

## **Quality Assurance in Course Development and Delivery in a Post-Pandemic World: Riding the Wave of Technology Transformations**

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### **Abstract**

As higher education institutions engage in course development and delivery in this post-pandemic context, quality assurance considerations must play a key role, as emergency remote teaching is not the standard for online learning. In this position paper, the author conducted desk research and sought to answer the following questions: i) What were the main technology transformations experienced by higher education institutions during the Covid-19 Pandemic? ii) What are some post-pandemic considerations for course development and delivery in higher education?; iii) What are the quality assurance considerations for post-pandemic higher education institutions seeking to deliver online courses? Sources were identified, reviewed and evaluated for credibility based on the quality of the publication, taking account of journal impact factor, relevance to the topic and the timeliness of the information. The articles were read and sentences, paragraphs, or sections that reflected the scope of the research questions were extracted and reviewed to see how they responded to the research questions. Findings confirmed that a wave of technology transformations took place, marked by increased use of Learning Management Systems and synchronous web conferencing platforms. It was found that the use of rubrics to identify quality indicators is an important quality consideration. It was also found that lecturers gained more experience with remote examination and virtual labs and simulations. There was enhanced online student support in institutions and more options for developing faculty competencies in online teaching. Overall, there was greater understanding of the continuum of online learning, and that specific resources are required to ensure quality in course development and delivery. It was recommended that institutions engage in appropriate and timely policy development, including the development of a clear quality policy that captures the standards for online learning. There should also be the application of an appropriate quality assurance framework, and the strengthening of those entities responsible for implementation of the activities crucial for online course development and delivery.

*Keywords:* quality in online learning, quality assurance in higher education, technology transformations post COVID-19, transitioning from ERT

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## **Introduction**

The COVID-19 Pandemic resulted in rapid upscaling in the use of technology in education, as educational institutions were forced to resort to remote teaching. Traditional face-to-face institutions rode a wave of technology transformations, which involved them engaging in more synchronous online delivery of courses, online assessments, and greater use of learning management systems. Just as these traditional institutions gained confidence in the delivery of remote teaching, the rise of Artificial Intelligence heightened the technology transformation wave. The desire to remain relevant, keep abreast of the technological transformations and meet the changing demands of stakeholders require higher education institutions to review course development and delivery to encompass more online approaches while considering how to cope with the challenges posed by rapid technological developments. As institutions engage in course development and delivery in this post-pandemic context, quality assurance considerations must play a key role, as emergency remote teaching is not the standard for online learning. Through desk research, this paper seeks to answer the following questions:

1. What were the main technology transformations experienced by higher education institutions during the Covid-19 Pandemic?
2. What are some post-pandemic considerations for course development and delivery in higher education?
3. What are the quality assurance considerations for post-pandemic higher education institutions seeking to deliver online courses?

The goal is to provide recommendations for ensuring quality assurance in online course development and delivery especially for traditional higher education institutions considering transitioning to dual-mode institutions.

### **Process for Conducting the Study**

The researcher utilised desk research to answer the research questions. Desk research involves the use of secondary sources of data, or previously published research, rather than collecting new data (Goundar, 2012; Kabir, 2016). This method is usually recognised as providing a starting point for further research (Kabir, 2016).

The process used to derive the data for this study commenced with an identification of the problem and the related research questions, outlined previously. This allowed the researcher to set the scope or parameters for the research with regard to subject area, location and time frame as follows:

*Research Question 1- What were the main technology transformations experienced by higher education institutions during the Covid-19 Pandemic* Scope – Journal articles, papers, reports, or websites dealing with use of Information, Communication Technology (ICT) for teaching and learning between 2020 and 2021. That is, during the height of the COVID-19 Pandemic, in higher education institutions within the Caribbean and globally. Information was also sought from non-profit and professional organisations committed to advancing quality in higher education and the use of ICTs, such as Educause, Quality Matters and the Online Learning Consortium.

*Research Question 2- What are some post-pandemic considerations for course development and delivery in higher education?*

Scope – Journal articles, papers, reports, or websites dealing with online course design following the Covid-19 Pandemic, i.e. from 2022 in higher education institutions within the Caribbean and globally. Information was also sought from non-profit and professional organisations committed to quality in higher education and advancing higher education through the use of ICTs, such as Educause, Quality Matters and the Online Learning Consortium.

*Research Question 3- What are the quality assurance considerations for post-pandemic higher education institutions seeking to deliver online courses?*

Scope- Journal articles, papers, reports, or websites dealing with quality considerations for online learning in general and specifically considerations following the Covid-19 Pandemic, i.e. from 2022 in higher education institutions within the Caribbean and globally. Information was also sought from non-profit and professional organisations committed to quality in higher education and advancing higher education through the use of ICTs, such as Educause, Quality Matters and the Online Learning Consortium

After setting the scope, resources were identified by conducting online searches utilising firstly, The University of the West Indies UWILinC information portal, and later using references made within resources identified, comprising academic journal articles, websites and blogs. This allowed for a compilation of a range of sources consistent with the scope identified for the research questions.

All sources were reviewed and evaluated for credibility based on the quality of the publication, taking account of professional reputation of the source, journal impact factors, relevance to the topic and the timeliness of the information. The articles were read and sentences, paragraphs, or sections that reflected the scope of the research questions were extracted and reviewed to see how they responded to the researcher's questions, and a narrative developed based on this review.

## **Technology Transformations Experienced by Higher Education Institutions During the COVID-19 Pandemic**

As the COVID-19 pandemic spread globally in the early part of 2020, traditional institutions of higher education were forced to stop in-person teaching and go into complete lockdowns, shifting to remote teaching and learning. The exact timing and duration of lockdowns varied according to country and institution. In Trinidad and Tobago, all schools, including higher education institutions (HEIs) were closed by the Government initially for one week commencing March 14, 2020. This closure was later extended as the pandemic progressed, with schools finally reopening for in-person attendance two years later, in April 2022. During the period of lock down institutions were forced to transition to delivery of teaching and learning, using online technology. The rushed, unplanned nature of this transition was termed Emergency Remote Teaching (ERT) rather than online learning (Bates, 2020; Hodges et al., 2020) and required rapid, and significant technology transformations to survive the remote teaching experience. These transformations involved the use of hardware and software, or innovative strategies, to structure and deliver teaching and learning remotely and provide student support.

### **Learning Management Systems and Synchronous Platforms**

The increased use of Learning Management Systems (LMSs) and other online platforms such as videoconferencing systems that could facilitate synchronous communication represented a significant technology transformation for some institutions that traditionally delivered in-person teaching and learning. An LMS is a software application or web-based technology used to plan, implement and assess a specific learning process (Kirvan & Brush, 2023). LMSs such as Moodle and Canvas allowed faculty to provide course materials, assignments, quizzes, and assessments for asynchronous learning, enabling students to access content at their own pace. Online platforms which allowed synchronous audio and videoconferencing such as Zoom, Microsoft Teams, and Google Meet were also used more widely for conducting virtual classes and meetings (Al-Badi & Khan, 2022; Mhlanga et al., 2022). These collaboration and communication tools were used to maintain connectivity and real-time interaction among students, faculty, and staff. The increased use of these platforms required some institutions to invest more to obtain licenses, in cases where there were none, or to expand licenses, for those where they existed for a limited capacity. The increased reliance on digital platforms required more robust cybersecurity measures and data privacy safeguards by the institutions. Universities were also obliged to invest in upgrading their networks, expanding bandwidth capacities, and ensuring reliable internet connectivity to support remote learning (Teich, 2022). In many cases universities had to also provide Internet access and digital devices to faculty, staff and students, to facilitate access.

The remote delivery of teaching and learning via LMSs and videoconferencing required a shift in assessment strategies.

### **Remote Examinations and Proctoring**

With in-person restrictions and the closure of physical testing centres, higher education institutions implemented remote examination solutions which required technological transformations. There was an increase in use of proctoring software for those institutions which could afford it, with the most popular being LockDown Browser (a custom browser that locks down the testing environment within a learning management system) and Respondus Monitor (Students use a webcam to record themselves during an online exam) (Flaherty, 2020). These tools functioned as surveillance tools, in an effort to minimize instances of cheating during online examinations. For those institutions who either could not afford proctoring solutions, or who were averse to the use of surveillance, alternative assessments were used. Alternative assessments “comprise various types of assessments such as oral assessment or VIVA via Zoom or similar video conferencing, submission of video recordings of presentations, live psychomotor skill demonstration via Zoom, take-home open book assessments, time-limited online open-book assessments and assignments” (Adama et al., 2023, Introduction section, para. 4).

### **Virtual Labs and Simulations**

Apart from concerns with assessment strategies and academic integrity, a major challenge of the transition to remote teaching was the teaching of science courses with a laboratory component. Those courses and programmes that relied on hands-on laboratory work and practical training had to find remote alternatives during the pandemic. Virtual lab solutions and gamified simulations were transformations engaged in by traditional in-person institutions. These strategies allowed students to gain practical experience remotely by replicating lab environments and enabling students to conduct experiments virtually (Alvarez, 2021; Vasiliadou, 2020).

### **Enhanced Online Student Support**

During the pandemic it was even more important for higher education institutions to maintain student support services remotely. As noted by Bouchey et al. (2021), the student services required included:

- retention services such as orientation, advising, coaching, course registration;
- student engagement services such as, counseling, and health services; and
- learning support such as library, writing centre services, tutoring, career services, and technology support.

To facilitate the continuation of these activities, some institutions deployed online help desks using existing staff responding online via email or texts via mobile phone, virtual advising sessions, and chatbots. These strategies using information and communication technology, aimed to replicate the support services previously offered in person.

### **Professional Development for Faculty**

The shift to ERT required both faculty and students to function in roles of online teacher and learner, for which many were not prepared. Institutions were tasked with providing faculty and

students with training and orientation respectively. This training involved at the most basic level, the use of the technology required to teach for example, an LMS or web conferencing software, to the more complex adaptation of online teaching and learning methodologies. The technology transformation in this case was the use of various forms of online training to facilitate professional development of faculty (Bates, 2023b).

### **Post-Pandemic Considerations in the Context of Course Development and Delivery in Higher Education**

The various technological transformations which took place as a result of the shift to ERT, and the ability of the institutions to continue operations during the pandemic, provided them with greater confidence in online modalities. There was consensus among HEIs that we should learn from the ERT experience and that remote teaching should remain a part of how we deliver teaching (Benito et al., 2021; Tesar, 2020). With the transition back to in-person delivery in the post-pandemic period, universities continue to explore ways to capitalize on the gains made through ERT. These post pandemic considerations need to be considered in the context of course development and delivery, as core aspects of the higher education landscape.

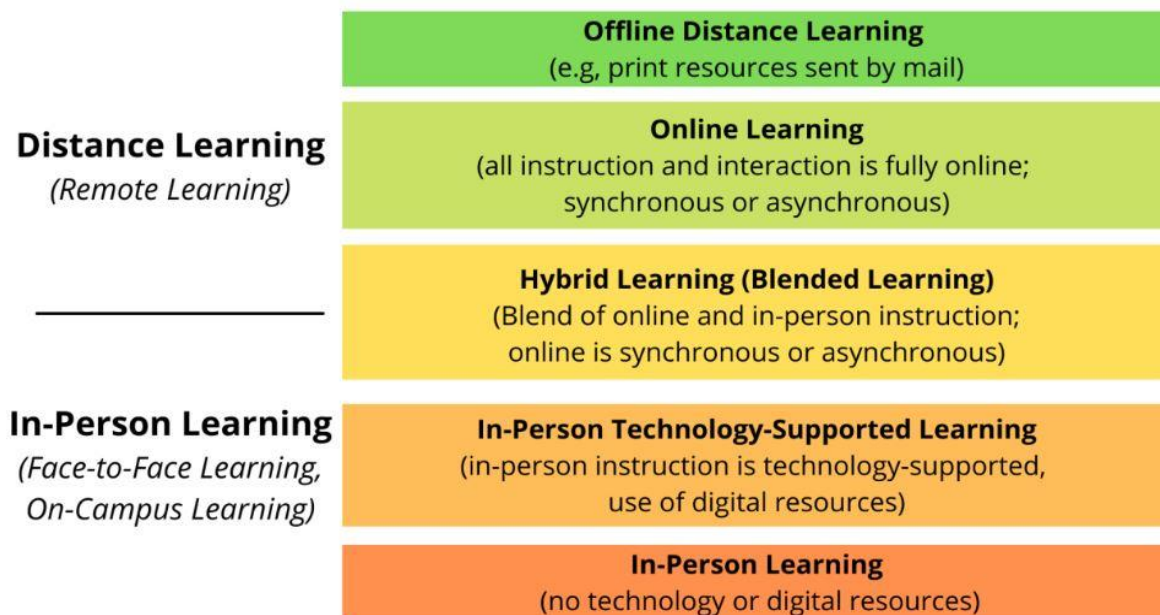
#### **More Online and Blended Learning**

One of the main considerations post pandemic, which has implications for course development and delivery, is the increasing use of technology for teaching and learning and the shift to more online delivery. Bates (2023a) opines that while there is a preference for in-person teaching by faculty, blended learning will increase in the future. He notes that in Canada “80% of administrators believe there will be an increase in courses offered partially online and 69% believe there will be more fully online courses, while only 58% believe there will be more in-person” (Bates, 2023a, CDLRA Research section, para.3).

Blended and online learning can be considered as existing on a spectrum, which is captured most succinctly in Figure 1: Modes of Learning Spectrum.

**Figure 1**

*Revised Modes of Learning Spectrum*



*Note.* From *Evolving Definitions in Digital Learning: A National Framework for Categorizing Commonly Used Terms* (p. 7), by N. Johnson, 2020, Canadian Digital Learning Research Association (<http://www.cdlra-acrfl.ca/wp-content/uploads/2021/07/2021-CDLRA-definitions-report-5.pdf>). CC BY-ND 4.0.

The Modes of Learning Spectrum framework makes a distinction between distance learning and in-person learning. It equates distance learning with remote learning, while the term “in-person learning” is equated with face-to-face or on-campus learning. It is also noteworthy that hybrid learning and blended learning are used interchangeably, and there are variations within these modes such as the flipped classroom and HyFlex learning. The flipped classroom involves the use of lecture capture to facilitate teaching and learning. In this mode, students are provided with video recordings of lectures prior to an in-person class, and they attend the in-person class for discussion or class activities (Bates, 2019). HyFlex learning, which is sometimes used interchangeably with the terms multi-access learning and co-modal learning, “allows students to choose their mode of learning on any given day and move fluidly between attending their classes in-person, synchronously online, and asynchronously online as they see fit. A key characteristic of HyFlex learning is that the locus of control lies with the student” (Johnson et al., 2022, p.95).

The variations of blended and online learning can become quite complex. The Modes of Learning Spectrum reflects the fact that given the variations, institutions considering transitioning from in-

person to online learning, should be aware that these variations will require varying levels of financial resources, guidelines for faculty, staff and students, and different levels of support and infrastructure, for quality assurance.

### **Coping With Assessments and the Challenges of AI**

As institutions increase the use of technology and as exemplified in the experiences during ERT, maintaining the integrity of online assessments is a challenge. Holden et al. (2021), believe that a rise in online assessments will present new opportunities for cheating. Bates (2023b) notes that “One of the concerns about online assessment is that instead of memorizing important facts and concepts, students will just look them up on Google or some other search engines” (p.7). Many instructors do not trust online assessments and as HEIs have returned to in-person teaching, some have returned to in-person proctored examinations. There is some confusion about what the nature of assessments should be in order to support academic integrity and reduce instances of cheating. One of the most concerning aspects has been the challenge of generative AI tools such as Open AI’s ChatGPT, which was launched in November 2022. One survey conducted by the global strategy consulting firm Tyton Partners found that the usage of Chat GPT will increase. They state “While institutional stakeholders are debating the next steps, students are adopting these tools at an exceptionally fast rate. Within just 100 days of ChatGPT’s launch in November 2022, nearly one in three surveyed students reported regular use of generative AI tools” (Bharadwaj et al., 2023, p.20).

### **Competencies of Teachers**

Just as the move to ERT required orientation for faculty and students, the move to a planned hybrid or online delivery in the future will require enhancing and supporting the competencies of teachers to be more effective in such an environment. It is not enough to transfer what may be done in an in-person lecture to the LMS or to the Zoom platform (Bates, 2023b). Teachers must be prepared to apply the technology to facilitate learning beyond core content. They must be able to facilitate the development of core 21st-century skills, such as critical thinking, and problem-solving, ensuring, that “content, pedagogy, and technology play unique and interactive roles in the teaching and learning process” (Ward & Benson, 2010, p. 484).

### **The Digital Divide**

Although during the pandemic efforts were made to alleviate challenges due to lack of access, the digital divide is still very much alive. Bates (2023b) notes that in North America there are significant numbers of higher education students who have inadequate or no Internet access, while the Tyton report states that up to 40% of students in the US experienced stress due to limited access to computers and unstable internet connections (Bharadwaj et al., 2023). As noted previously, the situation is worse in the Caribbean. A major consideration therefore for effective course delivery will be access to stable internet, devices, and applications. Instructors and product developers

should operate under the working assumption that students are under-connected, using multiple devices and browsers, and need to download content for offline access (Bharadwaj et al., 2023).

### **Quality Assurance Considerations in Post-Pandemic Higher Education Institutions**

#### **Seeking to Develop and Deliver Online Courses**

Quality in higher education has varied definitions. It is an elusive term with many interpretations. Schindler et al. (2015) suggest that institutions take a multifaceted approach to defining quality. They note the importance of getting stakeholder perspectives to develop a broad conceptualization of quality. Schindler et al. developed a conceptual model of quality which shows the interrelationships between stakeholder perspectives, concepts of quality, and indicators used to measure quality. This is depicted in Figure 2. The innermost section of the model depicts the importance of stakeholder feedback in contextualizing a definition of quality, and the next section presents four broad conceptualizations of quality (quality as purposeful, transformative, exceptional, and accountable). The outer portion of the model provides examples of quality indicators. The outermost layer is particularly important as it suggests those elements that can guide the development of standards. Even as it is acknowledged that there are many interpretations of quality, the concept continues to evolve as the higher education environment changes to take account of a climate that is Volatile, Uncertain, Complex and Ambiguous (VUCA) (Meri, 2021). It should be noted that many of the challenges to higher education in this new normal, are not new to distance education and online learning in particular. These challenges suggest the need for specific quality assurance standards and tools (Thurab-Nkhosi & Marshall, 2009) and the indicators identified in Schindler et al.'s (2015) conceptual model serve as a useful guide towards the development of standards for quality assurance specifically with regard to course development and delivery in online environments in higher education. In fact, many checklists and rubrics have been created to capture such standards, but perhaps the most popular are the SUNY Online Course Quality Review Rubric (OSCQR) (Online Learning Consortium (OLC), n.d.) and the Quality Matters (QM) Rubric (Quality Matters, n.d.), with slight variations.

**Figure 2**

*Conceptual Model of Quality Depicting Broad and Specific Strategies for Defining Quality in Higher Education*



*Note.* From “Definitions of Quality in Higher Education: A Synthesis of the Literature,” by L. Schindler, S. Puls-Elvidge, H. Welzant, and L. Crawford, 2015, *Higher Learning Research Communications*, 5(3), p. 7 (<http://dx.doi.org/10.18870/hlrc.v5i3.244>).

The OSCQR rubric is available for public use from the OLC. It addresses instructional design of a course and as such can be used during course design and after the course has been implemented. The OSCAR rubric has 50 criteria or indicators, across six categories: Overview and Information, Technology and Tools, Design and Layout, Content and Activities, Interaction, and Assessment and Feedback (Baldwin et al., 2018).



assurance system that promotes continuous quality improvement and that fall within the institution's definition or conception of quality (Martin, 2011). It is proposed that three main considerations be given, namely:

- appropriate and timely policy development
- application of an appropriate quality assurance framework such as Plan, Do, Check, Act (PDCA)
- the strengthening of entities responsible for implementation of the actions within the quality assurance framework, that are crucial for online course development and delivery

### **A Quality Policy**

A Quality Policy sets the framework for the commitment of the institution to continuous quality improvement. It provides the institution's conceptualization of quality aligned with the organisation's strategic direction. The quality policy "provides a framework for quality objectives and includes a commitment to meet applicable requirements ... as well as to continually improve" (Huckabone, 2020, p.1). Institutions that have a quality policy in place will need to ensure that it adequately takes account of objectives relevant to online teaching. The shifts in the post pandemic period will also require development of additional policies that address what is required for the move to online learning, specific assessment policies, including those related to the use of AI, such as academic integrity policies and curriculum development policies and processes.

### **Application and Entities**

The Plan, Do, Check, Act (PDCA) framework, also known as the "Deming Wheel," and "Shewhart Cycle" (Mindtools, n.d.) represents a continuous loop, involving 4 stages of activities, geared towards continuous quality improvement. The first stage, Planning, involves defining the problem or challenge in an institution and devising actions to address these. One can see that post COVID, the cycle suggests that any move to online or blended learning should involve planning as the first step. Important within this stage is the use of data analytics and learning analytics. It should be noted that online learning generates vast amounts of data which can provide insights into student engagement, performance, and learning patterns. The shift to ERT would have generated much data, in the planning stage it is important for institutions to collect such information to help administrators and educators provide relevant curricula and targeted support to students. This stage of the framework therefore requires the resources to facilitate planning activities. This may be planning units or planning officers and the technology that supports data analytics and learner analytics.

The second stage of the cycle involves implementing planned actions. This will require the human and infrastructural resources for course development and course delivery. Appropriate hardware and software and human resource requirements, including faculty who can function as not only lecturers, but course developers in the online environment. This will require the support institutions such as technology centres and faculty development units. Beyond development of courses and programmes there are support units that must address recruitment and retention issues in an online environment.

The third stage of the cycle is the monitoring and evaluation stage. This involves checking the effectiveness of the actions taken to allow for improvements, which will be the fourth stage. In the third stage of the cycle stakeholder feedback is critical, thus student, staff and employer surveys can yield useful information on the course and programme experience. Data on graduates and student outcomes is also critical at this stage, with all stakeholder data feeding into the fourth stage to guide revisions which can encompass changes to curricula, modes of delivery, hardware and software used, or to guide training for staff and students. Follow-up activities after the fourth stage should then lead to a return to the planning stage, where the cycle starts again. PDCA is an iterative process and, while there are stages, there is some level of interaction and dynamism across the stages which is represented in Figure 4 by the double-headed arrows.

While the PDCA considerations can be applied to almost any aspect of the operations within an HEI, here it is being applied to course development and delivery in a context of online learning. This is depicted in Figure 4, where Course Development and Delivery is represented as the core of the activity and the quality assurance considerations are placed within the PDCA framework.

The conceptual model assumes a shift that involves a move to an increased use of technology. It is focussed on course development and delivery but recognises that there are other operational issues to be addressed. Using the PDCA it reflects some of the considerations for quality assurance. There is however recognition that the model represents an ideal. Resource-strapped institutions will have to adjust and will have to determine what can be risked.

## **Conclusion**

The context for quality assurance in course development and delivery in a post-pandemic world is one of a wave of technology transformations marked by increased use of LMSs and synchronous Web conferencing platforms, more experience with remote examinations, virtual labs and simulations, enhanced online student support and more options for developing faculty competencies in online teaching. There is now greater understanding of the continuum of online learning, from in-person to fully online options, with a range of blended options in between. Within this continuum various levels of resources are required to ensure quality in course development

and delivery. It is proposed that institutions desirous of quality in curriculum development and delivery for online learning must ensure a robust QA framework that addresses at least three main considerations. These are appropriate and timely policy development, including the development of a clear quality policy that captures the standards for online learning; application of an appropriate quality assurance framework such as Plan, Do, Check, Act (PDCA) to guide activities; and the strengthening of those entities responsible for implementation of the activities crucial for online course development and delivery. Policy development by HEIs must address requirements for effective blended and online teaching and should establish relevant frameworks that encompass the internal entities.

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## **Approaches to the Preparation of Students for the World of Work: Views of Administrators from Postsecondary Institutions in Trinidad and Tobago**

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### **Abstract**

Preparing postsecondary students in Trinidad and Tobago for the world of work, with its constant changes in technology, globalisation, and labour markets, is a complex undertaking and largely the task of Postsecondary Institutions (PSIs). Shortfalls in important areas like flexibility, entrepreneurship, reskilling and requisite knowhow, could result from inadequate approaches to worker preparation. The views of PSI administrators are key in ascertaining how PSIs approach the provision of relevant skills, attitudes, and knowledge given the challenging, dynamic, and multidimensional nature of the world of work. Against this background, a qualitative collective case study was employed to critically explore the views of administrators on the approaches to postsecondary world of work preparations in Trinidad and Tobago. Interviews of nine (9) administrators from five (5) key postsecondary institutions were conducted. Directed content analysis, eclectic approaches and pattern coding were used in data reduction. The findings of the study revealed commendable strengths on approaches of postsecondary institutions, such as the provision of authentic learning opportunities and technology integration. Conversely, administrators noted challenges in the form of a prevailing exam culture and limited resources, among others. Advancing a comprehensive approach to postsecondary world of work preparation requires systemic improvement for overall development of students.

*Keywords:* world of work preparation; postsecondary education and training; postsecondary institutions; administrators' views; Trinidad and Tobago

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## **Background**

In response to the challenges posed by the constant changes and unpredictability in the world of work, attempts to prepare postsecondary students in Trinidad and Tobago (T&T) involved the establishment of postsecondary institutions (PSIs), policies, programmes, and other initiatives. The University of Trinidad and Tobago (UTT), the College of Science, Technology and Applied Arts of Trinidad and Tobago (COSTAAT) and the National Training Agency of Trinidad and Tobago (NTATT) were specifically formed to strengthen links between education and the world of work. Also, consecutive governments have subsidized tuition through programmes like the Government Assistance for Tuition Expense (GATE) and the award of scholarships.

While these initiatives have had some successes, challenges persisted in efforts to prepare postsecondary students for the world of work. Globalisation, rapid technological advancements, changing labour markets, disappearing jobs, tensions in employer-employee relations and an increased demand for soft-skills, have placed added pressures on countries to produce a more efficient and effective workforce. In T&T, particular difficulties consist of mismatches between the requirements of the world of work and existing educational policies and practices, high brain-drain rates, employers' dissatisfaction about postsecondary graduates' workplace competence, and a shortfall in labour requirements for economic diversification (Khadan & Ruprah, 2016). Against this backdrop, PSIs in T&T are expected to provide competent leaders, trained staff, relevant curricula and pedagogy, modernized infrastructure, financial resources, and stakeholder support (Jameson-Charles, 2012) in their world of work preparation.

According to Carruthers (2006), "The knowledge-based, global economy... demand[s] substantially improved opportunities for education and training beyond high school" (p. iv). Thus, PSIs' education and training have attempted to up their ante by incorporating requisite

technological skills, knowledge, and competencies for the work environment (Swanson, 1982). Postsecondary education emerged as the “engine” of economies (Hunt & Tierney, 2006, p. 1) that yielded benefits to everyone (Carnevale, 2016). In Finland, Norway, Switzerland, Austria, Germany, and the UK, tertiary institutions mushroomed in the last 30-40 years, resulting in the emergence of the “Knowledge Revolution” (Grubb, 2003, p. 3).

With the high quality of programmes offered in PSIs, including those in T&T, many employers have come to use PSIs’ credentials to gauge employee competence, however, employers today are finding it difficult to match such credentials with job requirements as there are great variations between institutions (Carnevale, 2016). Employers often complain about unprepared postsecondary graduates who lack necessary social and technical skills for the workplace (Employers Consultative Association of Trinidad and Tobago, 2019). Such concerns should not be ignored as T&T, a small developing nation desirous of breaking free from the constraints of its colonial past, needs a competent labour force to foster a vibrant economy (George & Lewis, 2011).

Unfortunately, T&T has inherited an historically flawed educational system that, despite major reforms, persists as stratified in the quality of its schooling provision, thus raising questions of equity. Against this backdrop, PSIs in T&T endeavour to equip graduates for employment in both the national and international arenas. It may come as no surprise, then, that the quality of education for human resource development continues to bedevil current efforts (De Lisle et al., 2010), and educational institutions in many cases tend to “stunt the development of many of our future adults” (Hackett, 2005, p. 1). In this light, T&T’s education sector, with its competitive and hierarchical structures, appears to be undermining efforts towards developing a high-quality postsecondary system.

T&T’s postsecondary education system can be commended for its alignment horizontally (PSIs to PSIs) and vertically (PSIs to the world of work) and in its focus on the development of the working public. In spite of these strengths, however, De Lisle et al. (2010) caution that: “Trinidad and Tobago... runs the risk of producing a low-quality and unequal work force, incapable of innovation, production and creativity” (p. 6). In addition to inherited flaws, existing inefficiencies could be attributed to an existing culture of ambivalence, where accepted subpar practices prevent consistent adherence to global standards (Farrell, 2017).

Additionally, a focus on certification detracts from preparing students for the changing world of work (Bass & Good, 2004). Highlighting the academic stream and prestigious subjects, like Mathematics and Sciences (Winch & Gingell, 2008) can drive PSIs to focus on preparing students for examinations rather than to function in a world beyond the classroom (Platt, 1970). Unfortunately, some PSIs fail to achieve the correct balance by myopically focusing on academic achievement. Emphasis on general objectives and learning outcomes of postsecondary curricula in T&T is required to reduce any excessive focus on teaching to the test. Notably, educators should

eschew praxis where “modes of formal assessment and evaluation are too narrowly defined and do not capture the range of outcomes desired; a situation compounded by teaching to the test which results in a narrowing of the taught curriculum” (European Union [EU], 2012, p. 26). The challenge for T&T is to free itself from the obsession with examinations and embrace an approach to postsecondary education for the development of a holistic individual.

Nonetheless, compared to other countries in the Caribbean, T&T’s postsecondary education system is well developed, as the high income earned from the oil-based economy has facilitated significant financial investments. Notwithstanding a drop in Global Human Capital Index from 87 out of 137 in 2017, T&T has been able to maintain a high-level of higher education and training (World Economic Forum [WEF], 2017). T&T has in the past been above the median in Latin America and the Caribbean region in the Global Competitiveness Index (GCI), with a rank of 66 out of 125 countries (Artana et al., 2007). Investment in education seems to be yielding benefits, but closer scrutiny is required as executives in T&T ranked poor work ethic in the labour force as the biggest problem in conducting business; they also expressed concern about the inadequately educated workforce (WEF, 2017).

In sum, successive T&T governments have responded admirably to developmental needs of the working populace. However, challenges continue to manifest in relation to mismatches in the labour force, employment issues, complaints about skills-gaps, rapidly changing technology and increased globalisation as well as stakeholder concerns about the adequacy of postsecondary preparations for work. Such a situation has revealed the need to ascertain the present ‘state of play’ with respect to preparation for the world of work and to focus on the institutions (PSIs) specifically set up for that task. While a more comprehensive investigation was conducted (Bitu, 2022), this article is delimited to one of the most important sources of data: that of PSI administrators. As directors, they occupy a privileged vantage point and their views provide valuable current data on the matter of the preparation of students for the world of work by PSIs in Trinidad and Tobago.

For the sample of this study, administrators from five (5) PSIs were selected. The first PSI is a TVET oriented institution with a focus towards workforce development for T&T’s energy sector; the second PSI is a TVET institution with multiple community-based sites, aimed at addressing the needs of the socially disadvantaged; the third PSI provided TVET and academic programmes for workforce development; the fourth PSI has a TVET and academic mandate towards a concentration on programmes for entrepreneurial development; the fifth PSI is a well-established traditional academic institution. All the institutions have tremendous value in workforce and human resource development in T&T and possess overall importance for national development.

