Research Ethics Application Form (REAF) should be completed by Doctoral level candidates enrolled on Dissertation stage 1.

This form is a **provisional approval** which means that the UREC committee has accepted the initial description of the project but this is conditional as changes may have to be implemented following Dissertation Stage 2 and piloting in Dissertation Stage 3.

This is a conditional offer and acceptance of the project needs to be verified and confirmed upon completion of the Research Ethics Application Form in Dissertation Stage 3.

Important Notes:

- An electronic version of the completed form should be uploaded by the student to the relevant submission link in the VLE. Student's supervisor will then review the form and provide feedback commentary. Once supervisor's initial approval is given then the supervisor will forward this to doctoral.studies-aa@unicaf.org, for provisional approval by the Unicaf University Research Ethics Committee (UREC).

- Please type your answers and **do not** submit paper copy scans. Only *PDF* format documents should be submitted to the committee.

- If you need to supply any supplementary material, not specifically requested by the application form, please do so in a separate file. Any additional document(s) should be clearly labelled and uploaded in the relevant VLE link.

- If you have any queries about the form, please address them to your dissertation or project supervisor.

UNICAF UNIVERSITY

UNICAF UNIVERSITY
RESEARCH ETHICS APPLICATION FORM
DOCTORAL STUDIES PROVISIONAL APPROVAL

UREC USE ONLY:
Application No:
Date Received:

Student's Name: Beverly Irena Augustine Allen

Student's E-mail Address: bevalle_2000@yahoo.com

Student's ID #: R1804D5102016

Supervisor's Name: Dr. Leonorah Nyaruwata

University Campus: Unicaf University Malawi (UUM)

Program of Study: UUM: EdD - Doctorate of Education

Research Project Title: An assessment of the Integration of ICTs into the Core Curricula of Public Secondary Schools in Antigua and Barbuda

1. **Please state the timelines involved in the proposed research project:**

Estimated Start Date: 02-Jan-2021 Estimated End Date: 31-Mar-2022

2. **The research project**

a. Project Summary:

In this section please fully describe the purpose and underlying rationale for the proposed research project. Ensure that you pose the research questions to be examined, state the hypotheses, and discuss the expected results of your research and their potential.

It is important in your description to use plain language so it can be understood by all members of the UREC, especially those who are not necessarily experts in the particular discipline. To that effect please ensure that you fully explain / define any technical terms or discipline-specific terminology (maximum 300 words +/- 10%).

This study seeks to assess the integration of ICTs into the core curricula in public secondary schools in Antigua and Barbuda. Attempts have been made over the years to integrate ICT in schools with the intention of improving teaching and learning. In 2016, the Ministry of Education introduced eBooks as a replacement for textbooks with every teacher and student given a laptop with subject content. As an educator for a number of years, the researcher is aware of the value of evaluating education initiatives to determine their value. Records at the Ministry of Education revealed no documentary evidence of past evaluations of ICT initiatives in education, hence the reason for this research. Research questions that will guide the process are:

1. Does the content of the core curricula designed for public secondary schools in Antigua and Barbuda reflect ICT components?
2. What is the extent of implementing ICT components contained in core curricula of public secondary schools?
3. What is the competence level of teachers in the use of ICT components for pedagogical activities in pubic secondary schools?
4. To what extent do students use ICT components for core curricula learning activities in public secondary schools?
5. What is the assessment model adopted to measure the extent of ICT components implementation in the core curricula in public secondary schools in Antigua and Barbuda?
6. Does the school environment promote effective implementation of the ICT components in core curricula content in public secondary schools?
7. What are the challenges militating against integrating ICT components in the core curricula content in public* secondary schools in Antigua and Barbuda?

UNIVERSITY

c. Recruitment Process for Human Research Participants:

Please clearly describe how the potential participants will be identified, approached and recruited (maximum 200 words).

The participants in this research will include 631 participants with 363 students and 255 core curricula teachers and 13 principals from public secondary schools. 19 teachers will be randomly selected from each school. Students will be randomly selected from the 13 secondary schools with a total of 27 students per school representing three (3) different grade levels. Only levels two (2) to four (4) will be utilized. Level one (1) will be omitted since students are new to the school and level five (5) students will also be omitted since all core areas are not pursued at that level. Nine (9) students per level will be engaged in the research. It must be noted that Maths and English are compulsory subjects at all levels. The next step will be to send consent letters to the parents of participating students explaining the aims and purpose of the research and the significance of the findings. The principals will be met face to face to explain the nature of the research and their consent sought for use of the schools and their participation in the process. Teachers' permission will be sought via their individual government email addresses.

d. Relationship between the principal investigator and participants:

Is there any relationship between the principal investigator (student), co-investigators(s), (supervisor) and participant(s)? For example, if you are conducting research in a school environment on students in your classroom (e.g. instructor-student).