### **Purpose of the Study**

The purpose of this research is to critically explore the approaches to the preparation of students for the world of work by PSIs in Trinidad and Tobago through the study of PSI administrators' views. Insights gained for preparing students for the world of work should have sufficient transferability across operational contexts and provide recommendations for educational reform for the PSIs in the study.

### **Literature Review**

Preparing postsecondary students for an unpredictable world of work requires a variety of approaches from PSIs as higher-order cognitive, interpersonal, and socioemotional skills (World Bank, 2018) are needed to cope with workplace uncertainties. "Highly skilled workers in the modern context are people who have received a good general education and who have then entered an occupation in which a range of specialised, but related skills are required" (Winch & Gingell, 2004, p. 6). Herein lies an educational philosophy with inherent connections between pedagogical content and essential practices for the development of a productive citizen. PSIs are thus expected to keep the education system in touch with the rapid changes in the world of work and thus make a meaningful contribution to society.

### **Expectations of PSIs**

Evaluation of the labour market is needed to improve the response of PSIs to global technological pressures on the world of work (WEF, 2016, p. 3). For example, PSIs must prepare millennials for work in the digital age (Hershatter & Epstein, 2010). Such a situation requires that PSIs, in developing their staff and programmes, would be mindful of rapid changes occurring in the workplace, as "current technological trends are bringing about an unprecedented rate of change in the core curriculum content of many academic fields" (WEF, 2016, p. 20). PSIs in T&T can examine and adopt the strengths of international models, such as, the German dual system (EU, 2016).

The Caribbean region needs workers "who have the skills for experimentation, data gathering, problem solving, group work, decision making, and risk taking... think like entrepreneurs and become flexible and multi-skilled" (Lochan, 2000, p. xi). Three (3) factors appear necessary if such workers are to emerge from the education system. Firstly, planning must be done with reference to theories related to the Caribbean colonial context. Secondly, an examination of the entire education system is needed. Finally, sociocultural factors which can either facilitate or hinder entrepreneurial and indigenous industries must be addressed if the education system is to be aligned to the requirements of preparing the Caribbean individual for the world of work

(Lochan, 2000). Attention to these issues requires a multidimensional approach if educational efforts in the Caribbean are to produce the “Ideal Caribbean Citizen” (CARICOM, 2014, p. 35).

### **Curriculum**

Curriculum can be defined as “a desired goal or set of values that can be activated through a development process, culminating in experiences for learners” (Wiles & Bondi, 2015, p. 5). In this sense, curriculum at the postsecondary level would ideally involve experiences as part of the developmental process to prepare students for the world of work. To this end, alignment of curriculum to occupational needs for economic and social development is critical. A curriculum is foundational in promoting sustainable growth through the quality development of the human resource by way of “sound and accessible education...as central to the achievement of social equity” (Curriculum Planning and Development Division, 2003, p. viii). Teaching and learning as part of curriculum delivery therefore need to be high-quality for all in society to have access to dignified and sustainable work.

### **Teaching and Learning**

Effective pedagogy can promote employability, which according to the CBI (Confederation of Business Industries) is “a set of attributes, skills and knowledge that the labour market participants possess to ensure they have the capability of being effective in the workplace” (CBI, 2010, p. 8). Hard and soft skills, as curriculum outcomes, can also be developed through work-related activities, case studies, individual presentations, and team-related tasks in a student-centred classroom (Griffiths-Watson, 2001).

T&T needs to develop its human resource potential through meaningful learning and relevant schooling practices (World Bank, 2018). Nettleford (2007) claimed that Eric Williams (the first prime minister of T&T) valued education as an avenue for people, emerging from a colonial past, to improve the quality of their lives. In like manner, Dewey (1938) saw education as progressive with schools nurturing values and ideals in addition to the technical requirements for operating in the workplace. Dewey espoused a pragmatist philosophy whereby a hands-on approach to learning was valued in which people learned by engaging in practical activities. Piaget (1952), Vygotsky (1986), and Bruner (1960) all suggest that approaches to knowledge construction best facilitated cognitive development through real-life activities in conjunction with strategies that targeted various learning styles.

A constructivist approach (Geldenhuys, 2006) to teaching and learning, in conjunction with behaviourism (Schunk, 2004), multiple intelligences (Gardner, 1983), differentiated instruction (Tomlinson, 2014) and authentic assessment can provide postsecondary educators with an array of theories and strategies for world of work preparation. Teaching and learning approaches, like collaborative learning (Thomas, 1992), alternative assessments, problem solving and transversal skills, such as, planning, communicating, and evaluating (Winch, 2013), are all part of a successful

workshop/classroom (Subran, 2013). Perhaps, integration of the academic and TVET tracks to produce a worker who can manage a new work environment, be all-round, and employable, is a sensible approach to educational reform (McLean & Lai, 2011) and more relevant to postsecondary world of work preparations.

### **Knowledge and Skills development**

Knowledge development at the postsecondary level is critical in assisting students to become employable. T&T's labour market landscape requires that postsecondary students possess broad knowledge of basic disciplines, such as, Mathematics, English, Science, and History. Students also need to have specialized knowledge related to specific areas or fields, such as information technology, and engineering. This kind of knowledge supplements tacit knowledge and enhances the overall knowledge needed for innovation and creation in the world of work (Lewis, 2013). A student-centred approach for a harmonization of postsecondary education and the needs of countries and economies should therefore be adopted (Kushida, 2015).

Skills development can make postsecondary graduates more employable as “The quality of the skills graduates bring to their work is more important than simply the number of people in the workforce holding qualifications” (Earle, 2010, p. 1). PSIs have a responsibility to provide students with the necessary skills for the workplace, especially as the WEF (2016) disturbingly reported that most education systems at all levels provide “highly siloed training and continue a number of 20th century practices that are hindering progress on today's talent and labour market issues” (p. 32). For this problem to be minimized PSIs must have appropriate skills-based training that is focused on “combining technical and high-quality skills with core abilities for learning, employability and communication” (United Nations Development Programme [UNDP], 2015, p. 21).

Given the demand for a versatile worker, Education 4.0 (technology integration in the teaching and learning process) emerged as an imperative at the postsecondary level (James, 2019). Postsecondary education is therefore expected to provide students with learning and innovation skills, digital literacy skills, and career and life skills necessary for the 21st century (Trilling & Fadel, 2009). In particular, the EU (2010) noted that education systems should promote “innovative and equitable approaches such as flexible learning pathways and focus on developing essential skills as well as intellectual and job-specific skills” (p. 4). With this view in mind, skills development and innovation are closely linked to developing an employable individual.

Stakeholders in postsecondary education have a responsibility to “ensure that the population has the appropriate skills-base combining technical and high-quality skills with core abilities for learning, employability and communicating” (UNDP 2015, p. 21). Partnerships with stakeholders for staff professional development would help educators explore “the existing pedagogic conceptions and beliefs and upgrade the current knowledge-base related to teaching and learning”

(Sahlberg, 2006, p. 12). For this purpose, teacher professional development through scholarships with government and other stakeholders is vital in developing countries like T&T (Brown, 2009) as there are limited incentives for educators to develop themselves professionally. More systemic collaborations and an integrated approach with PSIs and stakeholders in T&T would be beneficial. One example of a strong integrated approach is the Silicon Valley Ecosystem (Kushida, 2015). Business organizations and PSIs in Silicon Valley created a collaborative environment involving start-up firms, innovative business models, and leadership in high-tech areas.

### **Administrators as Leaders**

PSI administrators, an important category among stakeholders, have the responsibility for managing internal operations to meet the needs of external environments. As leaders, administrators are expected to provide opportunities to promote deep learning cultures so that postsecondary students can maximise their learning potential (Richardson, 2016). Administrators' leadership is critical for overseeing programmes, managing resources, supervising adjustment measures, and making sensible decisions to maximize the intended outcomes and minimize any problems associated with practice.

Administrators in PSIs play a pivotal role in the operationalization of educational policy for world of work preparations. "Educational leaders are not simply faced with making sense of policy from above, but also [must take heed of] the demands and aspirations from those below" (Bell & Stevenson, 2006, p. 19). This intermediate position of administrators is critical to the success of PSIs, given their multiple responsibilities. Administrators should therefore have a sense of self-determinism and operate with an inherent autonomy when interpreting and overseeing the implementation of education policy based on their past experiences as administrators (Capra & Luisi, 2014).

Having to deal with multiple policy directives and varied institutional scenarios, administrators are presented formidable challenges which should not be underestimated as, "a failure to fully understand the complex ways in which policy shapes and is shaped by leadership, [is a failure] to adequately explain the actions and practices of leaders at both the organizational and operational levels" (Bell & Stevenson, 2006, p. 8). So, while on the one hand trying to observe policy directives, administrators can have challenges with limited time (Cheung & Man Wong, 2012), resources, personnel, and technical expertise.

In T&T's context there are several internal and external challenges facing postsecondary administrators. Internally, they must overcome limited resources, historically low returns on postsecondary education (Artana et al., 2007), elitist education beliefs (De Lisle, 2009), and the bureaucracy associated with being state-financed institutions. Administrators are also tasked with maintaining a modernized curriculum and sustaining teacher development. Externally, they must deal with, globalisation, changing technologies, political change linked to discontinuity, and yet

preserve seamless vertical and horizontal alignment to the education system (De Lisle et al., 2010). To address these issues, careful thought is needed to prioritize certain challenges, while simultaneously addressing contextual modifications (Wang, 2010). James (2014) highlighted a bottom-top model of leadership, where collaboration is valued and effective for dealing with problems (internal and external) that confront PSIs.

## **Methodology**

### **Research Question**

How do administrators view postsecondary institutions' approaches to preparing students for the world of work?

### **Design**

A qualitative collective case study approach was employed as it facilitates the exploration of an issue in multiple settings (Stake, 2006). The study involved inductive reasoning, an iterative process and was richly descriptive (Denzin & Lincoln, 2011) as the researchers explored the views held by administrators from five (5) PSIs in T&T on preparing students for the world of work.

The PSIs were purposefully selected (Stake, 2006) based on the following criteria. Firstly, the authors identified the PSIs that had the highest enrolment figures in T&T for their respective areas. Secondly, the PSIs, based on their programme offerings, were considered important in terms of workforce and national development. Finally, the PSIs had to have diverse backgrounds in terms of their mandates, programmes, and focus so the authors could examine world of work preparations in varied contexts. Adhering to ethical principles, approvals were sought and obtained from PSIs' relevant Institutional Review Boards.

The interviews were conducted with the constructionist expectation (Crotty, 1998) that administrators' views on their institutions' approaches to preparing students for the world of work were constructed, based on personal and professional experiences. This epistemological assumption informed the researchers in the collection, interpretation, and analysis of interview data. Because of their years' experience, the administrators would provide current and past details and ideas about world of work preparations within and beyond the contexts of various PSIs, providing fodder for critical exploration. Semi-structured interviews of nine (9) participants from five (5) major PSIs in T&T (see Table 1) were employed to allow for probing questions to reveal broader and deeper explanations of the issue (Hays & Singh, 2012).

**Table 1**

*Participants*

<b>Type of Data</b>	<b>Institutions</b>	<b>Administrators</b>	<b>Age-range</b>
<b>Administrators Interviews</b>	Industrial PSI	Admin A	60-70
	TVET PSI	Admin B	30-40
	Community College PSI	Admin C	50-60
		Admin D	40-50
	Entrepreneurial PSI	Admin E	30-40
		Admin F	30-40
		Admin G	40-50
	Traditional Academic PSI	Admin H	50-60
		Admin I	40-50

The information gleaned from interviews of administrators was interpreted as part of the data reduction process to address the research question (Creswell, 2013). Directed Content Analysis was employed in analysing the data (Hsieh & Shannon, 2005). Eclectic (first cycle) and pattern (second cycle) coding were used to further reduce the data for presentation and discussion in a thematic and comparative format.

Limitations constitute the timeframe (within a 1-year period, ending in 2019) and specific contexts in which data were collected so that findings, though not generalizable, nevertheless have transferability.

### **Findings**

The findings from analysis of administrators' views on PSIs' approaches to the preparation of students for the world of work are discussed under the themes: *Overarching Influential Factors*, *Meaningful Curriculum* and *Adopt a Progressive Approach*.

#### **Overarching influential factors**

Overarching Influential Factors, emerged from the codes (quantified), *Stakeholder Partnerships* (22), *Various Alignments* (33), *Political Influence* (6), *Challenging Policy Issues* (12), *Weak Linkages* (10), *Limited Resources* (14), and *Staff Challenges* (13), reflecting major issues affecting the approaches to postsecondary world of work preparations.

*Stakeholder Partnerships*, which emerged from the interviews of administrators from Industrial PSI, TVET PSI, Entrepreneurial PSI, and Traditional Academic PSI, capture examples of partnerships in local and international business and industry, as Admin I (Entrepreneurial PSI) stated, "We engage with our stakeholders on a great level." In like manner, *Various Alignments*,

highlights several administrators' views on the vertical alignment of PSIs' practices to the workplace. Admin A (Industrial PSI), Admin F (Entrepreneurial PSI) and Admin G (Entrepreneurial PSI) opined that their PSIs, linked to the needs of industries, facilitated a clear path towards national development and was captured by Admin C's (Community College PSI) statement, "we are trying to meet [employers'] needs". Admin B explained that TVET PSI provided opportunities for people who were not able to acquire other types of certification, "they want to be certified so that the job can now acknowledge... them". These positive views point to the significance of synergistic connections in approaches to world of work preparations.

Conversely, administrators highlighted the complicated and taxing contexts in which their PSIs function. Political Influence signals the indirect impact of political and administrative pressures on PSIs' operations. For example, Admin D, from the government financed Entrepreneurial PSI, thought that governmental manoeuvres hindered policy and practice in the institution: "It is very hard to sustain traction and sustain engagement.... it changes ever so often because of the politics". Challenging Policy Issues, aptly expressed by Administrator D (Entrepreneurial PSI) "there are no policies on the world of work", reflects concerns of postsecondary administrators about weak policy guidance. Weak Linkages between the needs of the labour market and PSIs' practices was revealed by Administrators from Community College PSI, Entrepreneurial PSI, and Traditional Academic PSI; as the latter stated, "We are producing lawyers [and] doctors who are struggling to find a job." *Limited Resources* underlines administrators' concerns about the lack of resources for postsecondary world of work preparations. Admin E, for example, stated that "resources are always an issue" affecting Entrepreneurial PSI's ability to fulfil governments' mandate to stimulate entrepreneurial activity. Staff Challenges summarizes views relating to staff competence as succinctly expressed by Admin A (Industrial PSI): "the greater the skill of a teacher the better the product". These issues facing administrators do present formidable hurdles for management to overcome.

### **Meaningful curriculum**

Meaningful Curriculum captured administrators' views on issues affecting curriculum delivery as part of world of work preparations. Codes that led to this theme are: Authentic Learning Opportunities (16), Skills Development (19), Technology Integration (13), Students' Holistic Development (16), Need for Meaningful Curriculum (14), Knowledge Development (5), Time Constraints (4), Exam Culture (6) and Unacceptable Work Ethic (10).

Generally, commendable practices were recounted by administrators. Authentic Learning reveals administrators' views about teaching and learning approaches within PSIs. For example, Admin F said Entrepreneurial PSI had "A lot of the practical projects, like in mechanical engineering". Likewise, Admin G (Entrepreneurial PSI) explained, "companies hire our students during internship programmes." Skills Development highlights skills training for the world of work. Admin A (Industrial PSI) underlined, not only the value of TVET in the provision of industry-

relevant, but also, relational skills as he said, “we do all of the technical things, we also do the personal things through a life skills programme.” Admin H (Traditional Academic PSI) cautioned however, “[PSIs] may not be able to meet every need of every single employer”. *Technology Integration* identifies several administrators’ views on technology in curriculum delivery. In one example, Admin B stated that TVET PSI’s novel “mobile training unit” was key to exposing rural communities to technology. While Admin C (Community College PSI) opined, “In terms of technology we are comparable to all other institutions and may be surpassing some”. *Students’ Holistic Development* refers to preparing well-rounded graduates. Several administrators highlighted how they helped students to become all-round workers or “to be multiskilled” (Admin B - TVET PSI).

Amidst the constructive approaches there were significant lacunae. *Need for Meaningful Curriculum* captures views from administrators on the value of synchronising curriculum content with requirements of the labour market. Notably, Admin H opined that Traditional Academic PSI was “slow to change curricula”, signalling the need for more decisive curriculum reform. *Knowledge Development* reveals administrators’ concerns about the quantity and quality of PSIs’ knowledge-based learnings. Admin G for instance, indicated that Entrepreneurial PSI was guilty of knowledge-content overload: “I think we pushing too much... content too fast”. *Time Constraints* for world of work preparations highlights the limited time allocated for related initiatives, as Admin I (Traditional Academic PSI) stated, “I don’t think that we have the time”. *Exam Culture* encapsulates the view of some administrators about the challenge of excessive exam-driven focus on academics. For instance, Admin J (TVET PSI) articulated: “We have been concentrating too much on just academics.” *Unacceptable Work Ethic* signals administrators’ concerns about some students’ poor attitude towards work as voiced by Admin F (Entrepreneurial PSI): “I think [poor work ethic] is a cultural factor.” All in all, Meaningful Curriculum for the World of Work encompasses building on existing strengths and attending to recognizable gaps.

### **Adopt a progressive approach**

Adopt a Progressive Approach summarises administrators’ views about forward-thinking initiatives and practices for world of work preparations. Codes that led to this theme are: *Need for Good Leadership* (12), *Innovation for Job Creation* (7), *Recognition of the Need for Research* (9), *Concerns about Promoting Diversification* (8), and *Encourage Entrepreneurship* (7).

The significance of constructive vision and purposeful agency was captured by the views of administrators. *Need for Good Leadership*, underscores the importance of sound guidance. Admin A (Industrial PSI) points out that “Nobody to the best of my knowledge has called all the leading executives from industry, from education, and business, to have a chat about what we really need.” *Innovation for Job Creation* highlights efforts to develop students’ innovative capacities, as aptly captured by Admin C (Community College PSI): “we are trying to develop... creativity”. *Recognition of the Need for Research* refers to the importance of research as informing

programmes and courses for the world of work. Admin A boasted, “We are always engaged in research to know what is happening across the world”. Conversely, Admin G revealed the challenge of finding time in Entrepreneurial PSI for research, as she said, “[Academic staff] need time to...do research.” *Concerns about Promoting Diversification* captures matters raised about encouraging diversification. Admin C (Community College PSI) and Admin G (Entrepreneurial PSI) offered alternative avenues for economic development, such as, “agriculture”, “tourism” and “shipbuilding”. *Encourage Entrepreneurship* focuses on efforts to promote entrepreneurship with Admin C saying Community College PSI was “training [students] not just to... become employed, but to be an employer”. The views expressed by administrators all amount to avenues for tapping into the creative potential of individuals as essential in world of work preparation.

## Discussion

The theoretical framework drew upon literature pertaining to approaches in teaching and learning, educational leadership, systems theory and sociological insights into Caribbean contexts and citizenship. The following discussion reprises the findings in relation to the literature.

### Contextual Issues

Overarching Influential Factors faced Administrators in their PSIs with regard to approaches for world of work preparations.

Administrators identified the existence and importance of *Stakeholder Partnerships*, but a clear workforce development plan could enhance industry-PSI relationships. The Silicon Valley Ecosystem model (Kushida, 2015) provides a useful reference for building and establishing symbiotic partnerships among stakeholders through government support, sectoral services, postsecondary clusters linked to industries and quality human resource management.

Administrators’ views on *Various Alignments* warranted greater recognition for experiential approaches as that inherent to TVET (United Nations Educational Scientific and Cultural Organization, [UNESCO], 2016). A hands-on approach facilitates connection between the uniqueness of individuals and the needs of the world of work. In an era of disappearing jobs, students need to adapt and spot opportunities for self-employment. Promoting entrepreneurship requires that postsecondary activities, courses, and programmes play to the strengths of the learners, through a student-centred approach (UNDP, 2015).

Administrators had challenges with *Political Influence*. Most PSIs in T&T enjoy heavy government finance. However, the views of administrators confirm frustrations encountered when political views of the day form the basis for institutional and national decisions. For effective postsecondary world of work preparations, successive governments would do well to foster and maintain an ecosystem for the constructive and sustainable interaction of all stakeholders (Kushida, 2015).

*Challenging Policy Issues* highlighted the need to address the disruptive potential of inappropriate and absent policies (Bell & Stevenson, 2006) on postsecondary world of work preparations. Deficiencies and approaches to policymaking in T&T can have a counter-productive effect in postsecondary world of work preparations.

Administrators' concerns about *Weak Linkages* highlight the problematic nature of ambiguities in workforce development policies relating to the roles of PSIs in national development. Education systems need to remove siloed training approaches among PSIs for development of a labour force (WEF, 2016) that meets the needs of the country.

*Limited Resources* for delivery of programmes and other world of work initiatives negatively affect human agency. Maximizing the use of available resources for qualitative development and life enhancement requires an alternative view of human capacity (Capra & Luisi, 2014). Government should play a critical role in creating a conducive environment where there is a periodic exchange of staff from business parks and academia, as this can have utility for addressing the needs of various industries in a low-cost manner (Kushida, 2015).

*Staff Challenges* ironically reflect a problem associated with world of work preparation wherein the very outputs of PSIs, as institutions earmarked for workforce development, become misaligned to the requirements of the workplace. Concerns about teacher training for academic staff suggest that PSIs in T&T need to provide industry-relevant professional development for higher quality world of work preparations (UNESCO, 2016).

### **Curriculum for World of Work Preparation**

A Meaningful Curriculum operates through a seamless and integrated education system (De Lisle, et al., 2010) and avoids the pitfalls of individualized compartments. Only through alignment from kindergarten to postsecondary levels can the needs of all sectors in the T&T economy be met while producing globally marketable students.

Administrators' views on *Authentic Learning* suggest that the external environment is having positive influence on world of work preparations. Constructivist approaches (Geldenhuys, 2006) demonstrate the value of the workplace as sites for continuous learning in real-world situations (EU, 2016). An integrated ecosystem involving PSIs, industries, sectoral services, and the government, increases opportunities for such experiential learning (Kushida, 2015).

Many administrators held that their PSIs focused on the *Skills Development* needed for meeting the demands of the Fourth IR (WEF, 2016) and for producing the ideal Caribbean citizen (CARICOM, 2014). Within *Skills Development* there is value in the integration of TVET and academic disciplinary areas (McLean & Lai, 2011) rather than an obsession with passing theory-based examinations. An enhanced education framework, though greater collaboration among stakeholders, is necessary to redirect the education system towards holistic learning.

Some administrators felt that *Technology Integration* initiatives were limited and needed to expand to cater for millennial learners (Hershatter & Epstein, 2010). Attempts at technology integration in PSIs are commendable, but a greater effort is needed to meet the technological requirements of the ultra-fast Fourth IR (Carnevale, 2016). Too often technology integration is plagued by poor infrastructure, ignorance about contextual issues and a lack of monitoring and evaluation, all of which make the integration process subpar when it comes to world of work preparations.

*Students' Holistic Development* at the postsecondary level requires coordination among PSIs, industries, government entities and between TVET and academic disciplines (McLean & Lai, 2011) especially since worker flexibility is essential for the changing world of work (UNDP, 2015).

*Knowledge Development* is optimal within a context of holistic growth through well-planned experiential learning activities (Dewey, 1938) that integrate skills, attitudes, and competencies, rather than an approach to knowledge development at the expense of skills training. Postsecondary education can enhance the knowledge-based economy (Carruthers, 2006), but the way forward is to harness the strengths of T&T's human resource to develop indigenous knowledge-based avenues for social, economic, and national development (George & Lewis, 2011).

*Time Constraints* represent one part of a wider array of challenges facing administrators and their PSIs given the importance of world of work initiatives (Cheung & Man-Wong, 2012). Reconceptualization of education and training is needed as PSIs end up spending much time on preparing students to pass tests at the expense of preparation for life (Bass & Good, 2004). Change in teaching and learning, from the traditional *Exam Culture* with its emphasis on passing examinations, is desperately needed so that PSIs' could focus more on producing team-players, creative thinkers, and versatile workers.

Some administrators felt that students' *Unacceptable Work Ethic* was negatively affecting their educational performance. The problem of students' negative attitude towards work can be connected to an apathy and tolerance for mediocrity (Farrell, 2017) and could be linked to T&T's history as a colonial society. This poor work ethic should not be ignored (WEF, 2017) as employers want workers to exhibit positive attitudes (CBI, 2010). A major shift in educating and training, that focuses on life-skills development (Trilling & Fadel, 2009) is required to address such a problem.

### **Progressiveness**

A call to Adopt a Progressive Approach (Richardson, 2016) in T&T's context requires an understanding of the intention of policy for the purpose of implementation (Bell & Stevenson, 2006). Fostering innovation and creativity (UNDP, 2015) requires filling the *Need for Good Leadership* as T&T "runs the risk of producing a low-quality and unequal work force" (De Lisle et al., 2010, p.6). Focus on passing exams (Bass & Good, 2004) rather than producing liberal and

innovative individuals, places creativity in the background. Promoting university-industry research links (Kushida, 2015) follows from a *Recognition of the Need for Research* to serve mutual interests advantageous for anticipating workforce needs.

*Innovation for Job Creation* in PSIs can generate opportunities for new enterprises (Kushida, 2015) and address *Concerns about Promoting Diversification*. Systemic problems, such as, the certification culture, the colonial economic structure, limited resources, and weak industry-PSI links, would promote sustainable opportunities for diversification in T&T (Brown, 2009). Administrators recognized the need to *Encourage Entrepreneurship* as the entrepreneurial spirit (Lochan, 2004; UNESCO, 2016) is critical in the world of work. The traditional approach to preparing students for jobs must be replaced by a new model that requires students to be self-driven and innovative to detect opportunities for creating economic value.

### Recommendations

1. The issue of alignment and partnership raised by several PSI administrators signals the need for support from industry. A symbiotic relationship in which industry finances PSIs' research and the latter in turn provides the grist for data driven industry decisions can be beneficial for both entities. Firms that are technology leaders can provide opportunities for internships and apprenticeships, thus consolidating a collaborative framework and advancing opportunities for authentic learning.
2. There is need for training and networking at the postsecondary level and other levels in the education system. Consistent and relevant training for administration and staff must be provided as it can increase the quality of educational services provided by all educational institutions. This training can also be supplemented by conferences, stakeholder workshops, symposiums, and online networking, which would also ensure that cutting-edge knowledge and skills continue to exist in educational institutions and industries.
3. Administrators attested to the fact that policy direction was difficult for several reasons, including change in political directorates. A clear policy-framework based on sound data gathering and sharing would strengthen leadership's vision and minimize the negative outcomes associated with political interference in the operational goals of PSIs.
4. Noting the need for research by administrators, the study can be useful to research connected to PSIs. Future studies in other educational jurisdictions can draw upon and compare the findings from this research, towards the formulation of a framework that facilitates the building of new knowledge within context.
5. The promotion of self-employment and entrepreneurship requires a strategic framework of initiatives supporting the work of PSIs. An ecosystem that supports entrepreneurship must accompany programme initiatives of the PSIs so that young entrepreneurs in any area can access finance, legal assistance, office space, communication devices, and marketing support.

6. There is need for public consultations on preparing postsecondary students for the world of work, as the issue affects all citizens. Public consultation can offer a first-hand opportunity to change societal philosophies about examinations, TVET, and diversification.

### **Conclusion**

This study emerged from concerns about the adequacy of postsecondary preparations for the world of work, in relation to mismatches in the labour force, unemployment, underemployment, and existing skills-gaps. Rapidly changing technology and increased globalisation further exacerbated anxieties. Furthermore, T&T is a post-colonial society with a lingering mismatch between education and the needs of the world and work, which resulted in an absence of structural interdependence among physical and human resources, educational institutions, productive sectors, and government. Given the demand for creative ways of producing new products in the Fourth IR, PSIs must work within an ecosystem to stimulate entrepreneurship and diversification. PSIs require a futuristic outlook that is based on research and close relationships with stakeholders. A schooling ecology is required to establish a seamless education system that minimizes the disruptive effect of the legacies of certification-driven examinations. Administrators spoke about a lack of initiatives for diversification, entrepreneurship, innovation, and industry-links, all of which require an integration of institutions and support mechanisms. The creation of a knowledge-based economy, driven by innovation and entrepreneurship requires strong state programmes and policies, so PSIs can graduate students in new fields where they get support for the implementation of new ideas. PSIs, as stated by administrators, do engage in noteworthy world of work preparations such as the provision of authentic learning, focus on skills development, development of a holistic student, and integration of technology. There is, however, room for systemic improvement towards the development of a versatile student, able to confront current and future issues in the world of work.

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## **Virtual science simulations: The new frontier in science instruction in the post-pandemic Caribbean**

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### **Abstract**

Many departments of science within Caribbean Higher Education Institutions were forced to provide science laboratory simulations because of the COVID-19 pandemic. This quantitative, comparative, retrospective study examined nursing students' science laboratory performance prior to and during the COVID-19 pandemic. It utilized 2975 laboratory science scores from four lab courses completed by five cohorts of first year undergraduate nursing students across each academic year for the period 2017 to 2021 at a Caribbean university. Data were analysed using SPSS version 29. The study revealed that the students' mean laboratory scores appear to be higher for the period 2020/2021 to 2021/2022 in comparison to the years 2017/2018 to 2019/2020. An ANOVA indicated that there was a significant difference in means for laboratory grades and years ( $p < 0.05$ ). Tukey's HSD Post Hoc test revealed that the mean laboratory grades were all significantly different from each other except for 2020 and 2021. Based on this evidence, it can be concluded that there has been successful implementation of the science laboratory simulations during the pandemic and this can be incorporated as a best practice in digitally-enabled science instruction in the post COVID-19 era.

*Keywords:* Higher education; COVID-19; science laboratory simulations

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## **Introduction**

The traditional method for the teaching of science involves a blend of face-to-face classes for teaching theory with practical and experimental skills being conducted mostly in the exclusive domain of the laboratory space at schools, colleges and universities throughout the Caribbean. It is generally thought that the laboratory practice becomes the reinforcement of classroom theoretical science concepts (Fongkong-Mungal et al., 2021). As far back as 1992, it was highlighted by Ware (1992) that there was a need for a systematic and systemic change in secondary school science in developing countries so that there can be greater accessibility to all for science education. Fast forward to the 21st century Caribbean and several studies have shown that there have been very little deviations from the traditional method of teaching science where there is a heavy reliance on teacher-centred instruction and lab-work (Brewster, 2015; Cassie, 2022; George, 2013; Herbert & Rampersad, 2007; Herbert et al., 2009; Mohammed, 2013). Therefore, due to the onset of the COVID-19 pandemic in March 2020, there was a need for Departments of Sciences across the Caribbean and globally to adopt teaching and learning strategies to facilitate students' understanding of science concepts despite their inability to meet face-to-face. This had come about due to the nationwide lockdowns that were rampant at that time due to the health emergency. Many resorted to the use of laboratory science simulations to help supplement face-to-face laboratory experience due to the restrictions imposed by various governments. Internationally, the use of online and simulation laboratories incorporated as part of a blended approach has been shown to have a positive response by students to this type of intervention in the past and it has improved significantly their achievements academically (Eryilmaz, 2015; Harahap et al, 2019; Ocak & Topal, 2015).

There have been studies which examined the response of universities with respect to academic continuity during the pandemic (Bleeker & Crowder, 2022; Cockburn & Chami, 2022; De Four-Babb et al. 2022). However, there has been a paucity of Caribbean literature associated with the direct implementation of virtual science simulations and Caribbean students' experiences with them (Cassie & George, 2021). Even more so, there have been very few studies which conducted

any evaluation of the performance of students using virtual laboratory simulations when compared to face-to-face laboratory activities in any Caribbean territory prior to or during the pandemic. Therefore, it was necessary to examine Caribbean undergraduate science students' performance using virtual science laboratory simulations when compared to face-to-face laboratory activities prior to and during the pandemic. This could provide useful data that can guide decision-makers and policy-makers with regard to the continued use and effectiveness of this intervention in teaching and learning of science.

### **Literature Review**

There has been limited use of virtual science laboratory activities prior to the pandemic in the Caribbean (Cassie, 2022). There is evidence in the literature that supports its use in blended and online approaches to learning science. A recent study showed that students' outcomes have significantly statistically increased after having been exposed to a blend of modern educational methods (Bernard et al., 2017). Some studies have shown that students can perform just as well in an online environment as much the same manner as that being done face-to-face (Gulacar et al., 2013; Nennig et al., 2020). The usefulness of blended laboratory courses has been shown by Brewer, Cinel, Harrison and Mohr (2013). These courses included, *inter alia*, home experimental kits and a combination of online and hands-on learning. Faulconer, Griffith, Wood, Acharyya and Roberts (2018) used a quantitative study to show online students' propensity to perform better than their traditional face-to-face counterparts in the lecture and lab components. Even among secondary school students it has been shown that simulation-based technologies are more engaging than traditional methods (Figueiredo, 2023). A comparative study done among students in a Lisbon secondary school showed that when exposed to the utilization of computer simulations as opposed to traditional teaching strategy, the achievement rate in the post lesson test was in the range of 96.4% to 100% for the experimental group compared to 70.8% to 83.3% of the control group (Figueiredo et al, 2023).

The improvement in academic achievements has been shown by the use of online and simulation laboratories incorporated within a blended approach (Eryilmaz, 2015; Harahap et al., 2019; Ocak & Topal, 2015). Additionally, a review of the literature conducted by Celik (2021) revealed that, despite the increased effectiveness of computer simulations in science teaching over traditional teaching, it is only with the incorporation of other teaching strategies can there be significant gains in science process skills (SPSs).

With the advent of the COVID-19 pandemic many universities across the world and in the Caribbean had to offer virtual laboratory experiences and simulations to ensure continuity of teaching and learning within their various science related programmes. In a retrospective, comparative study of the teaching of clinical biochemistry course, Chinese researchers evaluated

the effectiveness of using a combination of online Problem-based learning (PBL) teaching and virtual simulation laboratory teaching through DingTalk (a free communication and collaboration software platform with features similar to a learning management system) during the pandemic as opposed to the traditional lecture-based learning (LBL) prior to the pandemic. It was found that the combined method of DingTalk based PBL was effective and an acceptable alternative strategy during the pandemic rather than the traditional LBL (Xie et al., 2022).

Also, within nursing education programmes there were innovative changes in the delivery of nursing education on account of the pandemic. In a systematic review, Amankwaa et al. (2022) examined three electronic databases for studies published between December 2019 – December 2021 using the Arksey and O'Malley framework, refined by Joanna Briggs Institute seeking to identify faculty innovations in nursing education as a result of the global COVID-19 pandemic. 111 out of the 1339 retrieved published works met the eligibility criteria and it was found that the innovative practices found in the studies focused on online teaching as an alternative to face-to-face delivery; providing an alternative to clinical placement; and faculty development (Amankwaa et al., 2022). It was also found that 27 research studies highlighted the integration of virtual simulations as part and parcel of the educational experiences during the pandemic period that used various platforms including Zoom, a three-dimensional learning management system, Microsoft Teams and 360 images. These studies showed that these technologies facilitated several virtual skill development experiences such as vital sign recording, health assessment activities, discharge planning and intramuscular injection administration (Amankwaa et al., 2022). Most significantly, Amankwaa et al. (2022), recognizing that the nursing education and by extension science education would be transformed beyond the pandemic, called for the assessment of the long-term effectiveness of innovations previously described.

There has been very little, if at all, any studies into the effectiveness of the use of virtual science laboratory simulations when compared to face-to-face laboratory exercises in the Caribbean (Cassie, 2022). This study sought to explore the effectiveness of the use of virtual simulation laboratories when compared to face-to-face laboratory activities. This was done by comparing students' laboratory performances in science courses prior to and during the pandemic at a Caribbean university. It can provide useful data that can guide decision-makers with regard to its possible permanent future inclusion in science programmes offered by Caribbean universities.

## **Purpose of Study**

This study was designed to achieve the following objectives:

1. Determine the science laboratory performance trends of nursing students at a Caribbean university over a five-year period, 2017-2021
2. Compare the effectiveness of face-to-face laboratory activities with use of virtual science simulations using laboratory performance grades of nursing students at a Caribbean university, prior to and during the COVID-19 pandemic
3. Compare the laboratory performance of nursing students at a Caribbean university in various science courses over a five-year period 2017-2021

The following research questions were formulated in order to achieve the objectives of the study:  
Research Question 1: What are the performance trends of nursing students in the laboratory components of science courses over a five-year period, 2017 to 2021?

Research Question 2: Is there a significant difference in the laboratory performance of nursing students at a Caribbean university in science courses prior to and during the COVID-19 pandemic?  $H_0$ : There is no significant difference in the laboratory performance of nursing students at a Caribbean university in a science course prior to and during the COVID-19 pandemic.  $H_1$ : There is a significant difference in the laboratory performance of nursing students at a Caribbean university in a science course prior to and during the COVID-19 pandemic.

Research Question 3: Is there a significant difference in the performance of nursing students in certain science courses compared to others prior to and during the COVID-19 pandemic at a Caribbean university?  $H_0$ : There is no significant difference in the laboratory performance of nursing students at a Caribbean university in certain science courses prior to and during the COVID-19 pandemic.  $H_1$ : There is a significant difference in the laboratory performance of nursing students at a Caribbean university in a science course prior to and during the COVID-19 pandemic.

## **Background and Context**

### **Description of Courses**

The first- year biology and chemistry courses under study formed part of the Bachelor of Science, Nursing Degree programme at a university in the island of Trinidad. These courses were taught concurrently during the first semester and second semester of each academic year and students were required to earn a passing grade in the semester I course before being allowed to register for the semester II course. The courses are usually completed in the following sequence: BIO1, Anatomy and Physiology I followed by BIO2, Anatomy and Physiology II; CHEM1, Introduction

to Inorganic and Organic Chemistry then CHEM2, Introduction to Biological Chemistry. In order to obtain a deeper insight into the content that is covered in these courses the following general course descriptions are being provided: BIO1 and BIO2 are a first part and second part course respectively that deals with the study of cell biology, functional anatomy and control of each organ system of the human being. CHEM1 is an introduction to the basic theories, principles and applications of inorganic and organic chemistry. CHEM2 course covers the study of basic concepts in biochemistry, including the structures and functions of biological molecules, metabolic and biochemical pathways, to include their roles in energy generation and regulation. The laboratory courses provided the supporting practical components that would support the theoretical concepts being taught in the theory section of the courses and are designated CHEML1, CHEML2, BIOL1 and BIOL2.

### **Lab Sessions – Prior to and During COVID-19**

Each laboratory course had a separate 3-hour laboratory session that was held face-to-face in the biology and chemistry labs prior to the pandemic (2017/2018 to 2019/2020). However, during the pandemic (2020/2021 to 2021/2022) the sessions were facilitated using Zoom and students were given access to the Labster virtual simulations in the Moodle platform. Prior to the pandemic students were provided laboratory manuals for them to read, review and prepare for the upcoming lab activities. Usually, pre-lab activities were completed and submitted for review on the day of the lab session. Students were given a lab talk which would include a small session about theory associated with the labs as well as guidance on safety, and submission of the lab report or write up. Feedback on their pre-labs were given before the end of the first hour of the session. Students were usually supervised and assessed as they conducted their experiments and collected data. Techniques were reinforced, practised and guidance given by laboratory assistants who would supervise a small group of students. Once the laboratory session was over, students were required to submit individual lab reports which were marked and contributed to their laboratory grade. The submission of these reports varied from same day submission to up to 1 week for submission usually at a designated area in the laboratory area on campus or via Moodle, the learning management system.

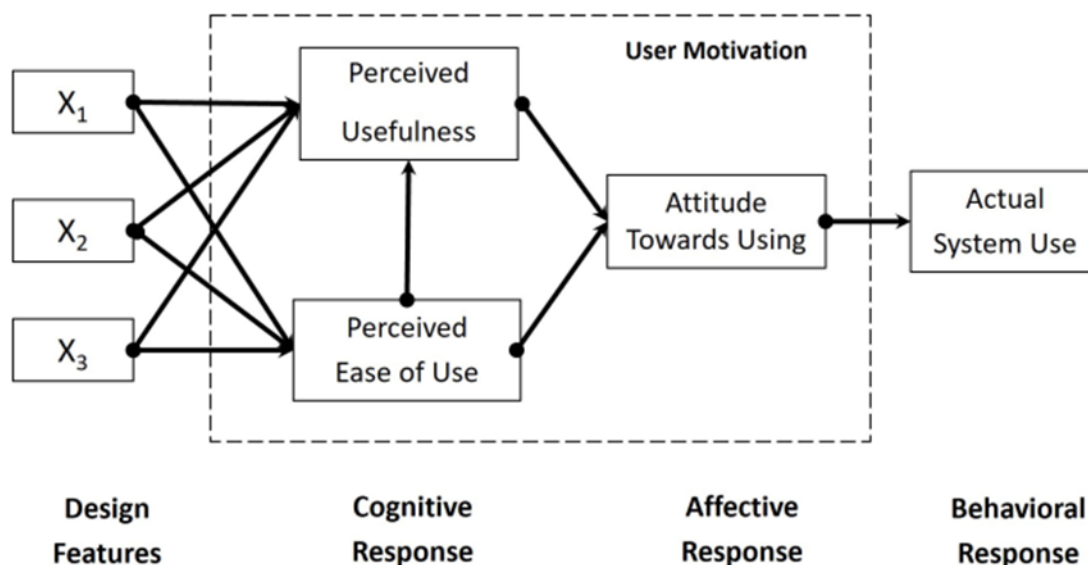
However, during the pandemic, virtual simulations were mainly incorporated for each of the laboratory courses as the Department of Science invested in the Labster software which was implemented in the beginning of the academic year 2020/2021 and its use was continued into 2021/2022. Labster (2023) describes virtual laboratories as interactive online science simulations that are used for teaching theory and lab techniques by immersing students in real world scenarios to apply knowledge to solve real world problems. The Department of Science invested in this commercial software for use with courses associated with the programmes offered by the department with students whose majors were in biology, nursing and consumer science. Additionally, it was also used in general science education courses which are part of the programmes of non-science majors of other departments of the university. Guidance was usually

provided by the laboratory technicians at the beginning of the lab session and students were allowed to either complete the simulations during the scheduled session or during a period of time when the access to the simulations were given. Students were expected to perform the virtual experiments individually and as they progressed through the lab session; they were required to answer questions based on the labs prompted by Dr. One, an A.I. drone lab assistant. The virtual labs from the Labster software were selected from those that were compatible with the learning outcomes that were expected in the face-to-face laboratory activities as far as possible.

### **Theoretical Framework**

The infusion and use of technology within the educational setting is not a new phenomenon. However, due to the COVID-19 pandemic there was an exacerbation of its compulsory implementation and the examination of its relationship to teaching and learning has also been put high on many research agendas (Sadeck, 2022). Consequently, having been forced to use technology within the COVID- 19 pandemic period due to governmental and institutional policies many educators had to provide alternative means for education continuity. This was done via emergency online remote teaching within the tertiary education institutions of the Caribbean as well as the rest of the world. Naturally, in order to accomplish this implied the use of technologies for teaching and learning. Furthermore, administrators and faculty would have had to implement very drastic changes in teaching practices, such as the use of science simulations especially where science was concerned. In most cases administrators and faculty at tertiary institutions may not have been too familiar with this type of innovation (Cassie, 2022). As a result of this, there would have been further implications for behaviour changes towards the adoption and use of technology. These such behavioural changes would rest upon the individual's personal choices and which can range from basic survival to advanced personal needs and those of the learners (Sadeck, 2022). Therefore, this study is grounded upon the adaptation of the Technology Acceptance Model (TAM) (Davis, 1985) as shown in Figure 1.

**Figure 1**  
*Original TAM Model (Davis, 1985)*



The TAM was developed by Davis (1985) with a focus initially on successful design and implementation of information systems. It was intended to provide greater understanding of the user acceptance processes as well as new theoretical insights. Additionally, it was intended to provide the theoretical underpinnings for a practical application of the user acceptance testing methodology (Davis, 1985). In fact, it was described as being able to determine the possibility of end users adopting particular technologies, understanding both influential external and internal factors that cause groups of users to either accept or reject technologies (Meerza, 2017).

Two main belief constructs as shown in Figure 1 are Perceived Usefulness (PU) and Perceived Ease of Use (PEU). These are considered to be the main determinants of TAM and all the other iterations that have followed since its introduction. As shown in Figure 1, PU and PEU (cognitive response factors) can have implications for the attitude toward using (affective response) which further impacts the behavioural response (actual system use) (Go et al., 2020).

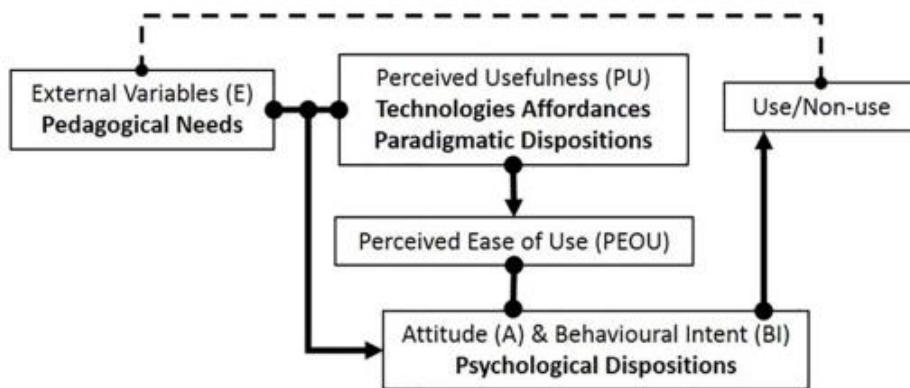
Since its first introduction in 1985, there have been several further modifications of the TAM (Davis et al., 1989, Venkatesh & Davis, 2000; Venkatesh et al., 2003; Venkatesh & Bala, 2008). However, the theoretical framework expounded by Sadeck (2022) which applies to this study made use of the original and the extended Technology Acceptance Model put forward by Davis et al. (1989). In this revised model, Sadeck (2022) suggested that

The external variable (E) was taken as the contextual influence, i.e., the COVID-19 compulsion, which gave rise to a NEED—the need represents pedagogical reasoning. •

Perceived usefulness (PU) was taken to represent the technologies affordances. • The attitude (A) construct was taken as the disposition (p.6)

**Figure 2**

*Representation of Adaptation of TAM (Sadeck, 2022)*



Thus, in the context of this model as shown in Figure 2, Sadeck (2022) proposed that the use or non-use of technology is dependent on pedagogical needs, technological affordances and pedagogical reasoning or needs. Thus, the Faculty of the Department of Science’s decision to implement virtual science simulations had its basis as satisfying the pedagogical need due to the pandemic since face-to-face labs were not possible. These science simulations provided all the technological affordances as it enabled learning of laboratory skills despite not having access to a physical lab. The psychological dispositions of the faculty would have supported the use of science simulations as the desired outcome of COVID-19 was educational and the use of these simulations would have been a means towards that goal. It was also a mandatory expectation by authorities that teachers should use technologies despite personal preferences. While this Sadeck (2022) model was intended initially to understand the depth to which technological affordances, disposition, and pedagogical reasoning at both primary and secondary school levels influence implementation (use/non-use) it can be also extended into the tertiary level too as shown in the previous discussion. The introduction of virtual science simulations can be clearly seen as an application of the adaptation of TAM within the constructs of the model.

## Methodology

This study was designed as a comparative, retrospective, quantitative study. In order to conduct the study permission was sought and received from the university’s ethical review board. This study made use of secondary data obtained from the undergraduate nursing students’ scores in the laboratory components of science courses during the academic years 2017/2018; 2018/2019; 2019/2020; 2020/2021 and 2021/2022. A description of the science courses used in the study as

well as the conduct of laboratory exercises prior to and during the COVID-19 pandemic were outlined in the previous background and context section. The laboratory performance scores were obtained from faculty and staff who taught these courses over each academic year. Prior to the pandemic (2017/2018 to 2019/2020) the data included each students' individual performance on each of the lab reports submitted for each of the respective labs. During the pandemic (2020/ 2021 to 2021/2022) automatic scores generated during and upon completion of the virtual laboratory simulation exercises formed the basis of the grade for that particular lab. Data were analysed using descriptive and inferential statistics obtained using SPSS version 29.

## Results

A total of 2975 laboratory scores from two chemistry courses, CHEML1 and CHEML2 and two biology courses, BIOL1 and BIOL2 that were completed by five cohorts of first year undergraduate nursing students across each academic year for the period 2017 to 2021 were analysed using SPSS version 29. Of the 2975 scores, 1585 were obtained for students exposed to face-to-face laboratory exercises whilst 1390 scores were obtained from students who used virtual laboratory exercises. There was a steady increase in the number of students doing all four courses per academic year except the 2018/2019 academic year as shown in Table 1 below.

**Table 1**

*Descriptive Statistics for scores by year for the period 2017 to 2021*

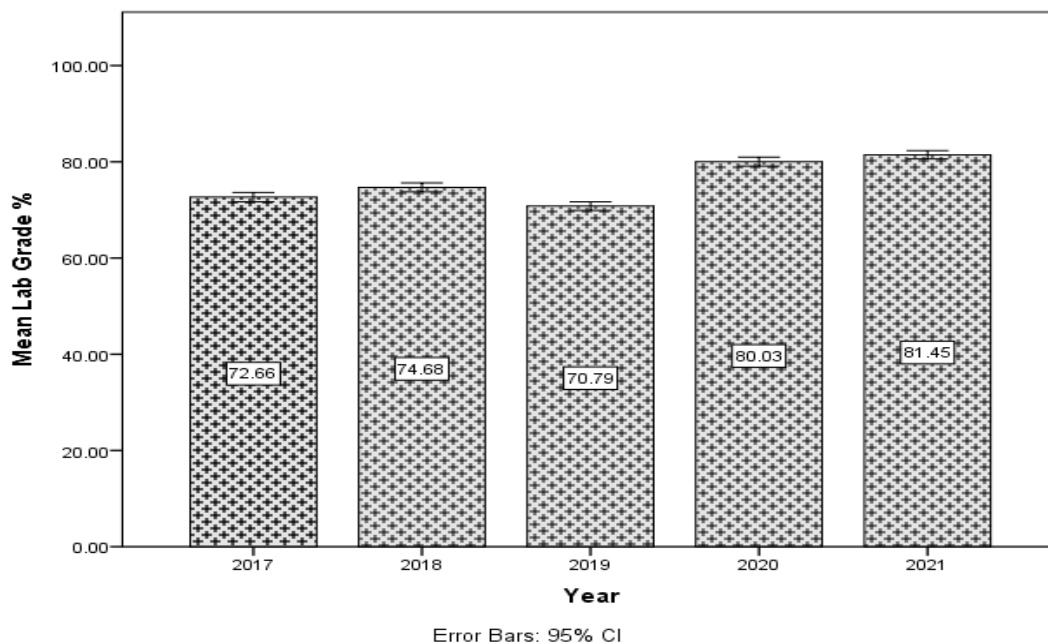
Academic Year	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2017/2018	517	72.66	11.13	0.49	71.69	73.62	36.00	100.00
2018/2019	505	74.68	10.64	0.47	73.75	75.61	33.00	100.00
2019/2020	563	70.79	10.73	0.45	69.90	71.68	40.00	99.00
2020/2021	660	80.03	12.19	0.47	79.10	80.96	11.10	100.00
2021/2022	730	81.45	11.88	0.44	80.59	82.31	15.00	100.00

It has been shown that the overall mean scores appear higher during the COVID-19 pandemic period (2020/2021 and 2021/2022) than the pre - COVID-19 period (2017/2018 to 2019/2020) as

shown in Figure 3 below. The academic years 2021/2022 and 2020/2021 also have the largest range in comparison to the years 2017/2018 to 2019/2020.

**Figure 3**

*Mean laboratory scores by year for the period 2017 to 2021.*



A one-way ANOVA was conducted to determine the effect of years (2017, 2018, 2019, 2020, 2021) on overall laboratory grades. The results indicate a significant effect, [F (4, 2970) = 103.285,  $p < 0.05$ ]. Post Hoc tests were conducted using Tukey's HSD test. The comparison revealed significant differences between all years except 2020 and 2021, 2017 and 2019.

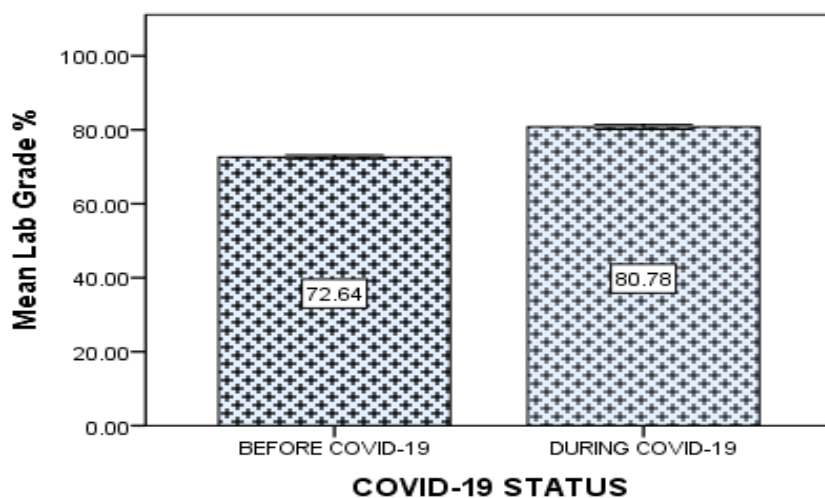
In order to compare the laboratory performance prior to and during the COVID-19 pandemic, the mean scores were calculated for the academic years from 2017/2018 to 2019/2020 (before COVID-19 period) whilst the mean scores were calculated for the academic years from 2020/2021 to 2021/2022 (during COVID-19 period).

Table 2 and Figure 4 show the overall mean lab grades were notably higher for students doing these courses during the COVID-19 pandemic than those who did the courses before the COVID-19 pandemic. However, there is a bigger range and standard deviation for student grades during COVID-19 as opposed to before.

**Table 2**  
 Descriptive Statistics for scores prior and during COVID-19

COVID-19 STATUS	N	Mean	Std. Deviation	Std. Error Mean	Minimum	Maximum
Lab Grade % BEFORE COVID-19	1585	72.64	10.94	0.27	33.00	100.00
Lab Grade % DURING COVID-19	1390	80.78	12.04	0.32	11.10	100.00

**Figure 4**  
 Overall Mean laboratory scores before and during COVID-19.



Error Bars: 95% CI

An independent samples t-test was conducted to assess for differences in the mean grades for laboratory courses before and during COVID-19. A significant difference ( $p < 0.05$ ) was noted with mean laboratory scores being higher during COVID-19 than before.

Table 3 and Figure 5 below illustrate the mean scores for all individual courses. It can be seen that the mean scores were higher during the pandemic for all courses except BIOL 2 which was lower during the COVID-19 pandemic than the period before the COVID-19 pandemic.

**Table 3**

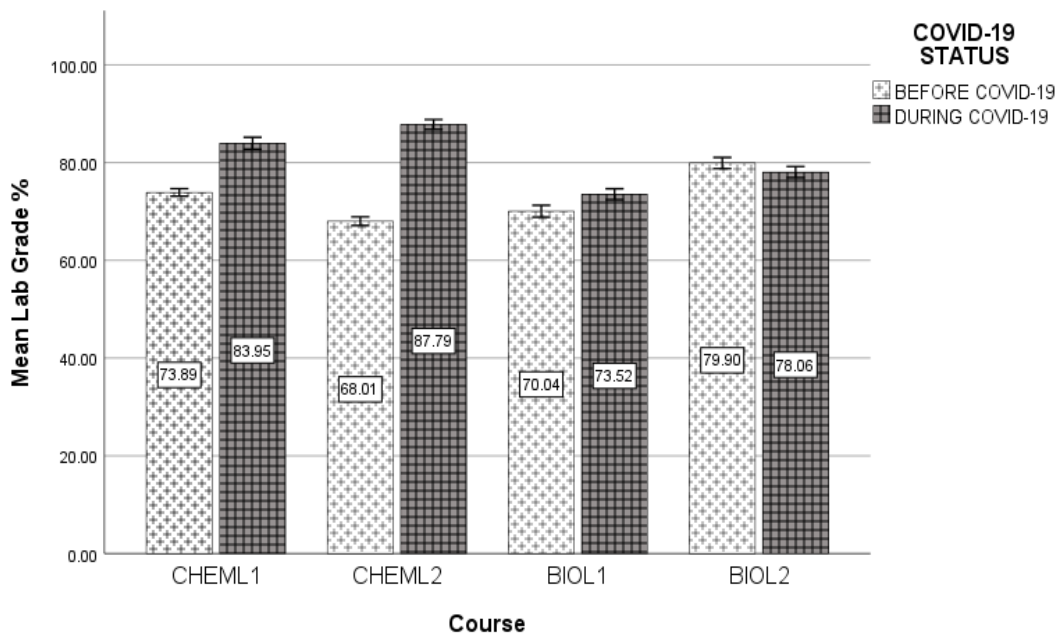
*Descriptive Statistics of scores for different courses Prior and During COVID-19*

COVID-19 STATUS		Mean	N	Std. Deviation	Std. Error of Mean	Minimum	Maximum
BEFORE COVID-19	CHEML1	73.89	463.00	8.40	0.39	33.00	90.00
	CHEML2	68.01	404.00	9.02	0.45	36.00	88.00
	BIOL1	70.04	398.00	12.37	0.62	38.00	99.00
	BIOL2	79.90	320.00	10.43	0.58	54.00	100.00
DURING COVID-19	CHEML1	83.95	369.00	11.91	0.62	11.10	100.00
	CHEML2	87.79	336.00	9.47	0.52	45.00	100.00
	BIOL1	73.52	367.00	10.88	0.57	33.00	96.00
	BIOL2	78.06	318.00	10.36	0.58	15.00	99.00

A one-way ANOVA was conducted to determine whether there was a difference in overall mean laboratory scores by courses before COVID-19. The results indicate a significant effect,  $[F(3, 1584) = 94.88, p < 0.05]$ . Post Hoc tests were conducted using Tukey's HSD test and indicated all courses had significantly different means scores from each other before COVID-19.

A one-way ANOVA was conducted to determine whether there was a difference in overall mean laboratory scores by courses during COVID-19. The results indicate a significant effect,  $[F(3, 1398) = 121.56, p < 0.05]$ . Post Hoc tests were conducted using Tukey's HSD test and indicated all courses had significantly different means scores from each other during COVID-19.

**Figure 5**  
*Mean Lab grades by courses before and during COVID-19.*



### Discussion

With reference to the first research question: What are the performance trends of nursing students in the laboratory components of science courses over a five-year period, 2017 to 2021? It was seen that over the five-year period that the laboratory performance of the nursing students in the science courses steadily increased for all the years except 2019/2020 (see Table 1 and, Figure 3). The years 2021/2022 and 2020/2021 also have the largest range in comparison to the years 2017/18 to 2019/2020. This is noteworthy as it coincides with the academic year 2019/2020, marking the onset of the pandemic period in March 2020. It is possible that the science departments would have been in a period of transition from face-to-face laboratory to online laboratory experience and some adjustments may have been made to course and lab schedules. It has been shown that it was challenging for some educators at that point to source suitable alternatives. Some educators would have devised their own strategies at the time and there would have been challenges with those who were unfamiliar with online teaching tools (Díez-Pascual & Jurado-Sánchez, 2022; Huang, 2020; Makamure & Tsakenic, 2020). This therefore points to the need for exposing and strengthening pedagogical strategies for educators in the post-pandemic era (Deák et al. 2021; Paul & Jefferson, 2019).

The use of science virtual laboratories within the context of the COVID-19 pandemic by faculty, staff and students of the Department of Science at the university is supported by the revised

theoretical framework of the TAM proposed by Sadeck (2022). The pedagogical need arose due to the pandemic as there were restrictions in meeting face-to-face and this led the department faculty to acquire available technologies that could provide alternative and yet equivalent laboratory experiences. This decision to implement the use of this software would have been based on the technological affordances, perceived ease of use and the psychological dispositions of faculty at the time.

Having implemented these simulations, it was important to now examine the effectiveness of its use by investigating students' performance especially during this period and by comparing it to the students' performance prior to the pandemic and this now leads into the testing of the hypotheses: H<sub>0</sub>: There is no significant difference in the laboratory performance of nursing students at a Caribbean university in a science course prior to and during the COVID-19 pandemic. H<sub>1</sub>: There is a significant difference in the laboratory performance of nursing students at a Caribbean university in a science course prior to and during the COVID-19 pandemic. The study found that the mean lab grades were notably higher for students doing these courses during the COVID-19 pandemic than those who did the courses before the COVID-19 pandemic. Upon further analysis it was shown that a significant difference ( $p < 0.05$ ) was noted with mean laboratory scores being higher during COVID-19 than before. This therefore supports the acceptance of the alternate hypothesis. This is supported in a systematic literature review completed by Chan et al., (2021) which indicated that virtual laboratories are more effective than passive teaching methods and show greater or equal effectiveness than hands-on laboratories. They go on further to report that studies have shown that the use of a blended combination of virtual labs and traditional methods yields even better results.

Additionally, Diwakar et al. (2023) in advocating for improved laboratory performance proposed that students can be given multiple attempts and longer duration to perform virtual laboratory experiments. This can auger well for improved proficiency in laboratory skills and competencies. Therefore, in the post-pandemic period, science laboratory exercises should include a blend of both face-to-face and virtual laboratories in order to broaden students' experiences and exposure to the best practices in 21st century pedagogy. This is important since there are many real - world applications of simulations in the training and professional development of students to become future career professionals. Cant et al., (2023) in their umbrella review of the use and effectiveness of virtual simulations in nursing education indicate that studies showed the students found that virtual simulations were easily accessible, fun, and engaging ways to learn. A qualitative study done among nursing students in South Korea by Kim et al. (2023) supports the notion that virtual simulations properly designed and implemented can improve student confidence and competence in the provision of patient-centred care.

The current study further investigated the performance of nursing students in certain courses compared to others prior to and during the COVID-19 pandemic by testing the hypotheses:

H<sub>0</sub>: There is no significant difference in the laboratory performance of nursing students at a Caribbean university in certain science courses prior to and during the COVID-19 pandemic.

H<sub>1</sub>: There is a significant difference in the laboratory performance of nursing students at a Caribbean university in a science course prior to and during the COVID-19 pandemic. It was found that there was a significant difference in the laboratory performance of the nursing students among each of the science courses prior to the pandemic and during the pandemic. Thus, this supports the acceptance of the alternate hypothesis. It was evident that there were improvements in students' laboratory performance prior to and during the pandemic. Of the four courses examined there was a steady increase in performance of three: CHEML1, CHEML2 and BIOL1. This is supported by the studies done by some researchers who found that virtual laboratories were equal or greater in effectiveness to hands-on laboratories and traditional methods of teaching (Celik, 2021; Chan et al., 2021; Reece & Butler, 2017; Xie et al., 2022).