☑ YES ☐ NO

If YES, please specify (maximum 100 words).

The principal investigator is a Ministry of Education official who is administratively responsible for national curriculum but does not have any direct relationships with the teachers using the curricula nor with the students.

5. Further Approvals

Are there any other approvals required (in addition to ethics clearance from UREC) in order to carry out the proposed research study?

☑ YES ☐ NO

If YES, please specify (maximum 100 words).

Approval must be sought from the Director of Education within the Ministry of Education to conduct research with students in schools. In addition, approvals will be sought from principals to conduct the research in their schools as well as from teachers and parents/guardians of students to participate in the research. If possible, approval will be sought from the Antigua and Barbuda Institutional Review Board (which is somewhat defunct) with the presentation of the Research Proposal and the instruments that will be used for the research for their review.

UNIVERSITY

6. **Potential Risks of the Proposed Research Study**

Are there any potential risks, psychological harm and/or ethical issues associated with the proposed research study, other than risks pertaining to everyday life events (such as the risk of an accident when travelling to a remote location for data collection)?

☐ YES ☑ NO

If YES, please specify (maximum 150 words):

7. **Application Checklist**

Please mark √ if the study involves any of the following:

☑ Children and young people under 18 years of age, vulnerable population such as children with special educational needs (SEN), racial or ethnic minorities, socioeconomically disadvantaged, pregnant women, elderly, malnourished people, and ill people.

☐ Research that foresees risks and disadvantages that would affect any participant of the study such as anxiety, stress, pain or physical discomfort, harm risk (which is more than is expected from everyday life) or any other act that participants might believe is detrimental to their wellbeing and / or has the potential to / will infringe on their human rights / fundamental rights.

☐ Risk to the well-being and personal safety of the researcher.

☐ Administration of any substance (food / drink / chemicals / pharmaceuticals / supplements / chemical agent or vaccines or other substances (including vitamins or food substances) to human participants.

☐ Results that may have an adverse impact on the natural or built environment.

UNIVERSITY

8. **Final Declaration by Applicants:**

(a) I declare that this application is submitted on the basis that the information it contains is confidential and will only be used by Unicaf University and Unicaf University Research Ethics Committee (UREC) for the explicit purpose of ethical review and monitoring of the conduct of the research proposed project as described in the preceding pages.

(b) I understand that this information will not be used for any other purpose without my prior consent, excluding use intended to satisfy reporting requirements to relevant regulatory bodies.

(c) The information in this form, together with any accompanying information, is complete and correct to the best of my knowledge and belief and I take full responsibility for it.

(d) I undertake to abide by the highest possible international ethical standards governing the Code of Practice for Research Involving Human Participants, as published by the UN WHO Research Ethics Review Committee (ERC) on http://www.who.int/ethics/research/en/ and to which Unicaf University aspires to.

(e) In addition to respect any and all relevant professional bodies' codes of conduct and/or ethical guidelines, where applicable, while in pursuit of this research project.

(f) I understand it is my responsibility to submit a full REAF application during Dissertation Stage 3 to UREC. If a REAF application is not submitted my project is not approved by UREC.

(g) I fully acknowledge that this form does not constitute approval of the proposed project but it is only a provisional approval.

☑ **I agree with all points listed under Question 8**

Student's Name: Beverly Irena Augustine Allen

Supervisor's Name: Professor Leonorah Nyaruwata

Date of Application: 07-Sep-2020

Important Note:
Please now save your completed form (we suggest you also print a copy for your records) and then submit it to your UU Dissertation/project supervisor (tutor). **In the case of student projects, the responsibility lies with the Faculty Dissertation/Project Supervisor.** If this is a student application, then it should be submitted via the relevant link in the VLE. Please submit only electronically filled in copies; **do not** hand fill and submit scanned paper copies of this application.

☑ **Before submitting your application, please tick this box to confirm that all relevant sections have been filled in and the information contained is accurate to the best of your knowledge.**

UNIVERSITY

c. Recruitment Process for Human Research Participants:

Please clearly describe how the potential participants will be identified, approached and recruited (maximum 200 words).

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Is there any relationship between the principal investigator (student), co-investigators(s), (supervisor) and participant(s)? For example, if you are conducting research in a school environment on students in your classroom (e.g. instructor-student).

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The principal investigator is a Ministry of Education official who is administratively responsible for national curriculum but does not have any direct relationships with the teachers using the curricula nor with the students.

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UNIVERSITY

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If YES, please specify (maximum 150 words):

7. **Application Checklist**

Please mark √ if the study involves any of the following:

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☐ Risk to the well-being and personal safety of the researcher.