### **Limitations**

This study was a quantitative one and as such was unable to capture the full experience of the students' use of science simulations and their feelings and motivations towards them. This would have added a further balance and richness to the study if it was a part of a mixed methods study. The study was limited to first year nursing students and no other science majors across other year groups, such as those in biology and/or chemistry degree programmes.

### **Recommendations**

Based on the study's findings it is being recommended that in the post-pandemic era that virtual laboratory and hands-on activities should be used in combination in the teaching and learning of science. Additionally, in order to enhance skill development activities and form a basis for evaluations, virtual laboratories can be implemented as pre-labs. These are some ways in which students' laboratory experience can be enhanced by the use of 21<sup>st</sup> century pedagogical best practices. This can generate interest and motivation for students who are desirous of pursuing Science, Technology, Engineering and Mathematics (STEM) education. Faculty should be encouraged to incorporate new and emerging teaching technologies in their classrooms. As a result of the findings of this study, this implies there is a need to review and develop instructional science curriculum for educators at tertiary level.

Additionally, a single laboratory experimental experience based on a specific topic should no longer be the only main method of assessment and evaluation of students' laboratory skills as has been the norm prior to the pandemic. In order to improve mastery, students should be afforded multiple attempts at the simulations after having been exposed to face-to-face equivalent

laboratory skill. This will be of benefit to students as it would afford more time for development of laboratory skills and competencies without the costly use of chemicals or need for physical supervision.

Future studies should include a comparison of laboratory performances among other science majors such as those students who do biology, chemistry and other science disciplines. This is being suggested because these students would have had more exposure and experience with the virtual science simulations across the various courses in their programmes and can provide a richer, fuller understanding and evaluation not only quantitatively but also qualitatively.

### **Conclusions**

The results of the study supported the incorporation of virtual simulations in the teaching and learning process for the development of nursing students' knowledge, scientific and psychomotor skills. This was evident in this study which found that there was an increasing improvement of science laboratory performances of nursing students for the academic years 2017/2018 to 2021/2022 except during the academic year 2019/2020 when the pandemic started. This improved performance can also point to the increasing ease of accessibility, fun and engaging nature that virtual simulations have been proven to provide for students and this has been well documented in the literature.

There is no doubt that the inclusion of virtual simulations can provide opportunities for students to be given multiple attempts and longer duration to perform virtual laboratory experiments. This has cost benefits for the institutions since expensive chemicals used in face-to-face laboratories will no longer be required. In the case of nursing education students who are required to ensure the development of specific skills and competencies, the use of similar virtual simulations in specific real-world scenarios can assist in mastery of these skills with no risk to patients' lives. Thus, this would redound to the benefit of all those associated with the implementation of nursing programmes.

Based on this study, it has been shown that the laboratory performances of the nursing students were much more improved during the pandemic when they were exposed to the use of virtual science simulations rather than prior to the pandemic where they would have been exposed to traditional laboratory exercises. The study provides evidence for the inclusion of virtual science simulations as a part of the teaching and learning strategies within blended science programmes for nursing students across the Caribbean in the post-pandemic era. This now provides further opportunities for nursing curriculum designers to develop curriculum that incorporates real-world, patient-centred care in virtual simulations as well as bringing application of knowledge and skills in the virtual simulations to real world scenarios.

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## **Enhancing Quality Instruction and Learning Experiences in Higher Education through ChatGPT: An Exploratory Case Study**

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### **Abstract**

Despite trepidations about the use of generative artificial intelligence (AI) and chatbots like ChatGPT, there is significant potential to enhance instruction in Higher Education (HE). Scholars have explored this Generative AI's features, and the implications for teaching and learning in HE since the release in 2022. This has led to discussions on academic integrity which have raised questions about the authenticity of students' creative output, ethical practices regarding intellectual property, as well as arguments about the validity of traditional assessments. However, there has been limited practical discourse on the opportunities for Generative AI as a tool for innovative authentic assessments and for fostering students' active participation in collaborative learning and self-assessment. Using an exploratory approach, this case study examines an instructor's use of ChatGPT to teach mathematics at a tertiary-level institution, investigating the capabilities of AI in enhancing students' engagement, assessment types, and instruction in higher education. The study involved 70 students and one instructor exploring strategies for promoting collaboration and engagement in mathematics talk communities, as well as implementing authentic assessments. The study's findings indicate that ChatGPT can provide insightful feedback on students' work and improve their learning experience through error-analysis type assessments while providing support to instructors in crafting classroom practices that foster critical thinking and problem solving. This study potentially offers a structured framework for maximizing the effectiveness of using ChatGPT in preparing learners for the 5th Industrial Revolution.

*Keywords:* Generative artificial intelligence, ChatGPT, mathematics talk community, pedagogy enhancement, authentic assessment, collaborative learning

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## Introduction

*“You are either ready for change or you are a dinosaur”<sup>1</sup>*

Since the significant advancement of generative artificial intelligence (AI) and chatbots like ChatGPT in 2022, Higher Education (HE) professionals have been raising concerns about their impact on teaching, learning, and academic integrity. Academic integrity involves adhering to ethical and professional principles, standards, practices, and a consistent system of values that guide decisions and actions in education, research, and scholarship (Tauginienè et al., quoted in Foltyněk et al., 2023). ChatGPT (Generative Pre-trained Transformer) is a language model that enables more natural and conversational interactions with computers, capable of generating human-like text, answering questions, and performing various natural language processing tasks (UNESCO, 2023). In response to concerns about its impact, some educational institutions have blocked access to OpenAI's website and issued statements warning against using ChatGPT for cheating (Heaven, 2023).

Despite these concerns, however, AI has the potential to enhance both academic and administrative HE operations. Reviews suggest that AI tools can provide insightful feedback on students' work and improve the overall quality of their learning experience (Ouyang et al., 2022). Scholars have explored ChatGPT's features and implications for teaching and learning in HE (Rudolph et al., 2023; Tlili et al., 2023), but varying opinions exist regarding academic integrity, including concerns with the authenticity of students' work and the effectiveness of traditional assessments, as well as ethical concerns about intellectual property (Perkins, 2023).

## Literature Review

### Quality Assurance and Artificial Intelligence in Education

Quality Assurance (QA) professionals have also weighed in, with organizations such as UNESCO, the UK Quality Assurance Agency (QAA), and the European Network for Academic Integrity (ENAI) issuing guidelines and recommendations on the use of AI in academia. Undoubtedly, Artificial Intelligence presents both challenges and opportunities for Higher Education Institutions (HEIs). For example, UNESCO-IESALC (2023) highlighted opportunities that ChatGPT could present in teaching, research, administration, and community engagement.

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<sup>1</sup> Quotation from a college leader in “Why Professors are Polarized on AI”. Susan D’Agostino (2023)

Further, the QAA outlined two significant ways AI can enhance and improve HEIs: integrating it into curriculum and assessment to deepen learning and build AI-confident learners, as well as using it to speed up processes and drive efficiencies (QAA, 2023). However, concerns remain, including academic integrity, potential grade inflation, depersonalization of feedback, the digital divide, and variations in graduate skills (QAA, 2023).

Academic integrity is of paramount concern to HEIs, as it directly impacts an institution's reputation. The QAA (2023) emphasized that trustworthiness and value of qualifications rely on the confidence that a student's work is genuinely their own. However, AI tools may not always align seamlessly with these standards, and detecting AI-generated content is challenging. To address this, Baker-Gardner et al. (2022) stressed the importance of education and training in fostering academic integrity, suggesting that punitive approaches are not always effective. Foltynek, et al (2023) focused on empowering stakeholders with skills and knowledge to ethically use AI tools, emphasizing the need for educational policies tailored to opportunities and challenges in AI Educational Development (AIED).

QAA (2023) in arguing for a re-evaluation of assessment strategies and the integration of AI tools in these strategies asked: should assessment test knowledge acquisition or be used as a learning tool? Despite this ongoing discourse, however, practical discussions about ChatGPT's potential applications as a tool for authentic assessments and student engagement are lacking. In the Caribbean, Accreditation Agencies have largely remained silent on this matter. However, in an attempt to address the issue, the University Council of Jamaica (UCJ) hosted the 7th Dennis Irvine Lecture in October 2023, focusing on the implications of AI for Quality Assurance. The invitation to participants emphasized the increasing recognition of AI's potential to transform educational practices (N. Murray, personal communication, September 29, 2023).

The University of the West Indies (UWI), the Caribbean region's leading higher education institution, has begun the discourse regarding ChatGPT, and issued a position statement aligning with UNESCO's guidelines. The UWI has also formed a committee to review policies on academic integrity, demonstrating a commitment to AI technology while upholding institutional principles (The UWI, 2023). The UWI's Core Values and Attributes of the Ideal UWI Graduate, including ethical values and IT skills, should guide how AI is used in education, research, and other areas of operation. This approach is meant to ensure that AI benefits the academy while maintaining integrity and excellence.

### **Concerns about AI Integration in Higher Education**

Undoubtedly, artificial intelligence (AI) has been increasingly transforming instruction in recent years, with organizations and higher education institutions investing significantly in AI-based instructional and learning technologies. AI-driven instruction now focuses on personalization and adaptive learning, using algorithms to customize educational content to individual learning needs, styles, and self-efficacy, ultimately leading to more engaging and effective learning experiences and improved student performance (Ouyang et al., 2022).

AI has also revolutionized the creation of educational materials, with Natural Language Generation (NLG) tools and chatbots streamlining development processes and enhancing learning quality. Intelligent Tutoring Systems (ITS) now mimic human tutors by providing real-time, personalized feedback. Ouyang et al. (2022) observed that chatbots, which are increasingly utilized in education, provide instant support to students by answering questions, assisting with administrative tasks, and even serving as virtual tutors in classrooms. AI streamlines assessment and grading processes, delivering timely and consistent feedback (Baker & Smith, 2019). Educators also leverage AI-driven Learning Analytics (LA) to identify patterns in student behaviour and performance, enabling data-driven decisions that enhance the overall learning experience.

Despite these benefits, concerns and criticisms persist regarding AI integration in higher education. Critics argue that while AI's promises personalized learning, it risks depersonalization by potentially offering a one-size-fits-all education (Zawacki-Richter et al., 2023). Ethical concerns arise from AI systems perpetuating biases from training data, potentially resulting in unequal treatment and discrimination. Privacy issues also emerge from extensive student data collection, raising concerns about data protection and misuse (QAA, 2023). Educators fear job displacement due to AI reliance. However, Sims (2023) assures that “the key to successfully integrating AI into education lies in understanding that AI tools are not a replacement for human expertise, but rather they are tools that can augment and enhance it” (para. 9)). An additional concern of educators is the ability of AI tools to produce essays, hence raising questions about the validity and reliability of traditional assessments. Indeed, AI tools are providing a necessary opportunity for HE stakeholders to reimagine the role of education in the 21st Century and rethink traditional assessment (Sims, 2023).

The concerns that have been raised regarding biases can be addressed through rigorous oversight and continuous improvement in algorithm design to mitigate these biases. AI can be used to tailor educational experiences to diverse learning styles and abilities, enhancing engagement and comprehension (Chang et al., 2023). By removing educators from administrative tasks, AI can be utilized to enable more meaningful interactions with students. Long-term gains in efficiency and effectiveness can offset integration costs. According to Chang et al. (2023), AI provides instant feedback to students, allowing them to monitor progress and make timely improvements, thereby enhancing their learning experience. Advancements in technology can lead to the development of

AI tools that foster creativity and critical thinking. AI provides the opportunity to foster global collaboration and accessibility, thereby, reducing geographical barriers and making education more inclusive.

While challenges exist, effective AI integration can transform higher education by enhancing the quality of learning experiences. This paper explores the impact of AI on instruction at a tertiary institution in the Caribbean and presents a case study, using the reflexive praxis method. It examines the use of ChatGPT in teaching mathematics and offers a framework for preparing learners for the 5th Industrial Revolution.

### **Theoretical Framework**

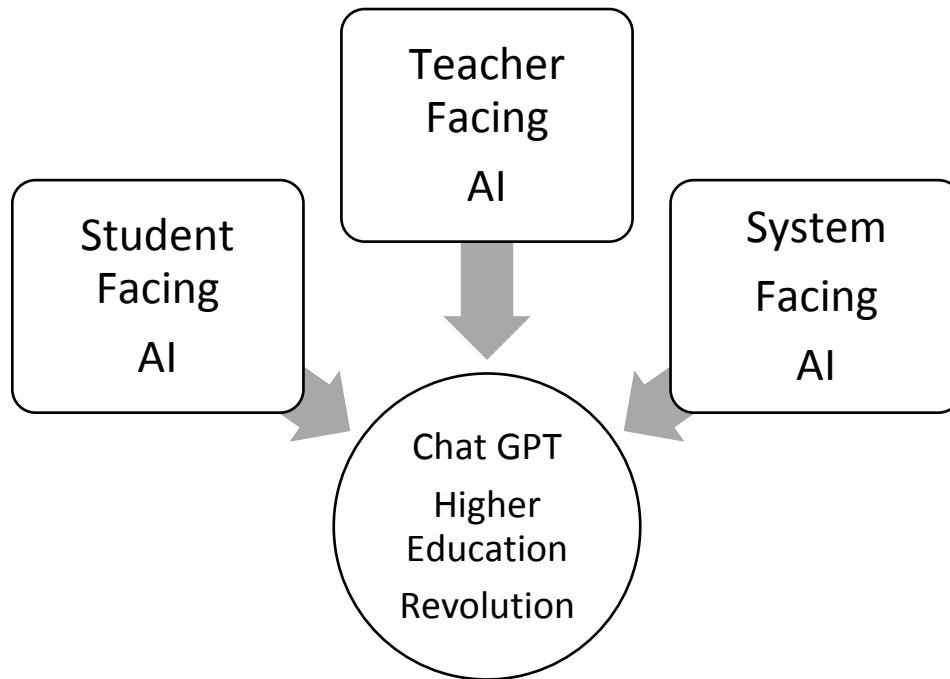
Artificial Intelligence in Education (AIEd) is nothing new, and has been evolving since the 1970s, with researchers exploring AI's potential to enhance learning technologies (du Boulay, 2016). However, recent advancements in AI, exemplified by ChatGPT, have transformed the field, offering sophisticated algorithms capable of learning, adapting, and improving independently (Tan, 2020). This technology has the capacity to revolutionize human interactions in education, leading to a paradigm shift in higher education instruction.

ChatGPT, powered by the GPT-3 architecture, represents a milestone in AI development with its 175 billion parameters, allowing for natural language conversations and contextually appropriate responses (Tan, 2020). It has revolutionized education by enabling AI-driven chatbots that provide instant support, answer questions, and assist with learning tasks, tailored to individual learning styles and improving student engagement and performance. Additionally, its language translation and accessibility features enhance inclusivity, benefiting non-native English speakers and students with disabilities. ChatGPT can also be used to streamline administrative tasks, facilitates content creation, and offers pedagogical guidance to educators, despite challenges related to bias, privacy, and equity.

To understand ChatGPT's potential impact on higher education, it's essential to contextualize it within frameworks like Baker and Smith's (2019) three dimensions: student-facing, teacher-facing, and system-facing AI (See Figure 1). Student-facing AI, such as Intelligent Tutoring Systems (ITS), personalizes learning experiences and provides tailored assistance in problem-solving, mimicking human tutors' support. ChatGPT's potential lies in enhancing personalized adaptive learning, particularly in subjects such as mathematics, supporting students' independent study.

**Figure 1**

*Theoretical Framework: An Adaptation of Three Educational Context for AI (Baker & Smith, 2019)*



Teacher-facing AI reduces teachers' workload by automating assessments, fostering innovative instruction, and providing feedback. AI-powered assessment applications, like Automated Essay Scoring (AES) systems, offer continuous feedback beyond traditional methods, enhancing students' writing skills across disciplines. ChatGPT can support educators in various disciplines, including mathematics, by enhancing students' writing skills through automated feedback.

System-facing AI in higher education monitors and evaluates students' performance, offering predictive models and real-time results. This integration of AI and Learning Analytics (LA) can enhance personalized, adaptive, and process-oriented instruction and learning, ultimately improving students' learning and performance. The synergy between AI and LA can provide quantitative performance metrics and qualitative feedback, fostering innovation and improving the quality of instruction in higher education.

### **A Case for Using ChatGPT**

OpenAI, a leading AI research laboratory, aims to advance 'friendly AI' for the benefit of humanity, ultimately aspiring to achieve artificial general intelligence (AGI) (OpenAI, 2015). AGI, or 'strong AI,' represents machines' ability to perform intellectual tasks on par with humans (OpenAI, 2015; Grace et al., 2018). As indicated earlier, in a significant move, OpenAI launched a free preview of ChatGPT on November 30, 2022. ChatGPT, based on the GPT-3 family of large language models,

engages in human-like conversations, amassing one million users within five days of launch (Jin & Kruppa, 2023).

ChatGPT's strength lies in its robust language understanding, making it suitable for chatbots and ITS that support students' self-efficacy in independent study. Its flexibility allows fine-tuning for specific tasks, enhancing the accuracy of responses (Deng & Lin, 2022). ChatGPT's speed and cost-effectiveness make it ideal for real-time applications and as a 24/7 personal assistant (Guo et al., 2022). However, it has limitations, such as struggling with contextual nuances and lacking real-time access to up-to-date information (Azaria, 2022). Despite this, ChatGPT remains valuable for various applications in higher education, provided users understand its capabilities and constraints.

### ***The Instructor's Perspective***

The instructor's interest in artificial intelligence (AI) was sparked in November 2022 shortly after the development of ChatGPT. This interest led to a desire to explore its educational potential. Despite initial reservations, the instructor recognized ChatGPT's ability to enhance students' learning experiences, especially in mathematics since that was his area of focus. The institution initiated a peer tutoring programme in January 2021 to support students who were facing challenges with quantitative courses. Inspired by the programme's success, the instructor decided to investigate how AI's could further enhance this peer tutoring initiative in Mathematics Education. In preparation, the instructor participated in a 4-week international professional development workshop on integrating ChatGPT in education. The workshop focused on using ChatGPT to enhance student engagement, creative thinking, and teaching resources, with adaptable activities for any content area. Sessions were asynchronous, allowing educators to implement ideas in their teaching. Participants shared their impressions of ChatGPT before and after the workshop, highlighting its potential in education. The instructor's impressions before and after the workshop are discussed later in the findings.

## **Methods**

### ***Research Objective and Methodological Approach***

The objective of this study is to explore the integration of ChatGPT in teaching mathematics at a Higher Education Institution (HEI) in the Caribbean. The study aims to investigate how AI-driven tools, particularly ChatGPT, could be used to enhance mathematical instruction, improve student engagement, and support learning outcomes in a pre-calculus course. The research also seeks to capture the reflections of both the instructor and students on the use of AI interventions in teaching and assessment.

The research team selected an exploratory case study to investigate the use of ChatGPT in mathematics instruction, which is a novel and evolving phenomenon. Given that the integration of AI tools in teaching is relatively new, the case study approach facilitated a detailed examination of the practical applications, challenges, and outcomes in a specific educational context. Moreover, the case study approach suited the research aims because it allowed the researcher to capture real-life experiences of both the instructor and students in the classroom setting. By focusing on qualitative data such as journal entries and student feedback, the exploratory case study provided rich insights into the use of AI tools and their impact on teaching practices. This approach was particularly useful when investigating new technologies and testing innovative teaching strategies.

### ***Research Paradigm***

The study employed the reflexive praxis research paradigm to examine the integration of ChatGPT in mathematics instruction. The reflexive praxis research paradigm is a qualitative research approach that emphasizes self-reflection and continuous critical evaluation throughout the research process. This paradigm involves the researcher actively engaging in reflective practice, considering their own role, biases, and assumptions, and adjusting the research approach based on evolving insights.

In this study, the reflexive praxis paradigm guided the research process by encouraging the instructor to continuously reflect on their teaching practices and the impact of ChatGPT interventions. The use of reflective journal entries from both the instructor and students allowed for ongoing evaluation of how AI tools were used in the classroom, what worked well, and what needed adjustment. This paradigm was suitable for the study because it aligned with the exploratory nature of the research, allowing the instructor to adapt and refine teaching strategies based on feedback. Additionally, it ensured that the research captured real-time experiences and reflections, providing a deeper understanding of the practical applications of AI in education.

However, the reflexive praxis research paradigm could introduce inherent biases in data interpretation because of the direct involvement of the researcher. The instructor's reflections and interpretations may be influenced by personal experiences, assumptions, and expectations about the use of AI in teaching. Nonetheless, to mitigate these biases, the research team employed multiple data sources to ensure triangulation and provide a balanced perspective. These included:

- (a) Reflective journal entries from both the instructor and students
- (b) Direct quotes from students to capture their unfiltered feedback
- (c) Early Informal Evaluation of Teaching (EIEOT) survey to gather additional student perspectives.

By incorporating student reflections and feedback, the study reduced the risk of relying solely on the instructor's viewpoint. The use of direct quotes and multiple data sources provided external

validation, ensuring that the research outcomes were not solely based on the instructor's interpretations. These measures, combined with journal entries and the EIEOT survey, offered diverse perspectives, which minimized bias and enhanced the credibility and reliability of the study's findings.

### ***Data Site and Participants***

The selected method and research paradigm were considered appropriate as the instructor, with over 22 years' experience teaching mathematics in the US and the Caribbean, taught a pre-calculus course at the first-year level. The course, offered at the newly established campus of The University of the West Indies in Antigua and Barbuda, aimed to provide students with foundational mathematical tools essential for understanding concepts in Social Sciences, Health and Behavioural Sciences, Humanities and Education, Computer Science, and Artificial Intelligence. The course ran from September to December 2023. However, the research was conducted from mid-September to the end of October 2023. The cohort consisted of 70 students who met the prerequisite of achieving a satisfactory pass in Caribbean Secondary Examination Council (CSEC) Mathematics or its equivalent.

### ***Data Collection***

Data for this study were collected through reflective journal entries from both the instructor and students capturing their reflections throughout the duration of the course. Direct quotes were used from these journal entries to highlight the various ChatGPT interventions employed during teaching and assessment. Additionally, the instructor administered an Early Informal Evaluation of Teaching (EIEOT) survey during the course to gather students' feedback and recommendations on the AI-inspired interventions. See Appendix A for survey instrument.

The EIEOT is an informal survey administered by the campus during the semester as a quality assurance evaluative tool to gather insights on the students' experience and implement interventions, where necessary. This survey facilitated anonymous feedback from students, which served as a catalyst for a cycle of: (a) student feedback, (b) review of students' feedback, and (c) implementation remedial actions, including students' recommendations in classroom practices, if necessary. This iterative process empowered students to become active stakeholders in providing feedback and shaping the didactical contract with their instructor, thereby enhancing their mathematical learning experiences during the course.

### ***Confidentiality and Anonymity***

The research aligns with The University of the West Indies Research Policy which permits studies of this nature to be exempt from the review process. According to the policy, "educational research involving normal educational practices, e.g. classroom instruction, strategies, curricula management techniques" is exempt from the ethics review process provided that students are not identifiable (UWI, 2011, p. 11). All students who participated in this exercise provided voluntary informed consent and are anonymized.

### ***The Data Collection Course for Teaching with ChatGPT***

The course centred on fundamental mathematical concepts and their practical applications, emphasizing mathematical reasoning and problem-solving skills. Students reviewed essential mathematical concepts early in the course, including operations with indices, factorization, solving linear equations, the use of brackets, simplification of fractions, and handling directed numbers. The course ran for 12 weeks, with 2 hours of lecture and 1 hour of tutorial session each week (See Table 1).

**Table 1**  
*Teaching Methods for Pre-calculus Course*

Method	Description
Lectures Duration: 2 hours	Interactive lectures will be used to introduce the main concepts of the course.
Tutorials Duration: 1 hour	Discussions and problem-solving sessions to facilitate student engagement in group or individual problem-solving processes. Activity sheets and practice exercises, pop-quizzes and various interactive formative assessments.

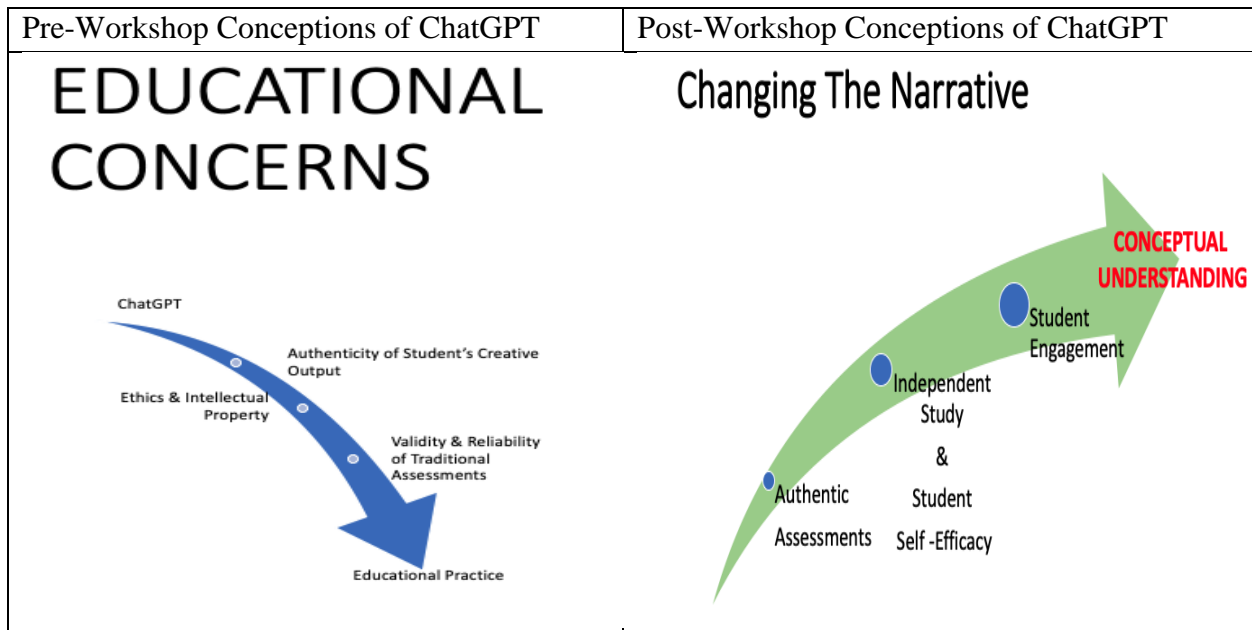
The teaching methods employed included interactive lectures to introduce main concepts and tutorial sessions for discussions and problem-solving. The course was designed to enable students to acquire competencies in describing and analyzing relationships among functions, equations, and inequalities. This included discerning and differentiating between various types of functions, equations, and inequalities, and identifying and utilizing appropriate approaches to solve equations and inequalities of varying complexities within real-world problems. Students were also expected to demonstrate versatility in problem-solving, interpreting solutions within real-world contexts, and tackling complex challenges using calculus methods. The instructor integrated ChatGPT into the course instruction and activities to enhance student learning. In the following section, the findings and analysis of the implementation of ChatGPT, along with supporting evidence and artifacts, are presented.

### **Findings And Analysis**

In this section we provide findings derived from the thematic analysis of journal entries by both the instructor and students. For themes associated with students' journal entries and survey responses, representative quotes are used accordingly. To protect students' identities, pseudo-labeling is used when presenting these representative quotes.

As discussed earlier, the instructor participated in a workshop on how to integrate AI in education. Figure 2 presents an artistic artifact of the instructor’s impressions before the workshop. This is referred to as an “educational concern”. The impressions after the workshop are captioned as “changing the narrative”, emphasizing the instructor’s desire to maximize the benefits of ChatGPT in his instruction.

**Figure 2**  
*Instructor’s Perceptions of ChatGPT Pre and Post-Professional Development Workshop*



The downward arrow in the pre-workshop conceptions of ChatGPT reflects the instructor's concern that ChatGPT could negatively impact teaching practices in mathematics. This apprehension was noted in journal entries during the course.

*I view any new technological advancement as having both merits and limitations. I must admit the current hype and discussion among fellow academics molded my initial thoughts that this AI will change the way we traditionally assess students and it seems that it does all the thinking so what is left for the students. If I ask students to create a diagram explaining a mathematical concept, will they do it or just leave it to ChatGPT which seems more advanced than relying on google etc.?*

The instructor's quote shows a balanced view on technological advancements, like ChatGPT. The instructor recognizes that while it is innovative, such technologies have both pros and cons. Initially swayed by fellow educators' excitement, the instructor believed ChatGPT could be used to revolutionize student assessments in higher education.

The instructor and other participants shared a common concern before the workshop: If AI, like ChatGPT, can effectively handle complex tasks and generate answers, what role is left for students in the learning process? The concerns expressed by the participants in the workshop align with those highlighted in the literature (Perkins, 2023) regarding academic integrity and authentic assessment. This caused apprehensions about students relying too heavily on AI for tasks like creating diagrams to explain mathematical concepts, potentially hindering their active engagement and critical thinking. The instructor's thoughtful consideration highlights the need to balance efficiency with ensuring students are actively involved in learning.

After the workshop, the instructor's perspective on ChatGPT shifted positively, symbolized by the upward trajectory of the arrow. He now sees ChatGPT as a powerful tool for use in enhancing students' understanding of mathematics. He viewed ChatGPT as an essential tool for crafting authentic assessments and fostering self-efficacy and autonomous learning. Using ChatGPT to provide tailored support in mathematics education will enhance student engagement thereby improving conceptual comprehension. Overall, the instructor regards ChatGPT as a transformative tool in education.

In a poignant post-workshop journal entry, the instructor articulated a profound conviction:

*In considering what I learned in this workshop I think ChatGPT, despite the concerns, can be an essential tool in bringing 21<sup>st</sup> century AI tools in my teaching. I can see where it can support my creation of authentic assessments whereby students are engaged with real-world problems that allow them to think critically and apply the mathematics concepts I teach. I can also see ChatGPT's role in helping them generate practice questions that reinforce what we did in class whenever they are studying alone or in groups. I can also see the benefits in enhancing my current lesson plans to incorporate more group discussions and collaborative activities that appeal to their interests. I think all of these benefits will be rewarding in my classes this semester.*

The instructor sees ChatGPT as a valuable tool for modernizing teaching methods. It helps create authentic assessments that engage students with real-world problems, fostering critical thinking and practical application of mathematical concepts. For students, ChatGPT supports independent study by generating practice questions aligned with class material. This encourages students to take ownership of their learning and reinforces classroom concepts through self-directed practice. Additionally, ChatGPT facilitates enhanced lesson planning, promoting engagement and a deeper understanding of the subject matter through group discussions and collaborative activities. Overall, the instructor expects these AI capabilities to enrich their teaching approach in the upcoming semester, demonstrating how AI can enhance traditional teaching methods. The following section demonstrates how the instructor integrated ChatGPT's features into teaching an undergraduate pre-calculus course with 70 students in semester 2, 2023, after completing professional development training in December 2022.

### **Introducing Students to ChatGPT within Higher Educational Context**

The instructor introduced ChatGPT to students in a comprehensive orientation session during the first week of the semester. The session covered the platform's features, account setup, and ethical use. The instructor's emphasis on informing students about ChatGPT's capabilities and limitations reflects the importance of transparency and ethical awareness when integrating AI tools into educational practices. This is consistent with the recommendations of Foltynek et al. (2023), who argue for the development of educational policies that guide the ethical use of AI in academia.

The instructor's live demonstration highlighted ChatGPT's applications beyond mathematics. Students were organized into groups for collaborative exploration, promoting independent study and quiz preparation. During the semester, the instructor administered the Early Informal Evaluation of Teaching (EIEOT) survey to the class to garner students' views on teaching and learning at that stage. This feedback on the instructional practices was generally positive. Below are selected students' quotes on ChatGPT integration as articulated in the EIEOT survey.

**Student A:** *I never realized that I can use ChatGPT to assist me with mathematics. I actually uploaded my notes and asked it to create questions on the notes I had written about Sets and interval notations. This really helped me, and I actually did well on that quiz on this topic the following week.*

Using ChatGPT for academic assistance, especially in mathematics, was a surprising and beneficial experience for this student. Initially unaware of ChatGPT's full potential, the student proactively uploaded the notes and asked ChatGPT to generate questions on Sets and Interval Notations. This assistance significantly contributed to the student's academic success, as he performed well on a subsequent quiz. The student's experience highlights ChatGPT's versatility in creating custom learning materials and practice questions, enhancing their understanding and success in mathematics. Another student reflecting on the EIEOT survey, stated:

**Student B:** *I really enjoy how I used ChatGPT to come up with questions for the question back for our upcoming quizzes on functions. I liked how it was able to tailor the questions in complexity so that you had a range of questions in terms of difficulty. I was pleased that I saw a few of those questions on our practice worksheet. I felt like I contributed to our collective learning.*

The students' feedback highlights their positive experience using ChatGPT to create practice questions for quizzes, particularly on the topic of functions. They appreciate ChatGPT's role in generating quiz questions, noting its value and accessibility in supporting their learning. They find ChatGPT's ability to tailor questions to varying levels of complexity advantageous, allowing them to create a comprehensive set of questions. The student also notes that the questions generated by ChatGPT aligned well with their practice materials, aiding their focus on essential topics.

Additionally, they express a sense of accomplishment and contribution to the learning community through their use of ChatGPT, potentially by sharing these questions with classmates. Overall, the student's experience demonstrates how ChatGPT can enhance personalized learning and preparation for quizzes while fostering collaboration within the academic environment. Another student in their reflection stated the following:

**Student C:** *I think the ChatGPT practice questions are good but I realized that you still need to check the answers cause[because] it could give you an incorrect answer or you needed to push it further to explain why that answer was selected.*

The student finds ChatGPT beneficial for generating tailored practice questions but emphasizes the importance of verifying answers independently. While acknowledging its usefulness, they caution that ChatGPT's responses may lack accuracy or thorough explanations. They suggest improving ChatGPT's explanatory capabilities for a more comprehensive understanding. Overall, the student's perspective highlights ChatGPT's usefulness in question generation but emphasizes the need for caution and suggests enhancements for better educational support.

### **Teaching-facing AI**

In utilizing teaching-facing AI like ChatGPT, instructors can streamline their workload by generating assessments, lesson plans, and activities to monitor student progress (Baker & Smith, 2019). This approach allows for adaptive and personalized pedagogy, as seen in the creation of differentiated instructional plans. By integrating ChatGPT, the instructor transformed the design of formative assessments, gaining valuable insights into student strengths and areas for improvement. An example of such a plan is presented in Appendix B.

Additionally, the instructor used ChatGPT to generate a quiz on interval notation of sets, tailored to real-world applications like banking or online shopping. By leveraging student interests collected at the start of the course, the instructor crafted questions that engaged students and assessed their comprehension. This innovative approach is exemplified in Figure 3, which showcases three questions created by ChatGPT to enhance assessment techniques.

### Figure 3

#### Prompt and Response for ChatGPT generated Quizzes

Create a quiz with 5 multiple choice questions that assess students understanding of interval notation of sets using real-world examples in banking and finance or shopping online

Certainly! Here's a quiz with 5 multiple-choice questions to assess students' understanding of interval notation of sets using real-world examples in banking, finance, or online shopping:

#### Quiz: Interval Notation in Real-World Scenarios

##### Question 1:

You want to buy a smartphone online, and the price range you're willing to consider is between \$300 and \$500. Which interval notation represents this price range?

- A) [300, 500]
- B) (300, 500)
- C) [300, 500)
- D) (300, 500]

##### Question 2:

You are looking for a savings account with an interest rate greater than or equal to 2% but less than 3%. Which interval notation represents this interest rate range?

- A) [2%, 3%]
- B) (2%, 3%)
- C) [2%, 3%)
- D) (2%, 3%]

##### Question 3:

You have a coupon that offers a discount of 20% off your entire purchase. You want to use it when your total purchase amount is at least \$50. Which interval notation represents the purchase amount required to use the coupon?

- A) [50, ∞)
- B) (50, ∞)
- C) (-∞, 50]
- D) (-∞, 50)

### Addressing Students' Misconceptions Through Gamification

During the course delivery, the instructor noticed that some students struggled with quadratic equations and decided to incorporate gamification to make learning more engaging. The goal was to turn mastering quadratic equations into an enjoyable adventure, helping students overcome misconceptions. By combining technology and pedagogy, the classroom became an enthusiastic environment for cultivating mathematical skills. Figures 4, 5, and 6 show examples of the gamification artifacts used by the instructor to assess students' understanding. Figure 6 illustrates the instructor suggesting ways to modify the game's difficulty to accommodate students with different proficiency levels.

ChatGPT proved invaluable in boosting student engagement and assisting the instructor in assessing students' proficiency in solving quadratic equations. ChatGPT also aided in planning lessons and implementing interactive gamification during tutorial sessions, helping monitor student progress in this area throughout the semester. These gamification features align with Sims' (2023) advocacy for incorporating AI in game-based instruction within higher education.

#### Figure 4

##### *Prompt and Response for ChatGPT's Gamification Instructions*

Create a game to test college students knowledge of and applying the quadratic formula

Certainly, here's a fun and interactive game to test college students' knowledge and application of the quadratic formula. Let's call it "Quadratic Quest."

**Objective:** To solve quadratic equations using the quadratic formula while racing against time.

**Materials Needed:**

- Whiteboard or chalkboard
- Markers or chalk
- Stopwatch or timer
- List of quadratic equations

**Gameplay:**

**Figure 5**  
*ChatGPT Gamification Example for Quadratic Equations*

**Gameplay:**

- 1. Setup:**
  - Divide the students into teams of two or more.
  - Draw a large grid on the whiteboard or chalkboard, creating a game board with columns and rows.
  - Label the columns A, B, C, D, etc., and the rows 1, 2, 3, 4, etc.
  - At the top of the board, write "Quadratic Quest."
- 2. Equation Selection:**
  - Prepare a list of quadratic equations of varying difficulty levels. Each equation should be assigned a point value based on its complexity.
- 3. Game Rounds:**
  - Each team takes turns choosing a cell on the game board by calling out a combination of a column letter and a row number (e.g., "B3").
  - The instructor or a designated scorekeeper writes the chosen point value on that cell.
- 4. Solving Equations:**
  - When a team selects a cell, they must solve the quadratic equation associated with that cell's point value within a time limit (e.g., 2 minutes).
  - To earn the points, the team must correctly apply the quadratic formula to find the solutions (real or complex) for  $x$ .
  - If they answer correctly within the time limit, they earn the points, and the cell is marked with their team's color or symbol.
- 5. Scoring:**
  - Keep a tally of each team's points on the board.
- 6. Winning:**
  - The game can be played for a set duration (e.g., 30 minutes) or until all the cells are chosen.
  - The team with the most points at the end wins the Quadratic Quest game.

**Figure 6**  
*ChatGPT Suggested Differentiated Gamification of Quadratic Equations*

**Variations:**

- To make the game more challenging, you can include quadratic equations with coefficients that require factoring before applying the quadratic formula.
- Add "challenge cells" with bonus points for teams who can solve equations mentally or without showing their work.
- Incorporate a final round where teams solve a particularly complex quadratic equation for a large point reward.

This game not only tests students' knowledge of the quadratic formula but also encourages teamwork and quick thinking. It's a dynamic way to reinforce quadratic equation-solving skills in a competitive and engaging manner.

## System-Facing AI and Non-Traditional Authentic Assessments

System-facing AI in higher education institutions plays a crucial role in monitoring and evaluating students' performance patterns. AI prediction models, including early warning systems, recommender systems, tutoring, and learner models, offer valuable capabilities. The instructor found the ability to provide timely feedback and interventions tailored to students at risk particularly beneficial. During the semester, weekly quizzes were introduced in tutorial sessions to offer formative feedback. These quizzes included various question types, such as short response, true or false, multiple-choice, and error analysis questions, to identify weaknesses and enhance conceptual understanding. For error analysis assessments, students were presented with worked solutions or explanations and asked to identify errors, provide reasons for their correctness, and offer correct solutions. This form of authentic assessment allowed students to articulate their opinions, engage in peer reviews, and use their knowledge to assess problem-solving. The ChatGPT output in Figure 7 illustrates an example of an error analysis question related to solving quadratic equations, highlighting students' struggles with efficient factorization in such equations.

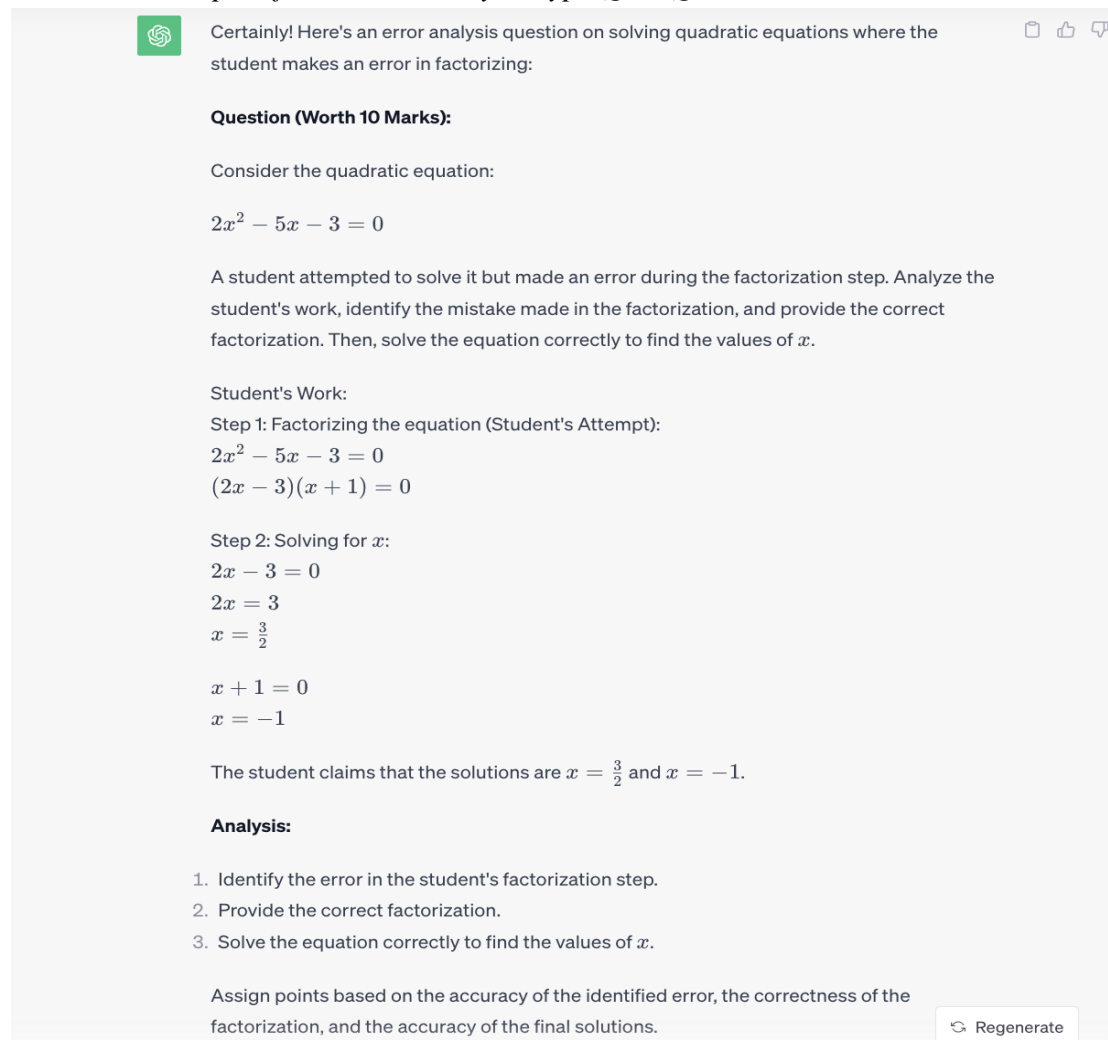
Figure 8 displays the instructor's request for a rubric to grade error analysis questions. Students also shared their views on this assessment format. When asked, "What should your instructor keep doing?" students praised the emphasis on critical thinking, collaborative learning, assessing understanding, and exploring non-traditional assessment methods. The following quote is representative of one student's feedback.

**Student D:** *One thing I want sir to keep doing is those error analysis questions. I found it interesting how you had to be alert and understand the material to be able to point out errors in the proposed solution in the quiz. You also had to push yourself to also come up with the correct answer. I liked this approach especially when sir allowed us to do it as a group and collaborate about identifying the errors and then coming up with the solution*

Student E values error analysis questions as they provide a deeper assessment of their understanding beyond mere problem-solving. They are pleasantly surprised by the group engagement these questions foster, noting the contrast with traditional math classes focused on notetaking. Student E appreciates the non-traditional approach of using error analysis questions, crediting their instructor for the innovative method that encourages discussion and peer learning during assessments.

## Figure 7

### ChatGPT Example of the Error Analysis-type Quiz Question



Certainly! Here's an error analysis question on solving quadratic equations where the student makes an error in factorizing:

**Question (Worth 10 Marks):**

Consider the quadratic equation:

$$2x^2 - 5x - 3 = 0$$

A student attempted to solve it but made an error during the factorization step. Analyze the student's work, identify the mistake made in the factorization, and provide the correct factorization. Then, solve the equation correctly to find the values of  $x$ .

Student's Work:

Step 1: Factorizing the equation (Student's Attempt):

$$2x^2 - 5x - 3 = 0$$
$$(2x - 3)(x + 1) = 0$$

Step 2: Solving for  $x$ :

$$2x - 3 = 0$$
$$2x = 3$$
$$x = \frac{3}{2}$$
$$x + 1 = 0$$
$$x = -1$$

The student claims that the solutions are  $x = \frac{3}{2}$  and  $x = -1$ .

**Analysis:**

1. Identify the error in the student's factorization step.
2. Provide the correct factorization.
3. Solve the equation correctly to find the values of  $x$ .

Assign points based on the accuracy of the identified error, the correctness of the factorization, and the accuracy of the final solutions.

Regenerate

Student D values error analysis questions for their engagement and challenging nature, requiring attentiveness and a deep understanding of the subject. They appreciate the critical thinking and problem-solving skills these questions develop. Collaborative learning in error analysis questions enhances their comprehension as they discuss errors and solutions with peers, collectively improving their understanding.

Another student in their reflection on the error analysis type questions stated:

**Student E:** *I think we should get more analysis of error type questions since it really assessed our understanding of the content and also had everyone in their groups talking this was strange for me in a mathematics class. I always thought you would be just copying notes and listening to the instructor. I never thought we would be discussing and*

*learning from each other during a quiz. This is a different non-traditional way of assessing us kudos to sir!*

**Figure 8**

*ChatGPT Generated Rubric Guidelines for An Error Analysis Quiz*

Certainly, here's a revised grading rubric for the Error Analysis Question on Solving Quadratic Equations with a total of 10 marks:

Criteria	Excellent (4)	Proficient (3)	Basic (2)	Limited (1)	Incomplete (0)
<b>Identification of Errors</b>	Accurately identifies and clearly explains all errors made in the provided work, including the specific step where the error occurred.	Correctly identifies most errors made in the provided work and explains them clearly, but may miss one minor error.	Identifies some errors in the provided work but misses important errors or does not explain them clearly.	Identifies only a few errors in the provided work and does not explain them clearly.	Does not identify any errors or provides incomplete explanations.
<b>Correction of Errors</b>	Provides the correct solutions for all identified errors and explains them accurately.	Provides the correct solutions for most identified errors and explains them accurately, with minor errors in explanations.	Provides correct solutions for some identified errors but makes significant errors in explanations or misses corrections for some errors.	Provides incorrect solutions for most identified errors and explanations do not align with correct solutions.	Does not attempt to provide core solutions for identified errors
<b>Clarity of Explanation</b>	Explanations for identified errors and corrections are exceptionally clear, well-organized, and easy to follow.	Explanations for identified errors and corrections are clear and mostly well-organized but may have minor clarity issues.	Explanations for identified errors and corrections are somewhat clear but lack organization and may be difficult to follow in places.	Explanations for identified errors and corrections are unclear and disorganized, making it challenging to understand the thought process.	Explanations for identified errors and corrections are absent or incomprehensible

**Total Points: (10 possible)**

- \* Excellent (9-10 points)
- \* Proficient (7-8 points)
- \* Basic (5-6 points)
- \* Limited (3-4 points)
- \* Incomplete (0-2 points)

Overall, students found error analysis questions intellectually stimulating, encouraging active engagement, critical thinking, and collaboration. They appreciated the opportunity that ChatGPT offers to identify and correct errors together, enhancing their understanding. Students commended ChatGPT for generating error analysis, noting its ability to gauge understanding, fostering group discussions, and challenge traditional classroom dynamics, leading to a more engaging and beneficial learning experience. The benefits of using error analysis in student learning align with Glovňová's (2019) assertion that error-analysis-based assessments enhance critical thinking skills in mathematics while also creating engaging learning experiences for students.

### **The Three Mathematical Context for Using ChatGPT**

In our theoretical framing we considered the three aspects of AI in Higher Education, namely student-facing, teacher-facing, and system-facing. Table 2 presents the roles of ChatGPT which is aligned to Baker and Smith (2019) three educational contexts and the documented instructors' use during the teaching of mathematics at a higher-education institution.

**Table 2**  
*Three Mathematics Educational Context for ChatGPT*

<b>Role in Mathematics Education</b>	<b>Category</b>	<b>Description</b>
Assisting with Authentic Assessments	Teacher-Facing	ChatGPT can help design and grade authentic assessments that evaluate students' real-world problem-solving abilities. It can generate complex math problems, assess student responses, and provide immediate feedback. This ensures that assessments align with real-life scenarios and promote deeper understanding.
Boosting Student Self-Efficacy	Student-Facing	By offering instant explanations and solutions to mathematical problems, ChatGPT can boost students' self-efficacy. When students receive timely and accurate assistance, they gain confidence in their problem-solving skills, which can motivate them to tackle more challenging math concepts.
Supporting Independent Study	Student-Facing	ChatGPT serves as a valuable resource for students engaged in independent study. It can provide explanations, examples, and step-by-step guidance for math topics, empowering students to explore and learn at their own pace. This fosters self-directed learning and autonomy.
Enhancing Conceptual Understanding	Student-Facing	ChatGPT can clarify complex mathematical concepts through plain language explanations and visual aids. It helps students build a strong foundation by providing additional insights and alternative approaches to problem-solving, thereby promoting a deeper understanding of mathematical principles.
Fostering Engagement	Student-Facing	ChatGPT can engage students through interactive conversations and gamification of math problems. It can turn learning into an enjoyable experience by presenting math

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		challenges in an engaging and interactive manner, keeping students motivated and focused.
Customizing Learning	System-Facing	ChatGPT can tailor its responses to individual student needs, adapting to their skill level and learning pace. This personalized approach ensures that students receive the appropriate level of support, challenging them without overwhelming them.
Improving Metacognition	Student-Facing	ChatGPT can encourage students to think critically about their problem-solving strategies by asking them to explain their thought process. This metacognitive reflection can enhance their understanding and problem-solving skills.
Providing Accessibility	Student-Facing	ChatGPT offers accessibility features, such as text-to-speech and translations, which can help students with diverse learning needs and linguistic backgrounds access and engage with mathematical content more effectively.

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The table illustrates ChatGPT's impact on mathematics education. In the teacher-facing category, it assists in designing and grading authentic assessments, enhancing the practical relevance of evaluations. For students, ChatGPT boosts self-efficacy by providing instant explanations, supports independent study with step-by-step guidance, and enhances conceptual understanding with clear explanations and visual aids. It also fosters engagement through interactive conversations and gamification. In the system-facing category, ChatGPT customizes learning experiences by tailoring responses to individual needs, improving metacognition by encouraging explanation of problem-solving strategies, and providing accessibility features for diverse learners. This case study supports Baker (2023) argument that education rather than punitive measures is crucial in fostering academic integrity. While there are diverse perspectives on the use of ChatGPT as noted in Tauginiene et al. (2018), the study forms the basis for further studies on how ChatGPT can be used in academia in an ethical fashion and supports authentic assessment and critical thinking.

### ***Shifting Perceptions of AI in Teaching***

In alignment with Ouyang et al. (2022) and Rudolph et al. (2023), who emphasized the potential of AI tools to enhance learning experiences, this study reveals how the instructor's apprehension towards ChatGPT evolved. Initial concerns mirrored widespread fears within HE, as articulated by QAA (2023), about AI's ability to depersonalize education and diminish active student participation. However, as the instructor engaged more deeply with ChatGPT, its capacity to foster student-centered learning and critical thinking became apparent. This shift underscores the

importance of balanced, informed perspectives on AI integration in education, aligning with the framework proposed by du Boulay (2016), which emphasizes the potential of AI to enhance both teaching and learning when thoughtfully applied.

### ***Enhancing Personalized Learning***

The study's findings align with Baker and Smith's (2019) concept of student-facing AI. ChatGPT's ability to generate personalized practice questions for mathematics students illustrates its role in creating adaptive learning environments. By enabling students to tailor their practice to individual needs, ChatGPT mirrors the principles of intelligent tutoring systems (ITS), which aim to provide real-time, personalized feedback (Tan, 2020). This reinforces Ouyang et al.'s (2022) findings that AI-driven instruction can improve student engagement and performance by adapting to diverse learning styles and abilities.

### ***Teacher-Facing AI and Workload Reduction***

Teacher-facing AI, as discussed in Baker and Smith's (2019) framework, also plays a pivotal role in enhancing educators' capacities. The study demonstrates how ChatGPT facilitated the creation of authentic assessments and interactive lesson plans, reducing the instructor's workload and allowing for more innovative teaching strategies. This aligns with the argument made by UNESCO-IESALC (2023) that AI can drive efficiencies in higher education while also improving instructional quality. By using ChatGPT to gamify the teaching of quadratic equations, the instructor was able to make the learning experience more engaging and accessible to students of varying proficiencies, supporting the findings of Sims (2023), who advocated for AI's role in rethinking traditional educational practices.

### ***Versatility and Collaboration***

While the study primarily focused on mathematics instruction, the findings suggest that ChatGPT's potential extends across a variety of disciplines, reinforcing UNESCO's (2023) assertion that AI can transform both academic and administrative functions in HE. The ability of ChatGPT to facilitate collaborative learning, as students worked together to create and share practice materials, highlights its role in fostering a more interactive and engaged academic community. This aligns with QAA's (2023) call for AI to be integrated into teaching and assessment practices that promote collaboration and engagement.

### ***Continuous Improvement and Future Directions***

Finally, the study identifies areas for continuous improvement, particularly in ensuring that students verify the accuracy of ChatGPT's responses and seek to deepen their understanding of the explanations provided. This ongoing refinement is necessary to enhance the effectiveness of AI tools in educational settings, aligning with Tan's (2020) call for rigorous oversight and continuous development in AI technology to mitigate potential biases and inaccuracies. The need

for improvement also echoes QAA's (2023) recommendations for a reevaluation of assessment strategies in light of AI's growing influence in education.

### **Conclusion**

The documented quotes and artifacts in the study's findings suggest that ChatGPT can emerge as a multifaceted educational tool, transcending the traditional boundaries of higher-education instruction. For example, its capacity to captivate and engage students extends beyond the realm of interactive conversations and delves into the realm of gamification, transforming the learning experience of students. By artfully presenting mathematical challenges in an interactive manner, ChatGPT afforded student engagement, motivation, and opportunities for honing conceptual understanding. Beyond its role in enhancing student engagement, ChatGPT also proves to be an asset in the domain of personalized learning. ChatGPT seamlessly intertwines with the instructional landscape, empowering educators to craft differentiated lesson plans that guide students on their individual learning trajectories. This adaptive and personalized approach, fostered by ChatGPT, not only supports students' self-efficacy but also amplifies its utility as a teaching-facing AI application. In essence, ChatGPT emerges as an indispensable partner in the dynamic and ever-evolving landscape of modern higher education.

The findings presented in this study provide a comprehensive look into the instructor's journey of integrating ChatGPT, an AI-driven chatbot, into higher education, particularly in the context of mathematics instruction. The study highlights the instructor's evolving perceptions and experiences, as well as the impact of ChatGPT on both teaching-facing and student-facing aspects of education. Furthermore, this study serves as an excellent demonstration of the effective utilization of ChatGPT, adhering closely to the guidelines outlined in the UK QAA. The instructor took the initiative to empower himself through training prior to introducing ChatGPT to students. A relevant recommendation would be for the institution to provide tailored training in ChatGPT to faculty and staff interested in integrating this tool into their teaching methods and functions. Quality Assurance guidelines on AI underscore the importance of engaging and empowering students in the use of AI (QAA, 2023). This was demonstrated in the study. As a second step, the instructor also engaged students through comprehensive orientation. The QAA contends that employers will not only anticipate, but also highly value graduates who are familiar with Generative AI when they enter the workforce. This stride aligns well with one of the defining attributes of The UWI's ideal graduate, which is being well-versed in information technology (IT) and should serve them well as they embark on their professional journey.

The study also met the Academic Integrity standard, a major concern for HEIs. Using the teacher-facing method, he was able to use ChatGPT to assist with providing authentic assessments for the students. Authentic assessment is, indeed, considered to be one of the ways of mitigating the challenges of academic integrity. While authentic assessment serves as a valuable tool in bolstering academic integrity, it is important to emphasize the significance of a wholistic approach. The need

for comprehensive measures that encompass clear policies, guidelines, and educational initiatives on academic integrity cannot be overstated. This multifaceted approach can help institutions maintain academic integrity while fostering meaningful learning experiences for students. In this regard, The UWI stands at the vanguard of this proactive movement in the region. Monitoring and evaluation hold significant importance, and as such, the system-facing component of ChatGPT should be integrated into The UWI Quality Management Framework (Plan-Do-Check-Act) to facilitate ongoing quality enhancement efforts. Importantly, also, the region's Accreditation Agencies must promptly catch up with the latest developments in AI and partner with HEIs to establish guidelines and standards for the implementation of ChatGPT and AI technology, generally.

Overall, ChatGPT's versatility and adaptability make it a valuable asset in modern mathematics education, benefiting both teachers and students across various aspects of the learning process. Additionally, the findings presented in this study indicate that ChatGPT has the potential to transform higher education by enhancing both student-facing and teacher-facing aspects. It can empower students in their learning journey, streamline instructional tasks for instructors, and foster engagement and collaboration within the classroom. However, ethical considerations and the need for continuous improvement should remain at the forefront of AI integration in education. This study serves as a valuable starting point for further exploration of AI's role in education and its impact on teaching and learning.

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## Appendix A

### Early Informal Evaluation of Teaching Survey

Course Code \_\_\_\_\_

Course Title \_\_\_\_\_

Instructor: \_\_\_\_\_ SEMESTER \_\_\_\_\_

- |                                                             |                            |                            |                            |                            |                            |        |
|-------------------------------------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|--------|
| 1. The instructor is well prepared.                         | always                     |                            |                            |                            |                            | rarely |
|                                                             | 5 <input type="checkbox"/> | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> |        |
| 2. The instructor makes good use of examples.               | always                     |                            |                            |                            |                            |        |
| rarely                                                      |                            |                            |                            |                            |                            |        |
|                                                             | 5 <input type="checkbox"/> | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> |        |
| 3. The instructor uses the technological tools effectively. | always                     |                            |                            |                            |                            |        |
| rarely                                                      |                            |                            |                            |                            |                            |        |
|                                                             | 5 <input type="checkbox"/> | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> |        |

4. The instructional videos (lecture recordings etc are very helpful. rarely always  
5  4  3  2  1
5. The instructor shows concern for student learning. always rarely  
5  4  3  2  1
6. The pace of the course is: too fast too slow  
5  4  3  2  1
7. The course content is: difficult easy  
5  4  3  2  1
8. How often do you use the course management/communication system (CANVAS, Piazza,)?  
always rarely  
5  4  3  2  1

To help your learning in this class, what should the instructor start doing?

To help your learning in this class, what should the instructor stop doing?

To help your learning in this class, what should the instructor keep doing?

## Appendix B

### ChatGPT Differentiated Lesson Plan on Arithmetic and Geometric Progression

**Prompt:** Create a differentiated lesson plan for a precalculus class on Arithmetic Progression Geometric Progressions for a pre-calculus college class. Use three tiers

#### ChatGPT Output: Lesson Plan: Arithmetic Progressions and Geometric Progressions

**Grade Level:** College Pre-calculus

**Duration:** 3 class periods (50 minutes each)

**Objective:** Students will be able to distinguish between arithmetic and geometric progressions, identify their common differences or ratios, and solve problems involving both types of sequences.

**Tier 1: Introduction to Sequences (1st Class Period)**

- **Objective:** To introduce students to the concept of sequences and familiarize them with arithmetic progressions (AP) and geometric progressions (GP).
- **Engagement (10 minutes):** Start with a real-world scenario, such as counting money over time, to illustrate the concept of a sequence. Discuss how this relates to topics covered in previous classes.
- **Exploration (20 minutes):** Teach students the basic definition of a sequence. Define arithmetic progression (AP) and geometric progression (GP). Provide examples of each type and discuss their differences. Highlight the importance of common differences (AP) and common ratios (GP).
- **Guided Practice (15 minutes):** Work through a few examples together as a class, both in terms of identifying sequences as AP or GP and determining common differences or ratios. Encourage active participation.
- **Independent Practice (5 minutes):** Assign simple problems to students to practice distinguishing between AP and GP and finding common differences or ratios.

#### **Tier 2: Arithmetic Progressions (2nd Class Period)**

- **Objective:** To delve deeper into arithmetic progressions, focusing on finding  $n$ th terms and the sum of terms in an AP.
- **Engagement (10 minutes):** Start with a real-life application of arithmetic progressions, like calculating monthly savings in a bank account, to pique students' interest.
- **Exploration (20 minutes):** Explain how to find the  $n$ th term of an arithmetic progression using the formula. Discuss the sum of the first  $n$  terms in an AP. Present examples illustrating these concepts.
- **Guided Practice (15 minutes):** Work through problems as a class to find  $n$ th terms and the sum of terms in an AP. Encourage students to ask questions and seek clarification when needed.
- **Independent Practice (5 minutes):** Assign practice problems related to arithmetic progressions. Include a mix of finding  $n$ th terms and sum of terms.

#### **Tier 3: Geometric Progressions (3rd Class Period)**

- **Objective:** To explore geometric progressions in-depth, focusing on finding  $n$ th terms, the sum of terms, and infinite sums in a GP.
- **Engagement (10 minutes):** Begin with a real-world scenario involving geometric progressions, such as the growth of a population over generations.
- **Exploration (20 minutes):** Introduce the concept of finding the  $n$ th term of a geometric progression using the formula. Discuss how to find the sum of the first  $n$  terms in a GP and infinite sums. Provide examples to illustrate these concepts.
- **Guided Practice (15 minutes):** Work through problems as a class to find  $n$ th terms, the sum of terms, and infinite sums in a GP. Address any questions or concerns that arise.