☐ Administration of any substance (food / drink / chemicals / pharmaceuticals / supplements / chemical agent or vaccines or other substances (including vitamins or food substances) to human participants.

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UNIVERSITY

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(a) I declare that this application is submitted on the basis that the information it contains is confidential and will only be used by Unicaf University and Unicaf University Research Ethics Committee (UREC) for the explicit purpose of ethical review and monitoring of the conduct of the research proposed project as described in the preceding pages.

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Student's Name: Beverly Irena Augustine Allen

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☑ **Before submitting your application, please tick this box to confirm that all relevant sections have been filled in and the information contained is accurate to the best of your knowledge.**

UREC Decision to Conduct Research

UNICAF UNIVERSITY

Unicaf University Research Ethics Committee Decision

Student's Name: Beverly Allen

Student's ID #: R1804D5102016

Supervisor's Name: Dr Leonorah Nyaruwata

Program of Study: UU-PhD-Edu-900-3

Offer ID /Group ID: O32303G34577

Dissertation Stage: DS 3

Research Project Title: An assessment of the Integration of Information and Communication Technologies (ICTs) into the Core Curricula of Public Secondary Schools in Antigua and Barbuda

Comments: No comments

Decision*: A. Approved without revision or comments

Date: 17-Mar-2022

Letter of Request to Antigua and Barbuda Institutional Review Board

BEVERLY I. A. ALLEN

BELLE VIEW ESTATE, P.O. BOX 2897

PHONE: 268 463-3242 CELL: 268 720-5013 WORK: 268 468-3044

EMAIL: bevalle_2000@yahoo.com

January 12, 2022

Mr Collin O'Keiffe
Chairman
Antigua and Barbuda Institutional Review Board
Antigua

Dear Mr O'Keiffe,

RE: Research Study

My name is Beverly Allen and I am currently enrolled in the Doctorate of Education (EdD) programme with Unicaf University, Malawi as part of the Organizational Change and Leadership Course, and I am presently working on my doctoral dissertation. The research focuses on the Integration of ICT in the Core Curricula of Public Secondary Schools in Antigua and Barbuda and would require gathering data from participants in those schools.

As part of the research study, I plan to conduct online surveys with teachers and students of core subjects to determine their use of ICTs for teaching and learning. Face to face interviews will also be conducted with school leaders to ascertain their perceptions of ICT integration in schools and the challenges they face in the process.

I hereby seek the approval of the Antigua and Barbuda Institutional Review Board to conduct research with core curricula teachers and students of Forms 2 to 4 in public secondary schools in Antigua and Barbuda. To ensure that proper research ethics are upheld, school leaders and teachers will be issued with Inform Consent Forms and the parents of students involved in the research will be issued with Guardian Inform Consent Forms for their consent.

It must be noted that the approval of the Antigua and Barbuda Institutional Review Board on this matter will assist in providing much needed data relating to the effectiveness of ICT integration into the curricula of public secondary schools in Antigua and Barbuda and will seek to inform future ICT initiatives in education.

Thank you for considering my request.

Regards,

Beverly I. A. Allen

Approval Letter from Antigua and Barbuda Institutional Review Board

INSTITUTIONAL REVIEW BOARD

ANTIGUA AND BARBUDA
MINISTRY OF HEALTH

21st February, 2022

To: Mrs. Beverly Allen

From: Chair, Antigua and Barbuda Institutional Review Board (ANU-IRB)

Reference #: AL-02/022022-ANUIRB

Title of protocol: Assessment of ICT Integration into the Core-Curricula Content Design and Implementation in Public Secondary Schools in Antigua and Barbuda.

Principal Investigator: Mrs. Beverly Allen

APPROVAL LETTER

The Antigua and Barbuda Institutional Review Board (ANU-IRB) of the Ministry of Health completed review of the captioned proposed project. The ANU-IRB has decided to endorse this project.

If there is need for major modification of this research project, such modification must be submitted to the Antigua and Barbuda Institutional Review Board for review and approval before implementation. A final review report must be submitted to the ANU-IRB at the completion of the project.

This approval is granted until 31st December 2022. If additional time is required, an interim request for extension of this protocol should be submitted to the ANU-IRB for the requisite clearance. The Antigua and Barbuda Institutional Review Board reserves the right to revoke its approval of the captioned Protocol.

Signature of the Chairman: .....

Colin B.S. O'Keiffe Bsc, Msc
(ANU-IRB Chair)

Pc: Permanent Secretary Ministry of Health, Chief Medical Officer, Ministry of Health

1.