- **Independent Practice (5 minutes):** Assign practice problems related to geometric progressions, including finding  $n$ th terms, sum of terms, and infinite sums.

**Assessment:**

For assessment, assign homework problems that require students to distinguish between arithmetic and geometric progressions, find  $n$ th terms, sum of terms, and infinite sums for both types of sequences. Evaluate their understanding through a quiz or exam at the end of the unit.

**Extension Activities:**

For students who excel in the material, provide challenging problems that require them to analyze real-world situations using arithmetic and geometric progressions. Additionally, discuss applications in finance, physics, and other fields where these progressions are commonly used.

**Differentiation:**

Tiered instruction allows students to work at their own pace and level of understanding. For additional support, offer one-on-one or small group sessions. For advanced students, provide extra resources and problems that go beyond the basic curriculum

## **An explanatory study on the implementation of a blended learning approach to teaching and learning at the Hugh Wooding Law School**

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### **Abstract**

In 2020, the COVID-19 pandemic necessitated that higher education institutions rapidly implement emergency systems, policies, procedures and technological infrastructure to transition to an online teaching and learning environment. Many institutions are contemplating which systems and infrastructure to retain post-pandemic after experiencing the benefits of online and blended learning (BL). This paper uses an explanatory sequential mixed methodology to examine the Hugh Wooding Law School's (HWLS) decision to implement a BL modality for the Academic Year 2022/2023. The study analyses secondary data from student and staff surveys, collects primary data by interviewing internal stakeholders, and assesses the findings against the Complex Adaptive Blended Learning System framework. The findings indicate that students and tutors were satisfied with the BL modality. It offers flexibility and convenience, promotes conducive learning environments, and provides a platform for learner support. The study concludes that to fully establish BL at the HWLS, more instructional, technological, and institutional support is required.

*Keywords:* blended learning, explanatory sequential mixed methodology, complex adaptive blended learning systems

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## Introduction

In 2020, the abrupt nature of the COVID-19 pandemic necessitated that higher education institutions (HEIs), including the Hugh Wooding Law School (HWLS), rapidly implement emergency systems to transition their regular face-to-face operations towards an online environment. This transition required the development of policies and procedures for online teaching and assessment, aligning components of the courses to online delivery, acquiring new technology, retraining faculty and supporting learners.

The HWLS, administered by the Council of Legal Education, is one of three law schools responsible for practical legal training in the Commonwealth Caribbean, leading to the Legal Education Certificate (LEC), a requirement for admission to practise law. Traditionally, the HWLS delivered its programmes face-to-face, but the pandemic necessitated a two-year shift to online learning. In 2022, with the relaxation of health restrictions and the re-opening of institutions to conduct face-to-face classes, the national regulatory body advised institutions to revert to regular operations. However, having experienced the online modality, several institutions, including the HWLS, began contemplating which systems and infrastructure to retain while maintaining a high-quality standard for teaching and learning in the post-pandemic era. Therefore, to maximise infrastructure use, retain the student population and reduce infection risk, the HWLS adopted a blended rotational approach to delivering teaching and learning for the Academic Year (AY) 2022/2023, alternating between weekly online and face-to-face sessions.

This paper examines the rationale for adopting the blended learning (BL) approach and its usefulness in delivering teaching and learning at the HWLS. The research questions guiding the study are: (1) What are the levels of satisfaction with BL among students and tutors at the HWLS? (2) How do students and tutors describe their experiences with BL, with a focus on the impact on engagement and teaching effectiveness? (3) How do the qualitative insights from interviews with students and tutors explain the quantitative findings on satisfaction levels with BL at the HWLS?

An explanatory sequential mixed design is used, which includes two phases. In the study's first phase, quantitative data from students and faculty on their experience with BL will be used to identify the strengths and limitations. The second phase will follow up on the quantitative findings by conducting interviews on students' and tutors' experiences. This phase will explain the rationale for adopting the BL approach.

The literature reviewed led researchers to the Complex Adaptive Blended Learning System (CABLS) framework developed by Wang et al. (2015). The researchers selected this framework due to its adaptability, interconnectivity, and presence in several CABLS elements within the HWLS's BL system. The results of the data analysis were used to assess the existing BL system by evaluating the six sub-systems: learners, teachers, technology, content, learning support and the institution. The paper examines the rationale for the BL approach, potential benefits, lessons learned, and drawbacks.

## **Literature Review**

This section discusses insights gathered from the literature surrounding various themes related to BL. These themes include defining blended learning, transitioning to blended learning, the benefits and challenges, and blended learning models.

### **Blended Learning Defined**

Post-pandemic, many HEIs implemented BL to slowly transition back to face-to-face teaching (Cobo-Rendón et al., 2022). BL is quite varied in terms of definitions, with one of the most frequently cited being Garrison and Kanuka (2004), who describes it as "the thoughtful integration of classroom face-to-face learning experiences with online learning experiences" (p. 96). Graham (2006) also stated, "The BL systems combine face-to-face instruction with computer-mediated instruction" (p. 5). Therefore, for this study, the HWLS defines BL as:

An instructional methodology that utilises technology to integrate traditional face-to-face classroom instruction with online learning components to create a flexible educational experience for students and teachers while maintaining the quality standards of traditional pedagogy.

### **Transitioning to Blended Learning**

The COVID-19 pandemic necessitated that many HEIs adopt online learning and BL strategies, particularly in developing countries like those in the Caribbean (Cobo-Rendon, et al., 2022; Nikiforova, 2021; Bleeker & Crowder, 2022). It resulted in quite possibly the most significant reactive change in higher education, forcing institutions that had not even considered before transitioning from face-to-face teaching to fully online platforms. This abrupt shift came with many challenges, as Roach (2022) noted in a study of Caribbean students. The author identified

issues such as internet connectivity, loss of social interaction, computer vision syndrome, shortage of educational materials, and the uncertainty and inexperience of operating online education.

Online and BL teaching methods are not entirely uncharted territory in a Caribbean context. Thurab-Nkosi (2018) noted that between 2005 and 2011, the University of the West Indies, St Augustine Campus, engaged in semi-autonomous BL projects and online courses. It was further noted that early BL adoption in the Caribbean focused more on technical, pedagogical design, and faculty development (Kistow, 2011).

Nikiforova (2021) posits that the shift to BL will likely continue as an ongoing practice. Several scholars contend that BL is an applicable post-pandemic educational model incorporating lessons learned during the pandemic (Cobo-Rendon et al., 2022). Moreover, BL can be an effective strategy for HEIs in the post-pandemic era, as it allows institutions to adapt to changing circumstances while providing flexibility, access, and cost-effectiveness (Bin Dahmash, 2020).

Several studies discussing BL adoption came from pre-pandemic years. While current scholars advocate for BL as a viable post-pandemic practice, literature that explores how BL impacts the overall quality of teaching and learning is scarce, particularly in the Caribbean. This explanatory paper at the HWLS can provide insight and contribute to the broader academic pool of Caribbean BL resources.

### **Benefits of Blended Learning**

Studies have shown several benefits to BL. For instance, Graham, Allan and Ure (2003, 2005), as cited by Graham (2006), put forward that three main benefits of choosing BL are improved pedagogy, increased access and flexibility and increased cost-effectiveness. The improvement in pedagogy has been reflected in the findings of multiple studies. For instance, Collis (2003), Graham (2006), Morgan (2002), and Smelser (2002, as cited by Acree et al., 2017) have demonstrated that BL can improve pedagogy through the use of student-centred strategies, increased active learning and the expansion of peer activities.

Next, flexibility is frequently cited across multiple papers as a benefit of BL. This learning mode allows for flexibility and interactivity in the learning process (Thurab-Nkhosi, 2018; Kistow, 2011; Bin Dahmash, 2020; Nikolopoulou & Zacharis, 2023). The flexibility can expand learning opportunities for students (Boisselle, 2014) by increasing accessibility to higher education between developed and developing countries. Further, BL provides increased convenience, improved self-regulated/directed learning, and access to a broader range of learning resources for students (Nikolopoulou & Zacharis, 2023).

Lastly, BL can result in lower overall withdrawal rates than fully online or face-to-face courses, making it more competitive as a revenue earner for institutions (Dziuban et al., 2018). BL can also

address equitable access and success challenges, offer innovative educational solutions and enhance the overall educational experience (Dziuban et al., 2018; Atef & Medhat, 2015). Moreover, BL can “potentially reduce costs to higher education institutions” (Thurab-Nkhosi, 2018, p 144). For example, institutions may experience cost reductions in printing learning material (Atef & Medhat, 2015).

### **Challenges of Blended Learning**

BL is not without its challenges. Cobo-Rendon et al. (2022) identified four main challenges from a design perspective. The first is incorporating flexibility; while BL can increase student flexibility, consideration must be made on integrating flexibility and what amount is desired. Secondly, there is the challenge of facilitating interaction. Moore (1993), cited by Cobo-Rendon et al. (2022), discusses the correlation between transactional distances in online classes and reduced social interaction. The literature revealed that students sometimes feel social isolation and imbalanced participation in the online aspect (Bin Dahmash, 2020). A BL system should be designed to stimulate interactions in both face-to-face and online modalities.

Third, there is the challenge of facilitating students’ learning processes. As a direct result of increased student flexibility and independence, self-regulation becomes an issue. The research has shown that while this environment benefits students with high self-regulation skills, it is detrimental to those who struggle (Owston et al., 2013; Tsai & Shen, 2009, as cited by Cobo-Rendon et al., 2022). It is then imperative that any BL design provides a means of facilitating students’ learning processes. The final challenge arises from social isolation, leading to lower student motivation, poor engagement and increased drop-out rates (Nikolopoulou & Zacharis, 2023). The BL system should foster a climate that promotes positive emotions and attitudes toward the course and learning experience.

Many technical challenges were also raised, such as lack of or inadequate provision of technical support, device compatibility issues, instructor incompetence in using digital platforms and internet connectivity issues (Kistow, 2011; Bin Dahmash, 2020; Cobo-Rendon et al., 2022). In developing countries, there are concerns about limited or slow internet access, frequent electricity outages, and browsing difficulties (Atef & Medhat, 2015). Furthermore, with online or blended platforms, there is a need for constant support and training for faculty and students (Pannan & Legge, 2016; Medina, 2018). These technological challenges sometimes result in higher costs to support these platforms and produce specialised digital content.

### **Blended Learning Models**

The review of the existing literature showed the importance of the BL system design. Many benefits can only be leveraged if specific considerations are made during the design phase. Institutions can be guided in their design using several existing BL models, depending on their resources, expertise and technological infrastructure. Guzer and Caner (2014) identified three BL models, citing

Osguthorpe and Graham (2003). The first allows the same students to experience both face-to-face and online components, the second blends face-to-face students with online students synchronously, and the third proposes that face-to-face students learn from external instructors via an online learning environment.

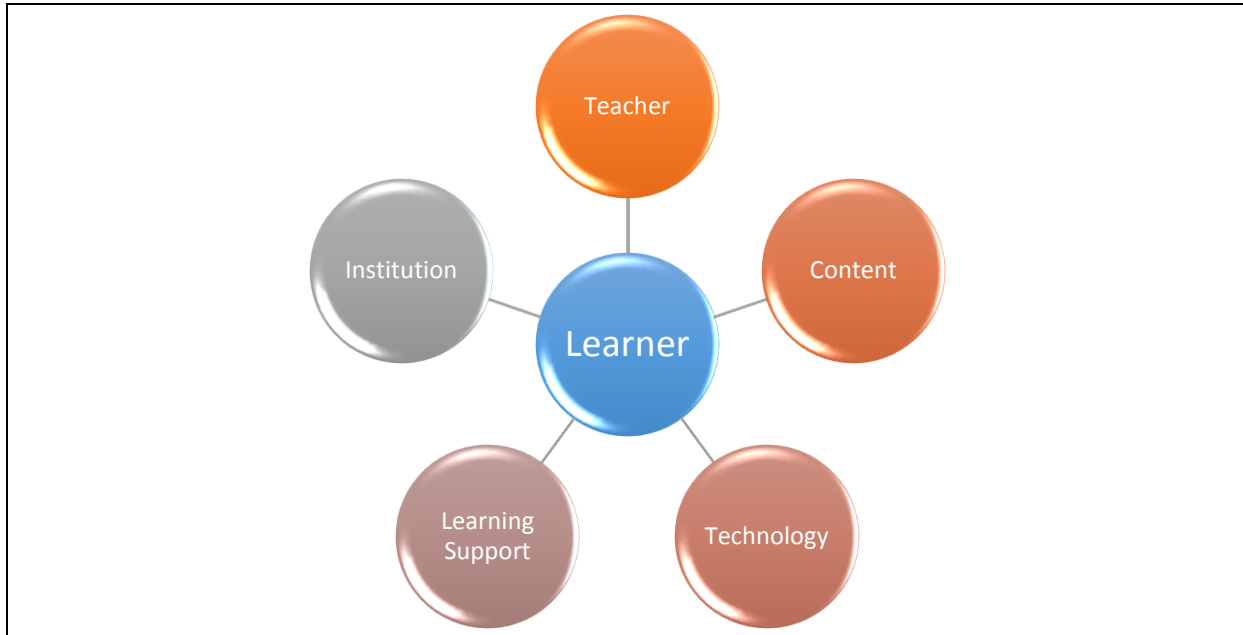
Moreover, Christensen, Horn and Staker (2013) and eDynamic Learning (2019) classified the various implementations into four primary models - Rotation, Flex, A la Carte and Enriched Virtual models. In the Rotation model, students alternate between learning modes, usually online and face-to-face, and often via a schedule. The Rotation model is then further separated into four sub-models: (a) The Station Rotation model, where students alternate between face-to-face and online. (b) The Lab Rotation model is where students have a classroom session and then go to a lab for practical work. (c) The Flipped Classroom model is where activities typically done in a physical classroom are now done online at home and vice versa. (d) The Individual Rotation model is unique because students can choose the modality, they would like their course or courses delivered.

The blended approach adopted by the HWLS is where students experienced both components, as Guzer and Caner (2004) outlined. The approach best fits the Station Rotation model, as online and face-to-face classes are scheduled to alternate weekly.

One criticism of BL models noted by Pannan and Legge (2016) was the lack of pedagogical focus within the models and definitions. They argue that an ample focus on pedagogy when designing a BL system is critical to the “quality of the learning experience” (p. 488). Their solution was to propose combining two models, a four-phase BL model and a two-layer BL model design. Together, these promote a student-centred BL design.

In a review of existing BL models and frameworks, Wang et al. (2015) found that they focused largely on specific elements of BL while lacking any emphasis on the dynamic relationships between these elements. The researchers proposed a complex adaptive systems theory for conceptualising BL, resulting in the CABLS. A complex adaptive system is any system comprised of interactive components that adapt and evolve in response to environmental stimuli, such as change and feedback. Thus, the CABLS provides a six-dimensional framework that interacts dynamically and non-linearly with each other. The six sub-systems are the learner, teacher, technology, content, learning support and institution (Figure 1). As with the Pannan and Legge (2016) model, the CABLS emphasises learning support as an essential component, with the learner at the model’s centre.

**Figure 1**  
*Complex Adaptive Blended Learning Systems*



According to the studies (Wang et al., 2015; Cleveland-Innes & Wilton, 2018; Ntim et al., 2021), the learner sub-system comprises not only the learners engaged in the system but also how their roles adapt and change as they interact with the elements of the system. This leads to them becoming more active participants in their learning processes. The teacher sub-system centres on instructors' roles, how they adapt pedagogies to the BL environment and how they co-evolve and grow with the other sub-systems.

The literature suggests that teachers in a BL system evolve into other roles, such as e-moderators, facilitators and mentors. The content sub-system involves creating, delivering and managing educational content and resources in the BL environment. The interaction between this sub-system and the others significantly impacts the selection and utilisation of content. The technology support sub-system is not only the technological infrastructure but also specific technology used for learner support, which means accessing and utilising content and communication tools for collaboration.

The learning support sub-system includes troubleshooting, academic and administrative support systems and access to materials and resources that enable learners to cultivate efficient learning strategies (Wang et al., 2015; Cleveland-Innes & Wilton, 2018). Finally, the institution sub-system encompasses institutional strategies, policies, support, and alignment with long-term educational objectives. This sub-system causes the institution to be “a major driving force behind the development of the sub-systems around it” (Ntim et al., 2021, p. 54).

## **Methodology**

This explanatory sequential mixed methodology study aimed to investigate how the HWLS implemented the BL approach to teaching using existing quantitative survey data and conducting interviews with stakeholders who participated in this approach during the AY 2022-2023. The ‘follow-up explanation variant’ was employed in this study as it “places priority on the initial quantitative phase and uses the subsequent qualitative phase to help explain the quantitative phase” (Creswell & Plano Clark, 2018, p. 82).

The primary intent of this design was to use qualitative results to explain the initial quantitative findings (Creswell & Plano Clark, 2018). As depicted in Figure 2, the two-phase design began with analysing three institutional research surveys with students and faculty (quantitative data), followed by conducting interviews (qualitative data).

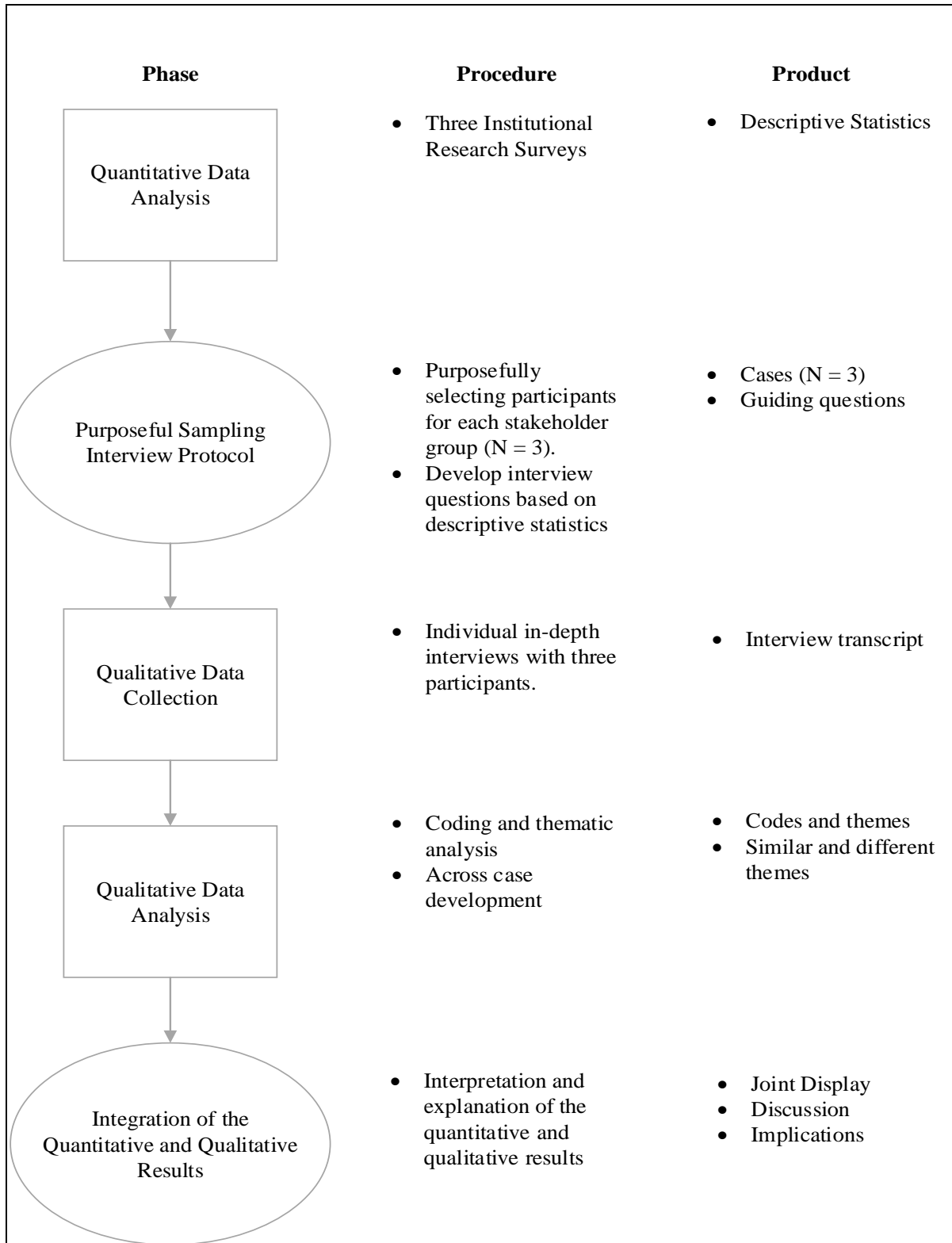
### **Quantitative Phase**

Three recent institutional research (IR) reports were analysed in the quantitative phase of this study. These reports include the Students’ Experiences with BL for AY 2022-2023 (IR Report One (Hugh Wooding Law School [HWLS], 2022)), Year One Student Satisfaction Survey AY 2022-2023 (IR Report Two (Hugh Wooding Law School [HWLS], 2023a)) and Tutors’ Experiences with Blended Teaching and Learning for AY 2022-2023 (IR Report Three (Hugh Wooding Law School [HWLS], 2023b)).

Firstly, the IR Report One sought to obtain feedback from first and second-year students on their satisfaction with the BL approach to teaching and learning during Term One, AY 2022-2023 (HWLS, 2022). This survey was distributed to 476 students in December 2022, and 231 participants responded, giving a response rate of 49%. For this sample size, at a 95% confidence level, the margin of error was 5%. Areas examined in this survey were students’ general information, overall satisfaction, and preferred teaching and learning modes.

Secondly, IR Report Two aimed to gather feedback from first-year students on the programme’s quality and services provided at the HWLS during AY 2022-2023 (HWLS, 2023a). In August 2023, the survey was distributed to 246 students, and 82 participants responded, resulting in a response rate of 33%. The margin of error was 7% at a 90% confidence level. Among other areas, the survey captured students’ experiences with in-person and online (BL) teaching and learning. Lastly, the IR Report Three sought tutors’ feedback on their experiences with the BL approach used during the AY 2022-2023 (HWLS, 2023b). The survey was distributed during July and August 2023 to 81 tutors consisting of Course Directors, Associate Course Directors, Associate Tutors, and Legal Aid Tutors of the HWLS. Forty-two responses were collected, giving a response rate of 51%. This survey collected data on the following areas: general information, information

**Figure 2**  
*Visual Display of Explanatory Sequential Design Procedure*



Note. Adapted from Creswell and Plano Clark (2018)

and communication technology, teaching and learning experiences, positive experiences, challenges with BL to teaching and learning, suggested training opportunities, and additional support required to improve the teaching and learning delivery.

The measurement scales were at the interval ratio scales. The categories for the interval ratio scales were: “Strongly disagree” (SD), “Disagree (D), “Agree” (A), and “Strongly agree” (SA). The Survey Monkey platform distributed and computed the frequencies and descriptive statistics for the abovementioned surveys.

### **Qualitative Phase**

The qualitative phase of this study enabled the researchers to follow up on selected quantitative findings on tutors’ and students’ satisfaction and experiences. This phase allowed the researchers to investigate and explain the BL approach’s rationale, benefits and limitations. Semi-structured interviews were conducted to collect the qualitative data.

Purposeful sampling was used to identify participants from the student and tutor populations. In this sampling methodology, the researchers decide on the participants’ purpose and then identify persons to participate (Bernard, 2012). As such, interviews were conducted with one tutor from the doctrinal courses (Respondent DC), one tutor from the clinical programme (Respondent CP) and one student (Respondent ST). The researchers chose these specific roles because the participants represent the diverse perspectives of the HWLS’s main internal stakeholders. The qualitative sample size was small due to time, convenience, and needing more detailed data. Importantly, with such a small sample size, the data may not adequately represent the diversity of viewpoints and restrict the generalisability of the findings. However, the researchers did not intend to consider the qualitative findings in isolation for this mixed methods study. The researchers used these findings to explain specific quantitative findings (Creswell & Plano Clark, 2018).

The data collection procedure followed the recommendations as set out by Creswell and Plano Clark (2018):

1. The participants in the qualitative phase would be a subset of respondents in the quantitative data collection.
2. The qualitative phase sample size is smaller than the quantitative phase.
3. Conduct the quantitative analysis first and identify areas for further qualitative investigation.

The interview protocol was based on selected quantitative findings from the three IR surveys highlighted previously. The protocol was used to prompt the three participants to explain the reasoning behind their responses to the quantitative findings and further explain their experiences with the BL approach. The first integration point in this study was using the quantitative data to guide the purposeful sampling and the development of the interview protocol (Creswell & Plano

Clark, 2018). Appendix A shows the connections between the selected quantitative findings, interview questions and rationale.

The interview protocol contained twelve questions surrounding the rationale for adopting the BL approach, the benefits and limitations of BL, and the required support. Guided by Kvale and Brinkmann's (2009) terminology of question types, the guiding questions comprised follow-up questions on the quantitative findings, probing questions to gain more explanations, specifying questions on particular areas of interest, and direct questions on BL at the HWLS. The interviews were conducted after the analysis of the quantitative data. The interview data were collected via face-to-face and virtual interviews (Zoom platform). The interviews lasted between 35 and 40 minutes, and responses were recorded using handwritten notes.

The qualitative data was analysed using a six-step thematic analysis process (Braun & Clarke, 2006). Firstly, the researchers familiarised themselves with the data by transforming the handwritten notes using a word processor, reading data and trying to gain a broad view. Secondly, the researchers generated initial codes from the interviewees' responses by aggregating interesting and descriptive phrases. Thirdly, the researchers generated potential themes by collating all relevant codes and data. Fourthly, the potential themes were reviewed against the qualitative extracts and refined where required. Fifthly, the refined themes were defined and named. Lastly, vivid and compelling extracts were used to describe the themes.

## **Results**

In this section, the results from the quantitative phase will be reported first, followed by the results of the qualitative phase. The next section will present the interpretation of the quantitative and qualitative results using a joint display.

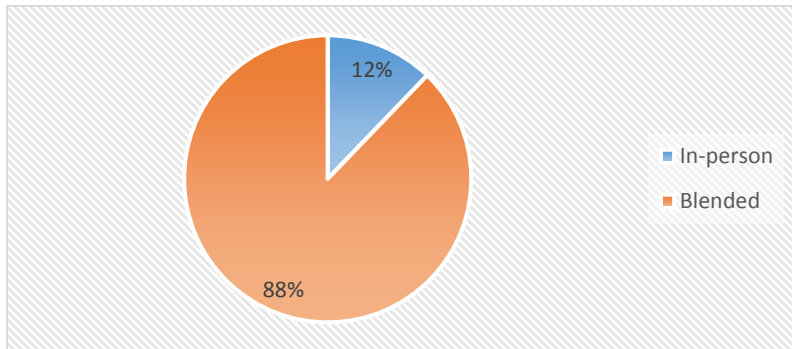
### **Quantitative Results**

This section presents the quantitative findings for the first phase of this study. As mentioned in the methodology section, three secondary institutional research reports were analysed. The quantitative findings were categorised under satisfaction and experiences with the blended approach. The findings were presented using graphs and tables.

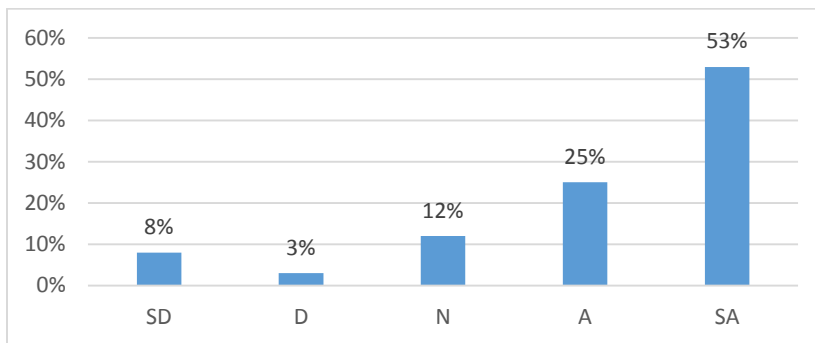
#### ***Satisfaction with Blended Learning***

Data from the surveys strongly suggest tutors and students were generally satisfied with the BL adopted for AY 2022-2023. As reported in IR Report One, the overwhelming majority of Year One and Year Two students (88%) preferred the BL mode to teaching and learning instead of in-person classes (HWLS, 2022) (Figure 3). Also, 78% of students were satisfied with the BL approach for course delivery (HWLS, 2022) (Figure 4).

**Figure 3**  
*Students' Preferred Mode of Teaching and Learning*

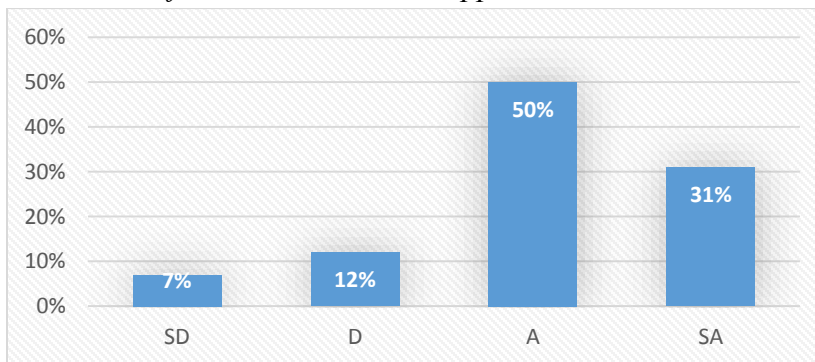


**Figure 4**  
*Students' Satisfaction with the Blended Approach*



Similarly, as reported in IR Report Three, 81% of tutors were satisfied with using BL for course delivery (HWLS, 2023b) (Figure 5).

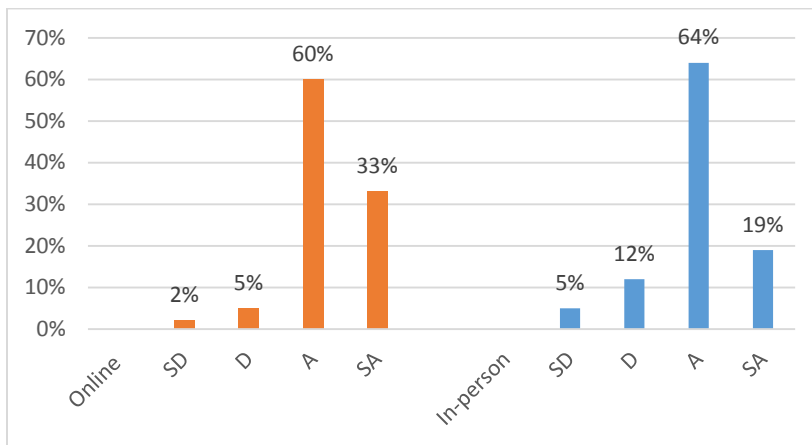
**Figure 5**  
*Tutors' Satisfaction with Blended Approach*



**Experiences with Blended Learning**

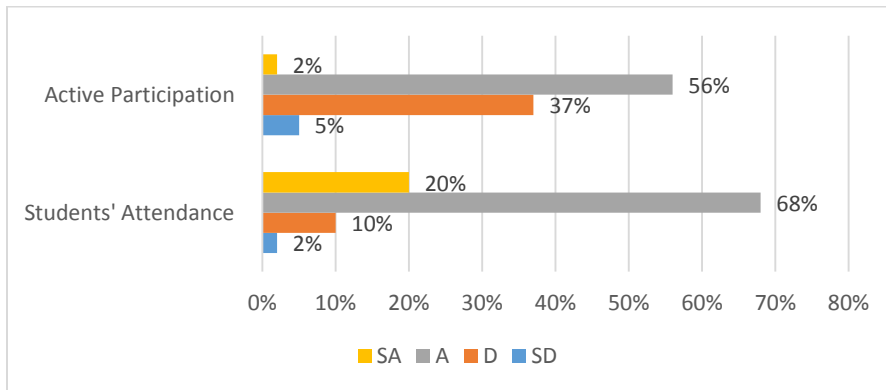
According to previous institutional research reports, most tutors and students have had favourable experiences with BL. For tutors, as reported in the IR Report Three, these experiences were with the classroom environment, student participation and ICT resources (HWLS, 2023b). Firstly, according to Figure 6, most tutors (93%) agreed/strongly agreed that the online classroom environment was conducive to teaching (HWLS, 2023b). In comparison, 83% indicated that the in-person classroom environment was conducive to teaching (HWLS, 2023b) (Figure 6).