FWA number :- FWA00019299
Institutional Review Board number :- IRB00009002
Institutional Review Board Org number :- IORG0007501
Contact :- email anuirb@gmail.com
IRB Chair 268-464-5685 Admin Officer 268-462-5685

Letter to Director of Education for Permission to Conduct Research

BEVERLY I. A. ALLEN
BELLE VIEW ESTATE, P.O. BOX 2897
PHONE: 268 463-3242 CELL: 268 720-5013 WORK: 268 468-3044
EMAIL: bevalle_2000@yahoo.com

January 04, 2022

Mr Clare Browne
Director of Education

Ministry of Education, Sports, and Creative Industries
Queen Elizabeth Highway
Antigua

Dear Sir,

RE: Research Study

I am currently enrolled in the Doctorate of Education (EdD) programme with Unicaf University, Malawi as part of the Organizational Change and Leadership Course, and I am presently working on my doctoral dissertation. The research focuses on the Integration of ICT in the Curricula of Public Secondary Schools in Antigua and Barbuda and would require gathering data from participants in those schools.

As part of the research study, I plan to conduct online surveys with teachers and students of core subjects to determine their use of ICTs for teaching and learning. Face to face interviews will also be conducted with school leaders and teachers to ascertain their perceptions of ICT integration in schools and the challenges they face in the process.

I hereby seek your approval to conduct research by way of surveys and interviews in public secondary schools with core curricula teachers and students of Forms 2 to 4. To ensure that proper research ethics are upheld, school leaders and teachers will be issued with Inform Consent Forms and the parents of students involved in the research will be issued with Guardian Inform Consent Forms for their consent.

Your approval on this matter will assist in providing much needed data relating to the effectiveness of ICT integration into the curricula of public secondary schools in Antigua and Barbuda and will seek to inform future ICT initiatives in education.

Thank you for considering my request.

Regards,

Beverly I. A. Allen

Consent Letter from the Director of Education to Conduct Research

Government of
Antigua & Barbuda
Ministry of Education and Sports
Government Complex, Queen Elizabeth Highway
St. John's, Antigua
Tel: 462-0192/462-0193/462-0198/462-0199
Overseas: 268-462-4959/1051
Fax: 268-462-4970

Mrs. Beverly I. A. Allen
Belle View Estate
P.O Box 2897
St. John's
Antigua

January 11, 2022

Dear Mrs. Allen,

Receipt is acknowledged of your letter dated 4th January, 2022 seeking permission to conduct a research in public Secondary Schools in Antigua and Barbuda with core curricular teachers and students of Forms 2 to 4 as part of your studies at the Unicaf University, Malawi.

It is noted that the research focuses on the Integration of ICT in the Curricula of public Secondary Schools in Antigua and Barbuda and would require gathering data from participants in those schools.

It is further noted that the research will be conducted through online surveys and interviews to students from Forms 2 to 4, school leaders and teachers.

The Ministry of Education and Sports is pleased to grant permission for you to conduct your research in public Secondary Schools in Antigua and Barbuda.

Kindly make contact with the principal of the schools so that arrangements can be made to facilitate your research.

We wish you all the very best with your studies.

Yours respectfully,

.....
Clare Browne Esq.
Director of Education

MINISTRY OF EDUCATION
JAN 11 2022

Appendix B: Letter of Intent, Gatekeeper Letter and Consent Forms

Letter of Intent to Education Officer Secondary regarding Conduct of the Research

BEVERLY I. A. ALLEN

BELLE VIEW ESTATE, P.O. BOX 2897

PHONE: 268 463-3242 CELL: 268 720-5013 WORK: 268 468-3044

EMAIL: bevalle_2000@yahoo.com

March 17, 2022

Dear Mrs Mills,

This letter serves to inform you that I am a Doctoral Student with Unicaf University, Malawi and as part of my degree I am conducting a study on **the Integration of Information and Communication Technologies (ICTs) into the Core Curricula of Public Secondary Schools in Antigua and Barbuda.**

Permission was granted by the Director of Education and the Institutional Review Board of Antigua and Barbuda to conduct the research in public secondary schools and I will be requesting the assistance of each public-school principal to be a participant in an interview for school leaders and to allow the administration of online questionnaires to the students of core subject areas in Forms 2 to 4. Another aspect of the research will involve the observation of classroom practice once feasible (based on the COVID-19 epidemiological situation) and the principals' permission would be sought in this regard.

This study will be using **online questionnaires for teachers and students, face to face interviews or interviews using Zoom videos for principals and observation of teaching practices in Forms 2 to 4 during the teaching of the core areas of English, Mathematics, Science and Social Sciences.**

Principals will be asked to officially notify the core subject teachers of the research and make a list of eligible teachers and students per class level available. A schedule will be prepared and shared with principals for the conduct of the interviews. In addition, permission will be sought from principals to facilitate the distribution and collection of Consent Forms for adults in the research (principal and teachers) and Guardian Inform Consent Forms for the students participating in the study. The information gleaned from all participants will be treated in strict confidence.

It is important to note that the findings of the research will add to existing research and provide insight for Antigua and Barbuda as the country continues to strive to achieve greater learning by integrating ICTs in the curricula. The research will be beneficial to school leaders and educators as it will address the way ICTs should be incorporated into core curricula. It will encourage teachers to focus on new teaching strategies and methodologies to improve students' learning,

foster creativity and innovation and encourage the customization of teaching resources and methodologies to cater to the diverse needs of the learners.

Your assistance in facilitating this process by informing principals and the Heads of Department for the core areas in public secondary schools about the research will be greatly appreciated. Please note that principals will also be provided with a Gatekeeper's document outlining the various aspects of the research.

Thanks for your assistance in executing this project.

Regards

_____

Beverly Allen (Doctoral Candidate)

Gatekeeper Letter to Educational Leaders

UNICAF UNIVERSITY

Gatekeeper letter

Address: Belle View Estate, Antigua

Date: 14-Feb-2022

Subject: Research on ICT integration at School

Dear Principal,

I am a **doctoral** student at Unicaf University, **Malawi**.

As part of my degree I am carrying out a study on **the Integration of Information and Communication Technologies (ICTs) into the Core Curricula of Public Secondary Schools in Antigua and Barbuda.**

Permission was granted by the Director of Education and I wish to know whether you would be willing to assist by being a participant in an interview and in facilitating the administration of online questionnaires to the students of core subject areas in Forms 2 to 4 and for allowing the observation of classes by the researcher in the said areas for this research.

Subject to approval by Unicaf Research Ethics Committee (UREC) this study will be using **online questionnaires for teachers and students, face to face interviews or interviews using Skype or WhatsApp videos for principals and observation of teaching practices in Forms 2 to 4 of the core areas of English, Mathematics, Science and Social Sciences.**

The project is entitled 'An assessment of the Integration of Information and Communication Technologies (ICTs) into the Core Curricula of Public Secondary Schools in Antigua and Barbuda'. My supervisor is Dr. Leonorah Tendayi Nyaruwata.

As a principal, you will be required to officially notify the core subject teachers at your school of the research, prepare a list of eligible teachers and students per class level and follow (if possible) the prepared schedule for conducting interviews with you, organizing the distribution and collection of Guardian Inform Consent Forms, facilitating the administration of online questionnaires during school hours and allowing the classroom observations of teaching practices.

Thank you in advance for your time and for your consideration of this project. Kindly please let me know if you require any further information or need any further clarifications.

Yours Sincerely,
Beverly I. A. Allen

Student's Name: Beverly Irena Augustine Allen
Student's E-mail: bevalle_2000@yahoo.com
Student's Address and Telephone: Belle View Estate, Antigua Telephone: 2687205013
Supervisor's Title and Name: Dr. Leonorah Tendayi Nyaruwata
Supervisor's Position:

Informed Consent Form for Educational Leaders and Teachers

Informed Consent Form

Part 1: Debriefing of Participants

Student's Name: Beverly I. A. Allen

Student's E-mail Address: bevalle_2000@yahoo.com

Student ID #: R1804D5102016

Supervisor's Name: Dr. Leonorah Tendayi Nyaruwata

University Campus: Unicaf University Malawi (UUM)

Program of Study: UUM: EdD – Doctorate of Education

Research Project Title: An Assessment of the Integration of Information and Communication Technologies (ICTs) into the Core Curricula of Public Secondary Schools in Antigua and Barbuda

Date: 14 February 2022

Purpose, Aim and Significance of the research project

The purpose of this study is to assess the integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda by examining core curricula for evidence of ICT components, the use of ICTs by teachers and students and the infrastructural and environmental factors that may influence their use. The research aims to conduct an assessment of ICT integration in the curricula of schools and the findings may add to existing literature and provide insight for Antigua and Barbuda as the country continues to strive to achieve greater learning by integrating ICTs in the curricula. The research may be beneficial to school leaders and educators as it should address the way ICTs should be incorporated into core curricula. It should encourage teachers to focus on new teaching strategies and methodologies to improve students' learning, foster creativity and innovation and encourage the customization of teaching resources to cater to the diverse needs of the learners. You are a core subject teacher or a principal of a public secondary school and will be significant in providing pertinent information on ICTs integration in public secondary schools.

The above-named Student is committed in ensuring participant's voluntarily participation in the research project and guaranteeing there are no potential risks and/or harms to the participants.

Participants have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In these cases, data collected will be deleted.

All data and information collected will be coded and will not be accessible to anyone outside this research. Data described and included in dissemination activities will only refer to coded information ensuring beyond the bounds of possibility participant identification.

I, **Beverly I. A. Allen**, ensure that all information stated above is true and that all conditions have been met.

Student's Signature: 

Informed Consent Form

Part 2: Certificate of Consent

This section is mandatory and should be signed by the participants.