**Figure 6**  
*Tutors' Experience with Classroom Environment*



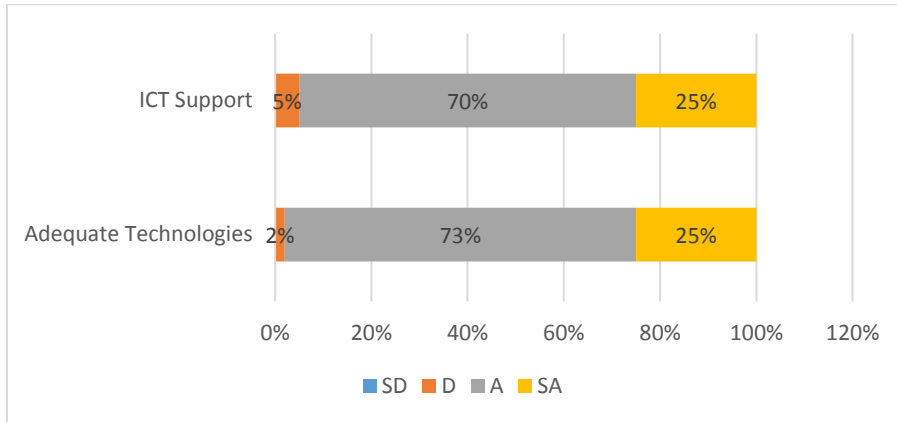
Secondly, most tutors expressed satisfaction with students' attendance and class participation in the BL environment (HWLS, 2023b). According to Figure 7, 58% of tutors agreed/strongly agreed that students actively participated during online and in-person classes (HWLS, 2023b). In comparison, 88% conveyed their satisfaction with class attendance (HWLS, 2023b) (Figure 7).

**Figure 7**  
*Tutors' Satisfaction with Students Participation and Attendance*



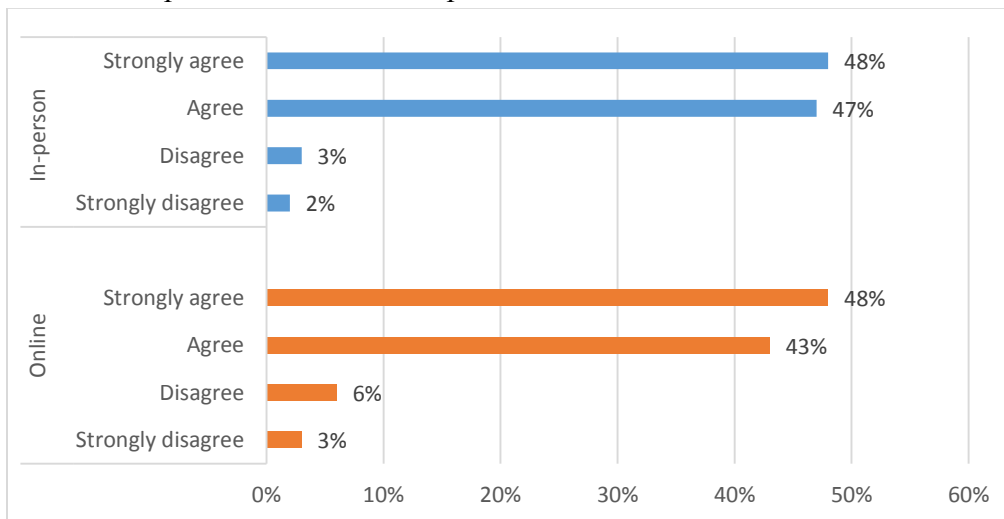
Finally, tutors expressed positive experiences with the information and communication technologies (HWLS, 2023b). Namely, 95% of tutors agreed/strongly agreed that the HWLS provided adequate ICT support (HWLS, 2023b) (Figure 8). Similarly, 98% agreed/strongly agreed that the technologies provided for BL classes were sufficient (HWLS, 2023b) (Figure 8).

**Figure 8**  
*Tutors' Experiences with ICT Support and Technologies*



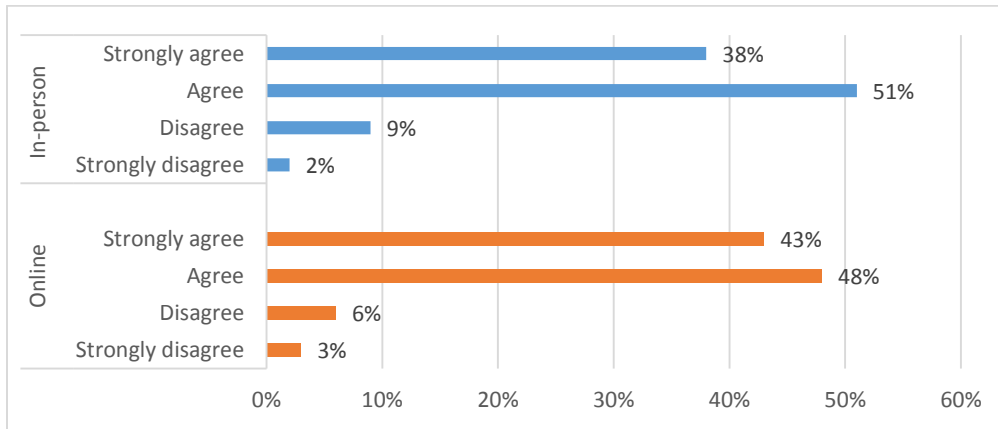
In comparison, as reported in the IR Report Two, students' favourable experiences were centred on participation, classroom environment, organisation of the classes and teaching methods (HWLS, 2023a). Firstly, most indicated that online and in-person classes promoted active participation. According to Figure 9, 95% of students agreed/strongly agreed that in-person classes encouraged participation, while 91% agreed/strongly agreed that online classes promoted participation (HWLS, 2023a).

**Figure 9**  
*Students' Experiences with Participation*



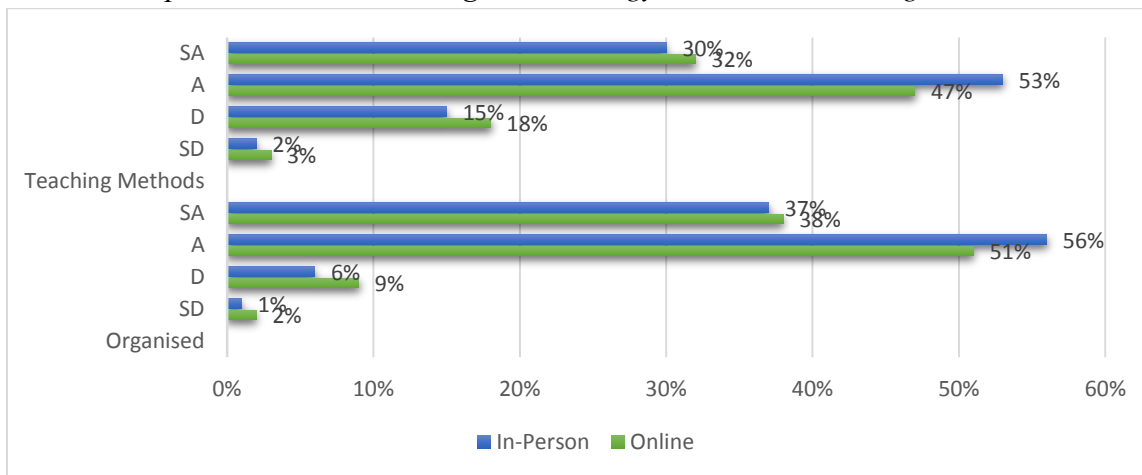
Secondly, the overwhelming majority of respondents indicated favourable experiences with blended classrooms (HWLS, 2023a). According to Figure 10, 89% of students agreed/strongly agreed that the in-person classroom promoted a conducive learning environment (HWLS, 2023a). Similarly, 91% of students agreed/strongly agreed that the online environment was conducive to learning (HWLS, 2023a).

**Figure 10**  
*Students' Experiences with Classroom Environment*



Lastly, according to Figure 11, 83% of students agreed/strongly agreed that the tutors utilised various in-person teaching strategies to match different learning styles (HWLS, 2023a). In the same way, 79% of students found that tutors used various online techniques to accommodate different learning styles. Also, 89% of students found the online classes were well organised, and 93% believed the in-person classes were organised (HWLS, 2023a) (Figure 11).

**Figure 11**  
*Students' Experiences with Teaching Methodology and Classroom Organisation*



Therefore, the quantitative findings suggest that students and tutors were satisfied with BL. Both stakeholder groups had positive experiences with this approach, particularly with the classroom environment and organisation, student participation, ICT resources and teaching methodology.

### **Qualitative Phase**

This section presents the qualitative findings for the second phase of this study. After the thematic analysis, two levels of themes were discovered – main themes and sub-themes. The main themes were rationale, benefits, limitations and support. Extracts and examples from the data would be used to support the themes and sub-themes.

#### ***Rationale for Blended Learning***

Themes such as the *response to the COVID-19 pandemic* and *merits gained* emerged about the rationale for adopting BL. The findings from the three interviewees indicate that the main reason for using BL for teaching and learning for AY 2022-2023 was a direct response to mitigate the spread of the COVID-19 pandemic, as there was a return of face-to-face classes. Therefore, in response, participants further articulated that the BL approach controlled the number of persons in the physical space, allowed adherence to social distance practices, and allowed a transitory period to return to normalcy.

After one academic year, participants expressed two main merits of this approach – space management and general acceptance by users. These merits provided the rationale for continuing the BL approach in AY 2023-2024. For instance, Participant CP stated, “Inadequate (physical) space to accommodate fully in-person teaching and learning allowed for the continuation of the blended approach.” Participants DC and ST further explained that general optimism among students and tutors led to the continuation of this mode.

Participants were also hopeful that this mode of delivery could continue at the HWLS since the online component provided technical competencies required for the workplace, such as a virtual courtroom, as expressed by Participant DC. Other reasons included the effectiveness of the approach, reduced cost, and improved class attendance. Participant ST stated, “The LEC programme is very demanding/rigorous, so the BL approach is effective. There was a reduced cost for transportation to commute to the HWLS. Also, class attendance was 75% due to the blended approach to teaching and learning.”

From the above descriptions and extracts, the rationale for initially adopting the BL approach seemed more like a reactionary strategy to combat or minimise the risks of spreading the COVID-19 virus. However, having experienced this mode of delivery, it appears that students and tutors welcomed this approach and found it compelling with its merits. As specified by Participant CP, “The blended approach will be the way forward.”

### ***Benefits of Blended Learning***

Participants praised the flexibility and convenience of the rotational BL approach. Participants highlighted the online component's ability to quickly organise students into groups and provide more opportunities for questions and clarification. Also, the Zoom break-out room, chat and raise hand features allowed for easy organisation and increased student engagement. As expressed by Participant DC, "This encourages student engagement whereas in a physical classroom, students would usually wait until class is dismissed to meet the tutor."

Meanwhile, the physical component allowed tutors to assess students' learning needs better than online, and students could work on case files, conduct research, make presentations, interact physically with staff and students and reduce screen time. Other HWLS stakeholders benefited from the BL approach. Participant CP expressed, "The needs of (Legal Aid) clients were catered for through the blended approach to teaching and learning." For instance, clients who cannot attend physical meetings can opt for a virtual one. On the other hand, clients who do not have access to technology can visit the HWLS.

In summary, BL's convenience and flexibility were ideal for teaching and learning as the online and physical components had unique but complementary characteristics. Both tutors anticipate positive outcomes and benefits for the new academic year, intending to make improvements where required.

### ***Limitations of Blended Learning***

Despite its merits and benefits, participants also mentioned several limitations. These limitations included poor student engagement, students' training needs, and technological challenges. Firstly, participants stated that not all students were fully engaged, even though they had several opportunities. As explained by Participant DC:

Although opportunities were provided to students, it is up to the adult learner to take advantage of the opportunities afforded to them. Students had the privilege to communicate with the tutor via WhatsApp messenger, telephone calls, in-person or virtual appointments, etc., to clarify information and obtain explanations on the learning materials.

Another limitation was the need to retrain students for BL, especially after two years of fully online classes due to the pandemic. As noted by Participant CP, "Time had to be spent on training students to think outside of the digital world after spending two years in an online environment." The qualitative findings showed that some students required an adjustment period returning to the physical environment. Participant CP further stated that students had to retrain in "searching and using books in the library and developing social skills and these tasks took more energy/effort from tutors."

The last limitation highlighted was the technological challenges faced by students. Most notable were the internet connectivity on campus, extensive screen time during online classes and some tutors lacking the knowledge to use the technological tools. Participants indicated measures were taken to address these challenges by providing asynchronous material on the learning management system for students' access, inviting students to sit in the tutor's office during online classes, and establishing a laptop rental system with the student representative body.

### ***Support Required***

Three areas of support required for BL to be effective were discovered during the analysis. These areas include instructional support, technological support, and institutional support. The tutors must recognise a learning gap and provide appropriate support before providing instructional support. Participant CP stated, "Having recognised that some students were weak in research skills and the ability to think critically, I formulated activities that encouraged critical and analytic thinking and problem-solving." Furthermore, tutors indicated that they took the time to explain the learning material, provided opportunities for students to ask questions beyond the classroom, and conducted frequent formative assessments to aid students' learning.

One-half of the rotational BL relies heavily on technological resources. Therefore, all three interviewees indicated that technological support is crucial for its effectiveness. The tutors indicated that technological advancement requires an appropriate plan and budgetary allocations, stable internet connection, modern educational technology and software acquisition, and more support personnel. Participant ST stated, "There should be more accessibility of a direct liaison to repair computers or sufficient IT support."

Participants also mentioned institutional support as an essential mechanism for BL. The HWLS increased its establishment by fully staffing its IT Department for AY 2023-2024 to complement the technological support mentioned previously. However, Participant DC stated, "More resources must be allocated to building the online teaching and learning environment." Further, Participant CP added, "Having students online and in-person in the same classroom should be considered as a way forward, which will involve redesigning the course."

Another aspect of institutional-level support is continuing with the various monitoring and evaluation processes. At the HWLS, some of these processes include shared governance, regular reporting of committees and departments, institutional research activities and quality reviews. Participant ST recommended "the continued use of the current monitoring and evaluation processes, which has placed the HWLS in a favourable position, to make decisions on the overall teaching and learning process."

## **Discussion and Conclusions**

This section presents the second integration point of this paper, which occurs when the researcher “integrates the two sets of connected results and draws integrated conclusions about how the qualitative results explain and extend specific quantitative results” (Creswell & Plano Clark, 2018, p. 80). The integration is represented in a joint display (Table 1), which presents the category and CABLS sub-system, quantitative findings, supporting qualitative themes and inferences from the two databases.

The main conclusion from this study is that although the rationale for adopting BL was a reactionary response to COVID-19, and having experienced the benefits and merits, the users are satisfied and have accepted it as a preferred approach to teaching and learning. Like many institutions affected by the pandemic, the HWLS implemented online learning as an interventional response so operations could continue. The transition to BL aimed to retain students, continue programme delivery post-pandemic as institutions returned to face-to-face classes and ensure a sustainable transition by utilising the same technological infrastructure for fully online classes.

The literature review identified the relevance of the CABLS as a framework for assessing the effectiveness of BL. Several elements of each CABLS sub-system were observed within the BL system at the HWLS. While technological upgrades were implemented and specific training was conducted with both learner and teaching staff, it is unclear if all sub-systems interact and co-evolve efficiently and if the pedagogical quality has been impacted.

Therefore, the goal is to use the CABLS framework to assess and evaluate the effectiveness of the BL system at HWLS. This discussion presents a gap analysis, which examines the underlying implications of the integrated results matrix within the CABLS framework to identify strengths, gaps and recommendations.

### **The Learner at the HWLS**

The findings show a strong relationship between the BL system and student (learner) satisfaction, highlighting increased flexibility and convenience. Most students reported high satisfaction levels and preferred BL to traditional face-to-face learning. BL also seems to encourage student engagement and improve active participation in the learning process (Wang et al., 2015; Cleveland-Innes & Wilton, 2018; Ntim et al., 2021). The findings suggest that lower student engagement can be attributed to their disengagement rather than any inherent system limitations. Also, integrating technology and online resources provides learners with flexible access to course materials, communication tools, and interactive activities. However, the effectiveness of BL in supporting the achievement of student learning outcomes was not assessed, requiring further research and investigation.

**Table 1**  
*Joint Display*

Category (CABLS Sub-System)	Quantitative Findings		Supporting Qualitative Statement (Students & Tutors)	Meta Inference
	Students	Tutors		
Preferred Blended (Learner and Teacher)	88% of students preferred BL, while 12% preferred face-to-face learning.		The rationale for the initial BL was a response to the COVID-19 pandemic. Merits of BL were space management and general acceptance.	Even though the rationale for adopting BL was a reactionary response to COVID-19, users have accepted and now prefer this approach to teaching and learning due to its merits.
Satisfaction with BL (Learner and Teacher)	78% of students were satisfied with the BL approach.	81% of tutors were satisfied with the BL.	The benefits of BL were space management, flexibility and convenience. Some limitations are poor student engagement, adjustment, and retraining of students and technology.	Participants were highly satisfied with the benefits of the BL approach, such as flexibility and convenience. However, some limitations were noted.
BL Environment (Content)	91% of students found online classes conducive to learning.  89% of students found in-person classes conducive to learning.	93% of tutors found online classes conducive.  89% of tutors found in-person classes conducive.	Benefits of BL: online components develop competencies required for the workplace. The physical classroom allowed for better assessment of students' needs.	Both components of BL seem to promote conducive classroom environments for learning.
BL was organised (Technology)	89% of students found online classes well organised.  93% of students found in-person classes well organised.		Benefits of BL: Tutors expressed that the online classes allowed for the effortless organisation of students into groups. While physical classrooms allowed students to work on files, interact with peers	Based on Tutor observation and student data, it can be inferred that both components of the BL were organised.

BL Active Participation (Learner)	91% of students found online classes encouraged active participation. 95% of students found that in-person classes encourage participation.	58% of tutors thought that BL encouraged active participation.	Benefits of BL - it encourages student engagement as students have multiple opportunities to engage with the tutor. However, not all students took advantage of these opportunities.	Based on tutor observation and student data, it can be inferred that BL significantly increases student engagement and active participation in most cases. Some students were not engaged due to their lack of effort.
Teaching Strategies (Teacher)	79% of students found tutors used various online teaching strategies. 83% of students found that tutors used various in-person teaching strategies.		Tutors try to identify learners' gaps and provide instructional support, such as formulating activities for critical thinking, providing detailed explanations of material, providing learning opportunities, and conducting frequent formative assessments.	The various instructional support activities contributed to high ratings of BL teaching strategies.
ICT Resources (Technology and Institution)		98% expressed sufficient technologies.	Measures to mitigate against some ICT challenges are posting asynchronous material, sessions with tutors, and laptop rental.	Based on the tutors' quantitative and qualitative data, it can be inferred that sufficient ICT resources were provided. However, more resources were recommended to improve the BL approach.
ICT Support (Technology and Institution)		95% of tutors expressed adequate ICT support.	Participants recognised the efforts of the HWLS to increase its ICT capacity. However, more resources may be required to build the BL environment.	The technical support provided was crucial for BL effectiveness, as evidenced by the high rating.

### **The Teacher at the HWLS**

The meta-inferences indicate a substantial relationship between the teacher sub-system and instructional support (teaching strategies). Teachers or tutors routinely try to identify learner gaps and adapt their instructional strategies accordingly. Most students find that teachers adequately vary teaching strategies to stimulate critical thinking, learning opportunities and formative assessments regardless of whether online or in-person. Furthermore, BL facilitates personalised instruction and increases student-teacher collaboration (Cobo-Rendón, 2022). Teachers appreciate this collaboration as it encourages student engagement and participation.

### **The Technology Sub-System at the HWLS**

Based on the meta-inferences, the technology sub-system significantly impacts the overall satisfaction with the BL system, with its growth and evolution linked to the learner and teacher sub-systems (Wang et al., 2015). ICT integration offers flexibility and convenience, with online group organisation being a popular feature. Students and teachers are satisfied with the ICT system's utility and accessibility. However, there is an expressed need for increased ICT capacity and more technological resources.

### **The Content Sub-System at the HWLS**

The content sub-system was not fully covered in the scope of this study. However, the meta-inferences suggest that both components of the BL system provide a conducive learning environment for students. This sub-system should be revisited to evaluate the efficacy of the BL course content and its alignment with the curriculum and to reveal its quality, relevance, alignment with learning objectives, and impact on learning.

### **The Learning Support Sub-System**

The meta-inferences reveal high participant satisfaction regarding ICT support, with tutors stating that the online component provides a solid foundation for instructional support. However, the study lacks data on other aspects, such as administrative support, accommodation of diverse learning needs, and institutional policies. It necessitates further research to understand its impact.

### **The Institution Sub-System**

The meta-analyses reveal that the HWLS provides adequate resources and processes for the BL system, including physical classes, class rotation schedules, increased ICT department size, software and platform purchases, user training, monitoring, and evaluative procedures and maintaining shared governance principles in the sub-system. However, the study's scope limits the complete examination of this sub-system, necessitating further research to gain insights into supporting institutional strategies, policy alignment with strategic goals and long-term vision. Institutional support is crucial in strategic decisions, such as continuing BL after the pandemic (Ntim et al., 2021).

### **Implications for HWLS**

The assessment outcomes using the CABLS as a framework indicate that the learner, teacher and technology sub-systems at the HWLS are the strengths of the current BL system and are highly effective, satisfactory and integrated. There is enough evidence to suggest that these sub-systems co-evolve and support each other adequately. Some inferred gaps may exist in the content, institution and, to a lesser degree, the learning support sub-systems.

For the HWLS to move the BL system from a reactionary to a deliberate approach, further investigation is needed to determine if the gaps result from the study's constraints or are inherent in the system's design. It is necessary to conduct more research to explore the impact of the content sub-system, learning support sub-system, and institution sub-system on the overall effectiveness of the BL system.

### **Limitations**

There were several limitations of this study. Firstly, a small qualitative sample size was interviewed due to time constraints, convenience, and the need for detailed information. Thus, the findings may not represent all students and tutors at the HWLS. Nonetheless, the quantitative and qualitative findings and their integration provided meta-inferences about their experiences within the populations.

Secondly, a key feature of the explanatory mixed methodology design is that "The researcher must decide which quantitative results need to be further explained" (Creswell & Plano Clark, 2018, p. 81). Therefore, there may exist other significant quantitative results that were not selected in this study. Future research could utilise another research design, such as a convergent design, where the intent is to obtain data (quantitative and qualitative) around the same topic(s) to understand the research problem.

Lastly, the findings of this study are specific to the HWLS, and caution should be made about generalising the claims beyond the research context. However, the recovery may have standard dimensions since all HEIs faced similar challenges during the COVID-19 pandemic. Therefore, the findings should be used as a comparative mechanism to identify best practices.

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**Appendix A**  
**Interview Guide with Rationale for Questions**

<b>Relevant Quantitative findings</b>	<b>Interview Question</b>	<b>Rationale for the question</b>
88% of students preferred BL.	<p><b>Ques 1.</b> Please share the reasons for using the BL for teaching and learning for the last AY 2022-2023.</p> <p><b>Ques 2.</b> Please share the reasons for continuing the blended teaching and learning approach for the new AY 2023-2024.</p> <p><b>Ques 5.</b> With the continuation of the blended approach, what positive outcomes do you foresee in relation to students and teachers?</p>	Explanation of students' preferred learning mode and experiences with BL.
78% of students expressed satisfaction with the course delivery.	<p><b>Ques 3.</b> Do you anticipate this course delivery mode will be the way forward at the HWLS?</p> <p><b>Ques 4.</b> What benefits did you observe last AY when using the blended approach?</p>	To explain students' satisfaction with the BL.

<p>81% of tutors expressed satisfaction with the blended approach for course delivery.</p>	<p><b>Ques 3.</b> Do you anticipate this course delivery mode will be the way forward at the HWLS?  <b>Ques 4.</b> What benefits have you observed last AY from using the blended approach?  <b>Ques 5.</b> With the continuation of the blended approach, what positive outcomes do you foresee in relation to students and teachers?  <b>Ques 11.</b> What technological support would be required to ensure the effectiveness of the blended approach?  <b>Ques 12.</b> At the institutional level, what support mechanisms are required to ensure the effectiveness of the blended approach?</p>	<p>To explain tutors' satisfaction with the course delivery mode, experiences, challenges, and suggestions for improving students' overall experiences.</p>
<p>58% of tutors found that students actively participated in online and in-person classes.</p>	<p><b>Ques 6.</b> What limitations have you observed with the blended approach?  <b>Ques 9.</b> There may be some students struggling or falling behind through BL. How would you support these students?  <b>Ques 10.</b> What instructional models do you use for teaching and learning, and how has this helped students' learning process and outcomes?</p>	<p>To understand students' active participation during classes, challenges, and suggestions for improving students' experiences</p>

<p>Online classroom environment conducive to learning (92%) of students agreed or strongly agreed.</p> <p>In-person classroom environment conducive to learning - (90%) of students agreed or strongly agreed.</p>	<p><b>Ques 3.</b> Do you anticipate this course delivery mode will be the way forward at the HWLS?</p> <p><b>Ques 7.</b> How would you cater to students who do not have devices and have disrupted internet connectivity to study online?</p> <p><b>Ques 8.</b> Although the minority (12%) preferred in-person classes, how much time do you anticipate students may need to adapt to the blended approach to teaching and learning?</p>	<p>To understand the reasons for the continued use of BL and how challenges would be addressed.</p>
<p>98% of tutors found TWEN suitable for posting learning material for asynchronous classes.</p>	<p><b>Ques 3.</b> Do you anticipate this course delivery mode will be the way forward at the HWLS?</p> <p><b>Ques 4.</b> What benefits have you observed last AY from using the blended approach?</p> <p><b>Ques 7.</b> How would you cater to students who do not have devices and have disrupted internet connectivity to study online?</p>	<p>To explain students' satisfaction with the LMS and teaching and learning activities.</p>
<p>91%_of students found that online classes promoted active student participation.</p> <p>96% of students found that in-person classes encouraged active student participation.</p>	<p><b>Ques 4.</b> What benefits have you observed last AY from using the blended approach?</p> <p><b>Ques 10.</b> What instructional models do you use for teaching and learning, and how has this helped students' learning process and outcomes?</p>	<p>To explain levels of student engagement during the delivery of BL classes.</p>

## Aligning Curricula and Educational Programmes to the Environmentally Sustainable Development Agenda in the Caribbean

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### Abstract

The Caribbean region encounters numerous sustainable development-related challenges such as environmental degradation and climate change. Additionally, the vulnerability of the Caribbean to external shocks, limited resources, and susceptibility to natural disasters further complicates the achievement of environmentally sustainable development goals. For much of the twentieth century, Western education systems prepared students to enter the workforce, contribute to society, and succeed in relatively predictable contexts. Today, people are in control of planet-making decisions that are dramatically reshaping social, economic, and environmental systems on a global scale. Within the Caribbean context, research needs to be conducted to provide conceptions and practices that are contextually relevant and appropriate as the region seeks to coexist within the global space. The primary goal of this study is to develop a greater understanding of how higher education institutions in the Caribbean can effectively integrate environmental sustainability principles into their curricula and educational programmes to address the unique environmental challenges in the region. Data were obtained from various databases by using a systematic review approach. The findings provide an overview of environmental sustainability initiatives in the Caribbean and identify challenges and barriers. The conclusions, limitations, and future research directions of this study were also considered.

*Keywords:* environmental sustainability, higher education, workforce development

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### Introduction

A safe and healthy working environment is vital for overall sustainability because it directly affects economic and social development (Psacharopoulos & Patrinos, 2018; Burgos-Garcia, 2007; ILO, (2019)). These two areas are closely intertwined as they aim to tackle humanity's pressing

challenges such as ensuring safe and decent employment, promoting economic growth, and addressing the climate crisis. Integrating sustainable development and occupational health and safety synergistically contributes to creating a more sustainable world, thus helping to build a better future. At its core, sustainability is often first and foremost associated with environmental preservation. The idea is to use resources in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs (Kidd, 1992 & Navarro-Pedreno, 2022).

Sustainable development was first proposed by the World Commission on Environment and Development in 1987 (Cassen, 1987). It is defined as a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. It aims to balance environmental, economic, and social elements (Ashraf et al., 2019) and involves improving and sustaining a healthy economic, ecological, and social system for human development (Ametepey et al., 2023).

The environmental element of sustainability focuses on conserving and managing natural resources and ecosystems (Lee et al., 2021). One focus of this element is climate action, which encourages policies and actions to reduce emissions, increase renewable energy use, and adapt to climate change for sustainable human communities. Another focus is on protecting ecosystems and species, thus maintaining biodiversity and contributing to human well-being, as biodiversity supports everything from medicine to agriculture to clean air and water. Economic sustainability emphasizes the efficient use of resources and promotes economic growth and prosperity (Borusiak, 2021). This element encompasses sustainable economic models aimed at stable employment, fair wages, and opportunities for advancement, leading to a stable society. Companies and organizations that focus on sustainability are often more resilient and adaptable to market changes.

The social sustainability element focuses on social equity, inclusivity, and justice and addresses issues such as poverty and inequality (Vallance et al., 2011). This involves creating social mobility, education, and healthcare systems that are accessible to everyone, regardless of their socioeconomic background. It also involves building strong communities with social cohesion, mutual respect, and the inclusion of minority or marginalized groups and preserving cultural identities and histories while fostering adaptability and growth.

Sustainability also extends to human health (Weber et al., 2023). Sustainable practices often aim to reduce pollution, promote clean water and air, and encourage safe and healthy living. This can be achieved through various means, such as sustainable agriculture, reduction of toxic materials, and promotion of lifestyle choices that contribute to long-term health. Safety is another crucial aspect of sustainability. This can refer to various issues, from industrial workplaces to community safety. Sustainability aims to create and maintain conditions under which humans can thrive without fear of injury or harm. Safe labour practices, safe technologies, community planning, and

emergency preparedness all fall under this category. Education and training in Occupational Health and Safety, and sustainable development are critical for fostering a culture of safety and prevention. Mainstreaming it into educational curricula can prepare future generations to prioritize safety and sustainability in their professional lives (Kavouras, et al., 2022).