Student's Name: Beverly I. A. Allen

Student's E-mail Address: bevalle_2000@yahoo.com

Student ID #: R1804D5102016

Supervisor's Name: Dr. Leonorah Tendayi Nyaruwata

University Campus: Unicaf University Malawi (UUM)

Program of Study: UUM: EdD – Doctorate of Education

Research Project Title: An Assessment of the Integration of Information and Communication Technologies (ICTs) into the Core Curricula of Public Secondary Schools in Antigua and Barbuda

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that the participant is free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g., audio recordings, video recordings) for the purposes of the participation to this study. I understand that all data will remain anonymous and confidential, unless stated otherwise.

Name of Participant (Print Name): _____

Participant's Signature _

Date: _____

Witness Print Name: _____

Witness Signature: _____

Date: _____

Guardian Informed Consent Form for Students

UNICAF UNIVERSITY

Guardian Informed Consent Form

Part 1: Debriefing of Participants

Student's Name: Beverly I. A. Allen

Student's E-mail Address: bevalle_2000@yahoo.com

Student ID #: R1804D5102016

Supervisor's Name: Dr. Leonorah Tendayi Nyaruwata

University Campus: Unicaf University Malawi (UUM)

Program of Study: UUM: EdD – Doctorate of Education

Research Project Title: An Assessment of the Integration of Information and Communication Technologies (ICTs) into the Core Curricula of Public Secondary Schools in Antigua and Barbuda

Date: 14 February 2022

Purpose, Aim and Significance of the Research Project

The purpose of this study to assess the integration of ICTs into the core curricula of public secondary schools in Antigua and Barbuda by examining core curricula for evidence of ICT components, the use of ICTs by teachers and students and the infrastructural and environmental factors that may influence their use. The research aims to conduct an assessment of ICT integration in the curricula of schools and the findings should add to existing research and provide insight for Antigua and Barbuda as the country continues to strive to achieve greater learning by integrating ICTs in the curricula. The research should be beneficial to school leaders and educators as it should address the way ICTs should be incorporated into core curricula. It will encourage teachers to focus on new teaching strategies and methodologies to improve students' learning, foster creativity and innovation and encourage the customization of teaching resources and methodologies to cater to the diverse needs of the learners. Your child is a student in Forms 2 to 4 of a public secondary school and would be significant in providing pertinent information on ICTs integration in the curricula of public secondary schools.

The above-named Student is committed in ensuring participant's voluntarily participation in the research project and guaranteeing there are no potential risks and/or harms to the participants.

Participants have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In these cases, data collected will be deleted.

All data and information collected will be coded and will not be accessible to anyone outside this research. Data described and included in dissemination activities will only refer to coded information ensuring beyond the bounds of possibility participant identification.

I, **Beverly I. A. Allen**, ensure that all information stated above is true and that all conditions have been met.

Student's Signature: 

Guardian Informed Consent Form

Part 2: Certificate of Consent

- This section is mandatory and should to be signed by the participant's legal guardian

Student's Name: Beverly I. A. Allen

Student's E-mail Address: bevalle_2000@yahoo.com

Student ID #: R1804D5102016

Supervisor's Name: Dr. Leonorah Tendayi Nyaruwata

University Campus: Unicaf University Malawi (UUM)

Program of Study: UUM: EdD – Doctorate of Education

Research Project Title: An Assessment of the Integration of Information and Communication Technologies (ICTs) into the Core Curricula of Public Secondary Schools in Antigua and Barbuda

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that the participant is free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g., audio recordings, video recordings) for the purposes of the participation to this study. I understand that all data will remain anonymous and confidential, unless stated otherwise.

I, _____, the legal guardian of _____

allow and provide consent that _____ can willingly

participate in the study.

I, _____, the legal guardian of _____

have been ensured that verbal consent given by _____

will also be given before the study.

Request to Use Survey

Beverly Allen <bevalle_2000@yahoo.com>
To:khogarty@usf.edu
Sat, Mar 26 at 4:50 PM

Dear Dr. Hogarty,

My name is Beverly Allen and I am currently a doctoral student at the Unicaf University of Malawi and working on my dissertation which focuses on the Integration of ICTs in the Curricula of Secondary Schools in Antigua and Barbuda. I had the opportunity to review your survey instrument which I believe has the potential to provide me with very useful information for my research. On this basis, I would like to request your permission to use this survey tool in my research.

Thanks for your consideration of my request and I anticipate a favourable response to my request.

Best regards,

Beverly I. A. Allen
Antigua and Barbuda

Permission to Use Survey

Kristine Hogarty <khogarty@usf.edu>
To: Beverly Allen
Sat, Mar 26 at 5:04 PM

Good afternoon, Beverly,

Thanks for your note. I am pleased that you are interested in our instrument and our work. I can certainly grant you permission to use it in your dissertation work. I only ask that you share your results upon completion of your study.

Good luck to you!

Take care,

Kris

Kristine Y. Hogarty, Ph.D.

Director of Assessment

COEDU, USF Tampa Campus

Appendix C: Research Tools

Teacher Questionnaire on ICT Integration in Schools

You are invited to complete the following survey which aims at **Assessing the Integration of Information and Communication Technologies (ICTs) into the Core-Curricula of Public Secondary Schools in Antigua and Barbuda.**

The questionnaire should only take 10 minutes to complete and it includes a section on teacher demographics and 4 other sections. Your responses are anonymous and will not be identified with you in any way.

By participating in this survey, you are indicating that you understand that your responses are anonymous and will not be identified with you in any way. You may skip any question that you find intrusive or offensive, but it will help me if you respond to as many questions as you feel comfortable with.

You have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In this case, the data collected will be deleted.

Please complete all questions and make sure you follow the instructions for each question.

Your responses will be kept confidential.

SECTION 1: **TEACHER DEMOGRAPHICS**

Directions: Please read the following statements and select the one response that reflects your answer.

1. What gender do you identify as? Choose one option.

☐ Male ☐ Female

2. What is the highest degree or level of education you have earned? Choose one option.

QUALIFICATIONS	
Doctorate	_____
Master's Degree	_____
Bachelor's Degree	_____
College Diploma	_____
Certificate	_____
Other, please specify	_____

3. How long have you been a secondary school teacher? State specific number of years below.
_____

4. At which secondary school do you teach? Please Specify _____

5. Which core subject area do you teach? You may choose more than one option.

☐ English ☐ Mathematics ☐ Biology ☐ Social Studies

SECTION 2: TEACHER PREPARATION FOR USE OF ICTS IN CLASS

Directions: For the following items, please select the one response that reflects the extent to which you have acquired ICT skills from the following sources. Select ONE option in each row.

1. Not at all
2. To a small extent
3. To a moderate extent
4. To a great extent
5. Entirely

	1 Not at all	**2 To a Small extent**	**3 To a Moderate extent**	**4 To a Great extent**	**5 Entirely**
6. As part of your undergraduate programme					
7. As part of your graduate programme					
8. As part of an in-service programme or professional development workshop					
9. Interacting/instruction from other staff members					
10. Independent learning (e.g. online tutorials or books)					
11. Distance learning courses					

Source: Hogarty et al. (2003b)

SECTION 3: CONFIDENCE AND COMFORTABILITY IN USING ICTS IN THE CLASSROOM

Directions: Please read the following statements and select the one response that best reflects your level of agreement

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
12. I have had adequate training in using computers/ICTs					
13. I use computers/ICTs effectively in my classroom					
14. I am comfortable using computers/ICTs to teach in my classroom					
15. I am comfortable giving students' assignments using ICTs					
16. I am confident using ICT tools in the classroom.					
17. Using computers/ICTs in the classroom enhance students' performance					
18. I am developing expertise in the uses of technology in the classroom					
19. Incorporating multimedia into lessons enhances teaching					

Source: Hogarty et al. (2003b)

SECTION 4: GENERAL SCHOOL OR ADMINISTRATIVE SUPPORT

Directions: Please read the following statements and select the one response in each row that best represents your level of agreement.

1. **Strongly disagree**
2. **Disagree**
3. **Neutral**
4. **Agree**
5. **Strongly Agree**

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
20. I have adequate time to learn computer skills.					
21. I have sufficient access to computers at my school.					
22. I receive a sufficient level of computer-related support at my school.					
23. Staff members encourage the use of computers/ICTs.					
24. The administration supports computer-related training.					
25. The administration actively encourages the use of computers in the classroom.					
26. The administration actively encourages the use of computers/ICTs outside the classroom.					

Source: Hogarty et al. (2003b)

SECTION 5: INTEGRATION OF ICTS IN THE CLASSROOM

Directions: Listed below are teaching modes in which ICTs may be used in the classroom. For each statement, indicate how often you use ICTs in each teaching mode. If you feel an item does not apply, then select (NA).

1. Not at all
2. Once a month or less
3. Once a week
4. Several times a week
5. Everyday
6. NA

	1 Not at all	**2 Once per month or less**	**3 Once a week**	**4 Several times a week**	**5 Everyday**	**NA**
27. Engage in individualized instruction						
28. Encourage student-centred learning						
29. Engage in small group instruction						
30. Use in cooperative groups						
31. Use ICTs as a reward						
32. Independent learning						
33. To teach new concepts						
34. Use as a research tool for students						
35. Problem solving tool for students						
36. Use by students as a productivity tool (to create charts, reports or other products)						

37. As a classroom presentation tool						
38. As a communication tool (e.g., email, electronic discussion)						

Source: Source: Hogarty et al. (2003b)

Thanks for your time in answering the questionnaire

Students' Questionnaire on ICT Integration in School

You are invited to complete the following questionnaire which aims at **Assessing the Integration of Information and Communication Technologies (ICTs) into the Core-Curricula of Public Secondary Schools in Antigua and Barbuda.**

The questionnaire should only take 8 minutes to complete and it includes 2 sections. Your responses are anonymous and will not be identified with you in any way.

By participating in this survey, you are indicating that you understand that your responses are anonymous and will not be identified with you in any way. You may skip any question that you find intrusive or offensive, but it will help me if you respond to as many questions as you feel comfortable with.

You have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In this case, the data collected will be deleted.

Please complete all questions and make sure you follow the instructions for each question. Your responses will be kept confidential.

SECTION 1: **STUDENTS' DEMOGRAPHICS**

Directions: Please read the following statements and select the one response that best reflects your answer.

a. What gender do you identify as? Choose one option. ☐ Male ☐ Female

b. What is your age? Please state specific. _____

c. Which secondary school do you attend? Name of school _____

d. Which grade level are you in? Choose one option.

☐ Form 2 ☐ Form 3 ☐ Form 4

SECTION 2: STUDENTS KNOWLEDGE AND USE OF ICTS IN SCHOOL

Directions: The following statements address your knowledge and use of ICTs. For each statement, choose one option that represents your opinion.

1. Not at all
2. Small extent
3. Moderate extent
4. Great extent
5. Entirely

	1 Not at all	**2 Small extent**	**3 Moderate extent**	**4 Great extent**	**5 Entirely**
1. I have had training in ICTs before attending secondary school					
2. I have had training in the use of ICTs while in school					
3. I have access to ICTs at school to do my schoolwork					

4. I use ICTs to do my classwork					
5. I use ICTs to do my homework					
6. I use ICTs to do research					
7. I use ICTs in my English classes					
8. I use ICTs in my Mathematics classes					
9. I use ICTs in my Social Studies classes					
10. I use ICTs in my Science (Biology) classes					
11. I learn when I am taught using ICTs					
12. ICTs should be used for teaching all subjects in school					
13. My principal encourages the use of ICTs for learning					
14. My teachers are knowledgeable about the use of ICTs for teaching					

Source: Source: Hogarty et al. (2003b)

Thank you for your time in answering this questionnaire

Interview Protocol for Educational Leaders

Preamble

This study seeks to assess the status of ICT Integration into the core curricula of public secondary schools in Antigua and Barbuda.

The purpose of this interview is to determine your perception of the ICT integration process in your school.

You have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In these cases, data collected will be deleted.

All data and information collected will be coded and will not be accessible to anyone outside this research. Data described and included in dissemination activities will only refer to coded information ensuring beyond the bounds of possibility participant identification.

Seek permission to record the session.

Interview Questions

1. How long have you been a principal at your school?

2. Do you have training in the use of ICTs for teaching?

3. What is your perception of ICT integration in your school?

4. What is your perception of your role in the integration of ICTs in your school?

5. How would you describe the support that you offer to teachers at your school to promote the integration of ICTs in the curricula of your school?

6. What do you perceive as barriers or hindrances to effective ICT integration in the curricula of your school?

Observation Protocol for Classroom Practice

The checklist will be used by the researcher while observing practice in core curricula classes in public secondary schools to determine the use of ICT components for teaching and learning.

	0 Not at all	**1 Small extent**	**2 Moderate extent**	**3 Great extent**	**4 Entirely**
Teacher uses ICTs throughout the lesson to teach concepts					
Teacher uses ICTs for consolidation of concepts					
Students use ICTs for independent learning					
Students use ICTs during the lesson to solve problems					
Teacher assigns homework that involves the use of ICTs					

What ICT components are embedded in the core curriculum lesson?

_____

_____

_____

_____

How do you use ICTs to teach your subject? (Record exact statements)

_____

_____

_____

Document Review Protocol for Core Curricula

The curricula of the core subjects in secondary schools will be examined for evidence of ICT components.

	0 Not at all	**1 Small extent**	**2 Moderate extent**	**3 Great extent**	**4 Entirely**
There are components of ICTs in the English Curriculum					
There are components of ICTs in the Mathematics Curriculum					
There are components of ICTs in the Science Curriculum					
There are components of ICTs in the Social Sciences Curriculum					

What components are embedded in each core curriculum?

ICT Components identified in English

_____

_____

ICT Components identified in Mathematics

_____

_____

ICT Components identified in Science (Biology)

_____

_____

ICT Components identified in Social Studies

_____

_____