This paper focuses on the importance of integrating sustainability into education for two reasons: first, workforce development and second, as a strategy to tackle environmental issues in the Caribbean. The primary goal of this study is to explore how higher education institutions in the Caribbean can effectively integrate environmental sustainability principles into their curricula and educational programmes to address the unique environmental challenges in the region. Three primary research questions were explored: 1) What are the current environmentally sustainable efforts and initiatives in the Caribbean? (2) What challenges and barriers do Caribbean higher education institutions face in implementing sustainable development education? and (3) What pedagogical approaches can be employed to enhance the effectiveness of sustainability education in the Caribbean higher education system?

## **Literature Review**

### **The Role of Higher Education in Advancing Sustainable Development in the Caribbean**

Education for sustainable development (ESD) can be used as a solution for addressing climate change impacts in the Caribbean region. The Caribbean is particularly vulnerable to the adverse effects of climate change, including rising sea levels, increased frequency and intensity of hurricanes, and changes in rainfall patterns (Douglass & Cooper, 2020). Aligning curricula and educational programmes for environmentally sustainable development into formal and informal education can address the sustainability challenges faced by Caribbean countries (Roofe & Ferguson, 2019). As the world faces pressing environmental challenges, such as climate change and resource depletion, higher education institutions should play an active role in preparing graduates who are equipped with the knowledge and skills to tackle environmental issues effectively (Rousell & Cutter-Mackenzie-Knowles, 2020; Reimers, 2024; Passarella, 2021; Senevirathne et al., 2021). Moreover, the literature emphasizes the significance of developing graduate attributes and employability skills that align with the demands of a rapidly changing job market, especially in fields related to environmental health and sustainability (Tomlinson, 2017; Plastow & Bester, 2020; Jepngetich et al., 2019).

Higher education institutions are responsible for cultivating graduates who possess not only technical proficiency, but also a strong sense of social responsibility. This aspect of their role in society is of utmost importance. Considering the increasing urgency of environmental concerns, graduates must comprehensively understand these challenges and be equipped to effectively tackle them. In light of the urgent environmental challenges confronting the global community, such as climate change and resource depletion, it is crucial for higher education institutions to assume a

proactive stance in cultivating graduates who possess the necessary skills and knowledge to effectively tackle these issues and make meaningful contributions to sustainable development.

Higher Education Institutions frequently contribute significantly to the economies and communities of their respective regions. Organizations can serve as exemplars by implementing sustainable practices, showcasing the practicality and advantages of adopting sustainable approaches. The implementation of sustainable practices on campus encompasses various initiatives, including, but not limited to, energy and water conservation and waste reduction (Ralph and Stubbs, 2013). By implementing sustainable behavior and practices, higher education institutions can cultivate a culture of environmental responsibility among their students and staff.

Universities play a leading role in research. Organizations can stimulate advancements in sustainable technologies, practices, and policies, thereby facilitating their widespread adoption globally. Higher education institutions can make valuable contributions to developing solutions for environmental challenges and offer students the opportunity to engage in practical learning and research. This can be achieved by active participation in research and innovation.

Additionally, higher education institutions are responsible for promoting sustainability by actively engaging with the community and forming partnerships. This process entails engaging in partnerships with local communities, businesses, and organizations to tackle environmental concerns effectively and advocate the adoption of sustainable practices (Blanco-Portela et al., 2017). Through active participation in the community, higher education institutions can facilitate valuable opportunities for students to effectively utilize their acquired knowledge and skills in practical real-life scenarios. This engagement not only enables students to make a positive impact on the environment but also enhances their overall learning experience.

### **Sustainable Development Goal SDG 4 Quality Education**

Sustainable development education aims to empower learners to make informed decisions to take responsibility for environmental integrity, economic viability, and social equity. The SDGs recognize the critical role of education in achieving sustainable development. Goal 4 of the SDG explicitly focuses on quality education and aims to ensure inclusive and equitable education for sustainable development and global citizenship. This calls for all learners to acquire the knowledge and skills needed to promote sustainable development, including education for sustainable development, sustainable lifestyles, human rights, gender equality, and a culture of peace and non-violence. The objective of this goal is to guarantee an inclusive and fair provision of high-quality education as well as to foster possibilities for lifelong learning for all individuals. The primary objectives of Sustainable Development Goal 4 are as follows:

- i. Universal access to cost-free, high-quality primary and secondary education for all students.

- ii. Enhancing the pool of individuals with pertinent skills for gainful employment and entrepreneurial endeavours.
- iii. To address gender inequities in education and promote equitable access to education across all demographic groups.
- iv. Enhancing educational infrastructure to ensure the provision of a secure, inclusive, and efficient educational setting.
- v. Increasing the availability of scholarships for students from developing nations to pursue higher education.
- vi. Enhancing the quantity of qualified educators via international collaboration.

One of the prevailing challenges currently facing the Caribbean region pertains to the repercussions of the COVID-19 pandemic in the education sector. The COVID-19 pandemic has necessitated a shift from conventional in-person teaching methods to online or distance learning approaches. This transition underscored the importance of revising assessment practices within higher education institutions in the Caribbean region. The digital divide in the region has been brought to light by the pandemic, as students face challenges in participating in online learning due to limited access to technology and internet connectivity (Thind et al., 2021). To guarantee the provision of high-quality education both during and after the pandemic, it is imperative to effectively tackle technological obstacles and devise inventive methodologies for instruction and evaluation (Griffith, 2023).

Furthermore, alongside the challenges mentioned above, prospects exist for the progression of Sustainable Development Goal 4 (SDG 4) in the Caribbean region. Higher education institutions are essential for implementing and achieving SDG 4 because of their extensive expertise in educational instruction and learning across multiple academic levels. Higher education institutions can advance Sustainable Development Goal 4 (SDG 4) through various strategies such as instructional practices, programme and course enhancements, research endeavours, and outreach initiatives. The University of the West Indies School of Education in Jamaica can be examined as a case study demonstrating how higher education institutions can positively impact Sustainable Development Goal 4 (SDG 4) by implementing educational programmes and initiatives. Higher education institutions have the opportunity to play a significant role in shaping and leading the SDG 4 agenda in the Caribbean by incorporating SDG 4 into their curricula and research agendas (Ferguson & Roofe, 2020).

To attain a high standard of education in the Caribbean, it is imperative to effectively address the unique requirements and circumstances of the region. Recognition of the significance of student-centered learning is crucial in addressing the task of providing high-quality education and enhancing student outcomes. Student-centered learning has consistently emerged as a prominent topic within numerous national education policies across the global south, including the Caribbean region (Joong, 2021). Educators can establish learning environments that are responsive to the

diverse needs and backgrounds of Caribbean students by implementing student-centered approaches. The attainment of SDG 4 holds significant importance in the overall achievement of the remaining Sustainable Development Goals. This is primarily because education serves as a powerful tool to reduce poverty, promote health and well-being, and cultivate economic growth and innovation.

### **Current Education for Sustainable Development Efforts and Initiatives in the Caribbean**

Environmental sustainability education can foster awareness of the challenges faced by our planet and promote sustainable practices. Given its vulnerability to climate change and rich biodiversity, the Caribbean region recognizes the importance of this kind of education.

Over the years, there have been multiple initiatives, both region-wide and within individual countries, to incorporate environmental sustainability education.

i The Caribbean Community Climate Change Centre (CCCCC) is instrumental in addressing climate change issues in the region. It has been promoting awareness, providing training, and encouraging the integration of climate change education into national curricula (Caribbean Community Climate Change Centre, 2021; UNESCO, 2016; Caribbean Development Bank, 2019).

ii The draft of the CARICOM Environmental and Natural Resources Policy Framework also touches upon the importance of public awareness, information dissemination, and education in environmental sustainability (CARICOM Secretariat, 2017 & 2012; UNEP & CARICOM Secretariat, 2018).

iii The Caribbean has collaborated with international organizations, such as UNESCO and UNICEF, to develop and promote environmental education initiatives. These partnerships also lead to the creation of resources, training programmes, and curriculum development (Hickling-Hudson, 2004 & Dorn, 2020).

Additionally, several initiatives have been initiated in the Caribbean region with the objective of increasing awareness of distinct environmental concerns. These campaigns focus on issues such as plastic pollution (UNEP, 2023 & Phillips et al., 2020), the conservation of coral reefs (CCI, 2022), and the promotion of sustainable tourism (Reefcheck, 2023, CARICOM, 2008, Travelife Sustainability Certification, 2023 & Blueflag, 2023). The effectiveness of environmental conservation in the Caribbean is contingent on the active involvement of local communities, grassroots movements, and consistent governmental policies.

Research shows that student engagement is closely linked to campus sustainability initiatives. Ordaz et al. (2021) suggested that university students and K-12 students could benefit from co-curricular activities sponsored in collaboration with community organizations. Universities should

actively incorporate and promote sustainable development, climate change, and environmental sustainability within curricula to further cultivate students' knowledge and develop critical thinking, skills, and self-efficacy related to sustainability. Moreover, Null and Asirvatham (2022) suggests including environmental sustainability education in teacher education programmes to equip K-12 teachers with the knowledge and skills to incorporate environmental sustainability education within their curriculum.

### **Theoretical frameworks that can be used to enhance integration of sustainable development education**

The integration of environmental sustainability principles into higher education in the Caribbean is a complex, multifaceted process. Telesford et al (2024) emphasized the importance of leveraging the unique context of small island states to deliver sustainable development and environmental health education. This can be achieved through active student engagement and the use of pedagogical methodologies that promote inclusivity. Griffith (2020) further underscores the necessity of integrating sustainability and Sustainable Development Goals (SDGs) into the curriculum, using innovative teaching strategies to engage students. Paulette (2019) highlighted the strategic role of higher education in the sustainable development of the Caribbean, calling for the replication of good practices and the identification of opportunities for improvement. Lastly, Ferguson (2020) identified key areas for further research and practice in environmental and sustainability education, including climate change education, teacher education, and the role of universities as models of sustainability. These studies emphasize the need for a comprehensive and context-specific approach for integrating environmental sustainability principles into higher education in the Caribbean.

The goal of this present article is to answer the question of how higher education institutions in the Caribbean can effectively integrate environmental sustainability principles into their curricula and educational programmes to address the unique environmental challenges in the region. A considerable amount of literature has been published on curriculum alignment with guiding theories, such as Constructivist Theory, Backwards Design (Understanding by Design), Systems Theory, Experiential Learning Theory, Transformative Learning Theory and Ecological and Social Justice Frameworks. These theoretical frameworks can be applied to curriculum alignment, particularly in the context of integrating environmental sustainability.

Constructivist theory, as discussed by Brau (2020), Whitman (1993), and Abha (2019), posits that knowledge is actively constructed by individuals through reflection and interaction with others. This theory has significant implications for education, as it emphasizes student-centered learning and the creation of a constructivist learning environment (Bada & Olusegun, 2015). However, Matthews et al. (2002) found that relativist and subjectivist interpretations can complicate the teaching of scientific content and inhibit communication with educationalists and policymakers. Additionally, Baviskar et al. (2009) observed that there are challenges in applying constructivist principles consistently, as some educational practices claiming to be constructivist do not fully

adhere to its essential criteria. Overall, constructivist theory underscores the importance of active reflective learning, in which individuals construct knowledge through personal and social experiences.

Understanding by Design is a specific framework that is grounded in the principle of backward design. It is a curriculum planning framework that emphasizes deep understanding and transfer of learning. It involves identifying desired results, determining acceptable evidence, and planning learning experiences (Roth, 2007). This approach has been successfully applied in various educational contexts including science education (Alhamsi, 2015), mathematics learning (Pramesti, 2023), and integrated classes (Kim, 2022). However, Akbas & Basaran, (2023) observed that some educators find the backward design process challenging due to a lack of practical strategies and resources, and that training and professional development are imperative for teachers to effectively implement understanding by design (Kim et al. 2022).

As defined by Murray (2018), experiential learning is a methodology that integrates theoretical and practical elements, emphasizing the importance of experience in learning. According to Kolb (1976), experiential learning is a central life task, not only for managers but also for all human systems. Austin (2015) also emphasizes that it is particularly valuable for both students and faculty in higher education. However, there are challenges in interpreting and applying this approach, such as the lack of clarity regarding what constitutes a concrete experience (Morris, 2019). Experiential learning theory, when effectively integrated into curriculum design, bridges the gap between theoretical knowledge and practical applications. This approach is beneficial across various educational contexts such as teacher professional development (Girvan et al., 2016) to management education (Bevan et al., 2012) highlighting its versatility and effectiveness in promoting meaningful learning experiences.

Mezirow's transformative learning theory, developed in the late 1970s, posits that adults can undergo fundamental changes in their worldview through a process of critical reflection and self-examination (Kurnia, 2021; see also Kitchenham, 2012; Kuriakou, 2023). This transformation is triggered by "disorienting dilemmas," prompting individuals to question their assumptions and beliefs (Fleischer, 2006; Merlini, 2007). This theory emphasizes the role of context, critical reflection, and dialogue in facilitating transformative learning (Schnepfleitner, 2021; Calleja, 2014). It has been applied in various fields, including adult education, theology, and science education (Fleischer, 2006; Dibiase, 2000). Much of the available literature on education for sustainable development in the Caribbean focuses on content, but the above studies collectively underscore the need for a comprehensive and context-specific approach to integrating environmental sustainability principles into higher education in the Caribbean.

## Methodology

The primary goal of this study was to explore how higher education institutions in the Caribbean effectively integrate environmental sustainability principles into their curricula and educational programmes to address the unique environmental challenges in the region. A systematic literature review was employed to answer the research question. Creswell and Creswell (2018) stated that a literature review is a written summary of articles, books, and other documents that describe the past and current state of knowledge about a topic. This literature search aimed to examine the current efforts, challenges, and potential strategies for the effective integration of sustainability in higher education institutions through several theoretical frameworks that can be applied to curriculum alignment in the context of environmental sustainability.

### Literature search strategy

In this study, three groups of sources were selected to search for articles. Group 1 included the Google Scholar, EBSCO, and SCOPUS databases. In Group 2, recent and in-press articles in relevant journals such as *Sustainability*, *Journal of Applied Research in Education*, *International Journal of Sustainability in Higher Education*, and *International Journal of Environmental Research and Public Health* were searched. In Group 3, organizational websites such as the United Nations, United Nations Environment Programme, World Health Organization, and International Labour Organization were reviewed for relevant articles and reports. The search terms used in this study include “Education for Environmental Sustainability”, “Environmental Sustainability efforts and initiatives in the Caribbean”, “Quality Education”, “SDG4,” and “sustainable education pedagogies”.

### Inclusion and exclusion criteria

The articles were addressed under the following conditions: 1) the articles were published in English; 2) the articles were published between January 1990 and January 2023; and 3) the evaluation of the environmental initiatives was through document analysis, self-reported questionnaires, or face-to-face interviews.

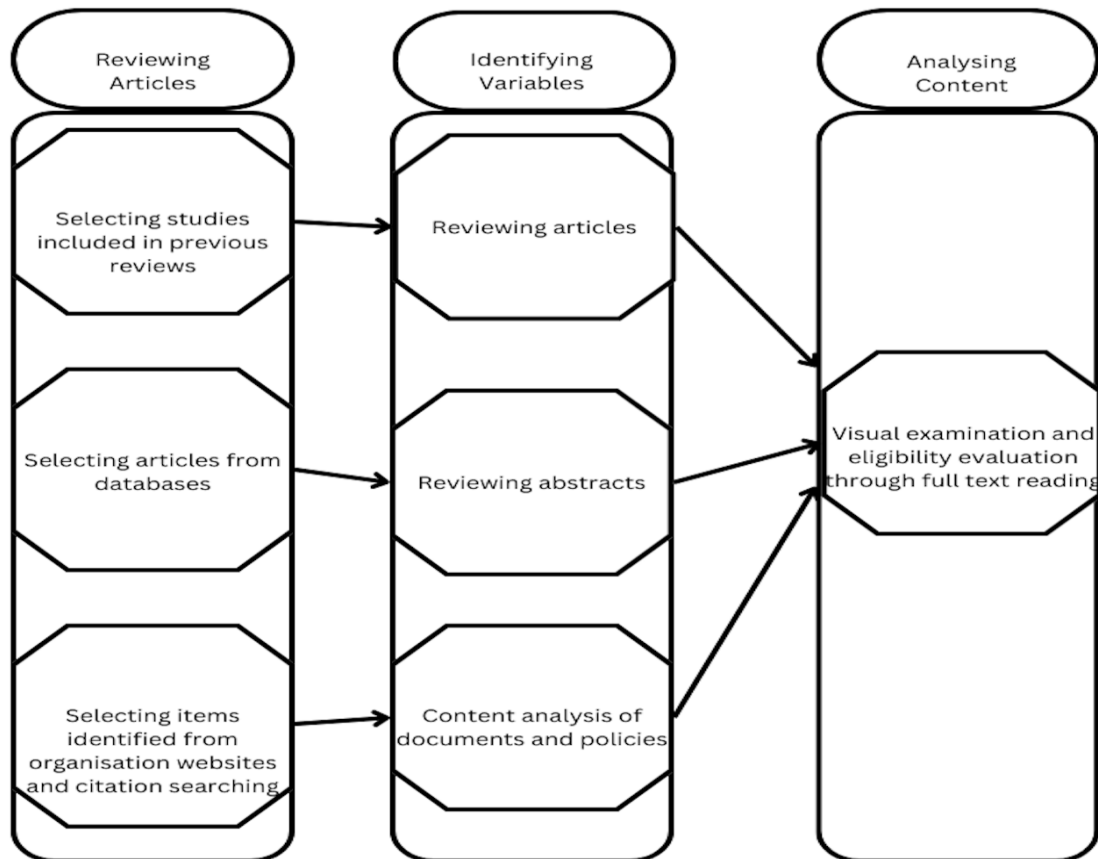
### Selecting appropriate paper and data analysis

Procedures for selecting suitable articles related to this study is shown in Figure 1. The study's data collection procedure utilized a systematic review approach (Grant & Booth, 2009) divided into two phases: preliminary appraisal and content analysis. In the preliminary appraisal phase, a search was conducted among databases, relevant journals, and organization websites. Based to the titles and keywords, 151 articles were selected. The authors carefully reviewed the abstracts of the articles to identify themes, and 62 articles were selected based on the study's criteria. After reviewing the articles based on compliance with the research criteria, 45 articles that included the characteristics of entry were selected. The article's specifications, including the author's name, year of publication, and item validity, were reviewed in the next step. In the second step, that is, the

content analysis step, the study themes were investigated for relevance to this study. These results were reported and discussed in the Findings section of this paper.

**Figure 1**

*Flowchart of the Literature search and inclusion.*



*Study Limitations*

Aside from the commonplace limitations of qualitative review studies, some study-specific limitations also exist. The literature coverage is limited and may exclude some relevant studies. Future research should consider using more databases to collect numerical data and country visits to allow for more reliable, transparent, and objective data collection.

## **Findings**

### **Integrating Sustainable Development into Education: A Pathway to Resilience and Innovation in the Caribbean**

Integrating sustainable development into education is closely related to the United Nations Sustainable Development Goals (SDGs) (Salvia et al., 2019). The SDGs were developed from the Millennium Development Goals (MDGs) and earlier initiatives of the United Nations (Afolaranmi & Amodu, 2022). The SDGs were established by the United Nations in 2015 as a global framework to guide countries and stakeholders in achieving sustainable development by 2030. The SDGs cover many interconnected issues including poverty eradication, gender equality, climate action, sustainable cities, responsible consumption and production, and biodiversity conservation. They provide a comprehensive and integrated approach to address the social, economic, and environmental dimensions (Kamalan, 2017) of sustainable development.

Sustainable development is at the core of the SDGs, as it aims to promote economic growth, social inclusion, and environmental sustainability. The SDGs recognize that these three dimensions are interconnected and mutually reinforcing and that progress in one area depends on progress in others. For example, achieving poverty eradication (SDG 1) requires addressing issues such as access to education (SDG 4), gender equality (SDG 5) and sustainable economic growth (SDG 8).

Education plays a crucial role in the achievement of sustainable development. Recognizing this, the United Nations (UN) has included education as a critical component of the SDG. Education for sustainable development (ESD) is an important guideline for the UN's Sustainable Development Goals (SDG) (Kioupi & Voulvoulis 2019). It is defined as an approach to education that promotes the knowledge, skills, values, and attitudes necessary for individuals to contribute to sustainable development (Li et al., 2022).

Integrating sustainable development into education is paramount in addressing the current world's pressing environmental, social, and economic challenges. By integrating sustainable development into teaching, students can be equipped with the knowledge, skills, and values necessary to create a sustainable and equitable future. Education plays a crucial role in the development of skills and knowledge that contribute to the transformation of mindsets and establishment of a sustainable vision (Halmaghi et al., 2021). Incorporating sustainable development into education requires integrating relevant knowledge and skills into the curricula across all educational levels. In addition, it calls for enhanced collaboration between scientists and educators. By working together, scientists and educators can develop curricula that promote the conception of common values, personal and collective integrity, social responsibility, and freedom of choice (Gacic & Cesarevic, 2021).

A key area that supports this goal is higher education. Higher education institutions play a unique role in shaping the minds of future leaders, professionals, and changemakers. By incorporating sustainable development principles into curricula and educational programmes, educational institutions can prepare students to become responsible global citizens equipped to address sustainability challenges in their respective fields (Salleh et al., 2019). This integration can occur across various disciplines including engineering, ICT, criminology, and agriculture.

Integrating sustainable development into education offers several benefits. First, it helps to raise awareness and understanding of the interconnectedness of environmental, social, and economic systems. Students learn about human impacts on the environment, the importance of social equity and justice, and the need for sustainable economic practices (Ramos & Balance, 2021). This knowledge enables them to make informed decisions and take responsible action personally and professionally. Second, integrating sustainable development in education helps develop values such as social responsibility, ethical decision-making, and global citizenship. Students learn to consider the long-term consequences of their actions and make choices that contribute to the well-being of both the present and future generations. Value-based education cultivates a sense of responsibility and empathy towards the environment and society.

Furthermore, integrating sustainable development into education promotes critical thinking and problem-solving skills. Students are encouraged to analyze complex sustainability challenges, evaluate different perspectives, and develop innovative solutions. This fosters a culture of innovation and creativity that is essential for addressing the complex and evolving sustainability issues faced in the Caribbean.

Integrating sustainable development into education also prepares students to change their job market. As sustainability becomes increasingly important in various industries, employers seek professionals with knowledge and skills related to sustainable practices (Ebaid, 2021). By incorporating sustainability into curricula, higher education institutions can ensure that graduates are well prepared to meet the demands of an evolving job market and contribute to sustainable development in their respective fields.

Given the region's particular challenges, education for sustainable development (ESD) is crucial for the Caribbean. The Caribbean is particularly vulnerable to climate change impacts, such as frequent and severe hurricanes, sea-level rise, coral reef degradation, and changing weather patterns affecting agriculture. These impacts disproportionately affect Caribbean communities, highlighting the need for tailored adaptation strategies (Dorkenoo et al., 2022; Cashman & Yawson, 2019). By integrating sustainability into higher education programmes, future generations are better prepared to deal with environmental challenges (Nurse et al., 2014). Education for Environmentally Sustainable Development (EESD) plays a vital role in addressing

these impacts by providing local knowledge and adaptation strategies tailored to the vulnerabilities of Caribbean communities.

The Caribbean economy relies heavily on tourism and agriculture, both of which depend on a healthy environment. Educating students on sustainable practices helps to safeguard these economic pillars. The EESD is also relevant for addressing the financing needs associated with climate change mitigation and adaptation in the Caribbean. Owing to limited domestic resources, the Caribbean Small Island Developing States (SIDS) faces significant financial challenges in implementing climate change actions (Mohan, 2023). By integrating climate finance education into the curriculum, students can develop an understanding of the economic mechanisms available for climate change, mitigation, and adaptation as well as the importance of international climate finance in supporting the region's climate objectives. This knowledge can help inform policy decisions, enhance the effectiveness of climate finance utilization, and promote sustainable development in the face of climate change.

Moreover, EESD is relevant to the Caribbean's pursuit of sustainable economic development and the blue economy. The blue economy, which focuses on the sustainable use of ocean resources, presents opportunities for economic growth and environmental conservation in the Caribbean (Huang, 2022). The EESD can provide the necessary knowledge and skills to harness the potential of the blue economy and contribute to its sustainable development.

Caribbean Higher Education institutions have made notable efforts to integrate environmental sustainability into their curricula and overall institutional frameworks. These efforts reflect a growing awareness of the region's vulnerability to environmental challenges such as climate change, biodiversity loss, and resource depletion. Below are some examples of how sustainability is being incorporated across several institutions in the region.

**Barbados** – The Centre for Resource Management and Environmental Studies (CERMES) at the University of the West Indies offers Master's and Doctoral programmes along with short courses and workshops (CERMES, 2023). The institution's programmes are designed to address Caribbean-specific environmental issues, such as coastal ecosystem management and climate resilience. CERMES also plays an active role in regional research, contributing to projects that explore sustainable resource management and adaptation to climate impacts.

**Belize:** The University of Belize Environmental Research Institute (UB ERI) enhances national scientific capabilities for sustainable natural resource management (UB ERI, 2023). The institute collaborates with government agencies and local communities to conduct research that directly informs environmental policy in Belize. The program has been particularly effective in promoting field-based learning, allowing students to apply theoretical knowledge in real-world contexts.

**Guyana** – The University of Guyana provides programmes in Environmental Management, Renewable Energy, Climate Change, and Disaster Risk Management (University of Guyana, 2023). The institution has partnered with international organizations to bring cutting-edge sustainability research and technology into the classroom, enabling students to work on live projects that support the country's sustainable development goals.

**St Lucia** – In St Lucia, the Curriculum and Material Development Unit offers a Massive Open Online Course (MOOC) on climate change in collaboration with the University of Seychelles and the Commonwealth of Learning (Commonwealth of Learning, 2020)

**Suriname** – Anton De Kom University offers a degree programme in Environmental Science focusing on sustainable resource management (Anton De Kom University of Suriname, 2023).

**Trinidad and Tobago:** The University of the West Indies and the University of Trinidad and Tobago provide various environmental and climate change education programmes. These include Bachelor's, Master's, and PhD programmes, certificates, and research opportunities (The University of the West Indies, 2023; The University of Trinidad and Tobago, 2023).

### **Challenges and barriers**

The incorporation of sustainability into the curricula of higher education institutions presents several challenges. A significant obstacle arises from the absence of unified methodologies that can effectively facilitate comprehensive and inclusive implementation of sustainability (Ramisio et al., 2019). Another challenge is determining how sustainability should be incorporated into the curriculum. This includes identifying specific topics to be taught and selecting appropriate pedagogical approaches (Mintz and Tali, 2013).

Furthermore, it is imperative to acknowledge and tackle the challenges and tensions that emerge during the planning phase of sustainability education. These challenges encompass disagreements on sustainability and sustainability education, the role of course designers, and collaborative decision-making processes (Herranen et al., 2020). The presence of diverse groups in sustainability-oriented educational projects poses several challenges, such as conflicting perspectives, group dynamics, and facilitation challenges (Cincera et al., 2019).

Additionally, it is imperative to address the challenges associated with integrating teaching and research, facilitating alternative educational routes, and securing adequate financial assistance (Ashford, 2010). Successful integration of sustainability into the curriculum relies heavily on student engagement. It is imperative for students to actively engage in the learning process and be provided with opportunities to apply sustainability concepts and skills in real-world contexts (Li et al., 2022). Nevertheless, students may encounter various obstacles, including limited exposure to sustainability issues, insufficient motivation, and conflicting time commitments (Li et al., 2022).

To tackle these challenges, institutions can offer experiential learning opportunities, encourage student-led initiatives, and integrate sustainability into co-curricular activities (Menon and Suresh, 2020).

The incorporation of sustainability into a curriculum presents a distinct set of challenges. These include institutional barriers, curriculum design and implementation, faculty and student engagement, and resource constraints. Effective leadership, fostering interdisciplinary collaboration, providing faculty development opportunities, and actively engaging students are imperative to successfully address these challenges. By effectively addressing these challenges, higher education institutions can successfully integrate sustainability into their curricula and adequately prepare students to assume the role of responsible and engaged global citizens.

### **Discussion**

Multiple strategies can be employed to optimize the incorporation of sustainability principles into curricula within higher education institutions. Research has consistently shown that student engagement is a vital factor in the integration of education into sustainable development (Jain, 2020). Sundaresan (2017) emphasized the role of higher education institutions in promoting sustainable human development through value education, which can be enhanced by student participation and engagement. The active involvement of students in valuable learning experiences equips them with the ability to contribute effectively as catalysts for change. Several instructional methods can be employed, including project-based learning, case studies, virtual simulations, and real-world problems. The approach outlined in this strategy entails engaging in projects that specifically target real-world sustainable challenges (Fuertes-Camacho et al., 2019). Incorporating indigenous knowledge involves actively engaging with indigenous communities and integrating sustainable practices and worldviews into a curriculum. The celebration and communication of successes can serve as a catalyst for further integration and motivation among faculty members and students. This can be achieved by showcasing success stories that inspire or encourage others.

Another strategy that can be employed to enhance the integration of sustainability into higher education curricula is its incorporation into higher education policies. To showcase a dedication to sustainability, institutional leadership can establish explicit policies and guidelines that prioritize the integration of sustainability. Curriculum audits review current curricula and identify opportunities to integrate sustainability principles. The primary objective is to ensure that the curricula align with sustainability goals.

To enhance the effectiveness of assessment and feedback mechanisms, assessment tools can be specifically designed to measure sustainability outcomes. According to Boud (2000), the integration process can be refined and improved through regular feedback from students and

faculty members. In addition to the aforementioned strategies, cultural and contextual factors that impact the incorporation of Sustainable Development Goals (SDGs) into higher education curricula should be considered. Vukic et al. (2021) emphasized the importance of curriculum innovation, which considers local environmental, social, and economic contexts. This approach guarantees that the curriculum is tailored to the local context and adheres to cultural norms while also aligning with the sustainable objectives set at the national level.

Partnerships should be established with non-governmental organizations (NGOs), businesses, local communities, and government agencies to enhance the curriculum with external knowledge and practical experience. Developing specialized sustainability courses, which will involve designing and providing standalone courses focused on various sustainability topics, is recommended. This approach ensures that students are provided with ample opportunities to explore and study the subject matter. Assessing and revising sustainability practices consistently is necessary as this field is constantly evolving. It is essential to conduct periodic evaluations of the curriculum to ensure alignment with current advancements and research.

By considering these strategies and approaches, higher education institutions can optimize the incorporation of sustainability principles into their curricula. The strategies encompass various components, such as faculty development, curriculum mapping, alignment with Sustainable Development Goals (SDGs), the establishment of competencies for sustainable development, the utilization of active learning methods, involvement in real-world projects, and the encouragement of interdisciplinary collaboration and community engagement.

However, incorporating sustainability into a university system presents challenges for education, research, operations, and outreach (Velazquez et al., 2006). Filho et al. (2018) discussed the challenges and benefits, emphasizing the multifaceted impact on various aspects of higher education. Farinha et al. (2019) highlighted the importance of sustainability strategies at the institutional level within the broader framework of higher education public policy systems. Moreover, the study by Tabucanon et al. (2021) emphasizes the commitment of higher education institutions to integrate sustainable development into their policies, practices, and programmes. This commitment underscores the growing recognition of incorporating sustainability into higher education policies. Universities can create a structured framework that promotes sustainability across all facets of academic and operational activities.

Future research could identify the requirements for recontextualizing pedagogy to incorporate SDG programmes in higher education institutions within the Caribbean context. Future studies can also look at the pedagogical requirements that can form the foundation of a model for the Caribbean region. The objective of the model is to ensure that the identified pedagogical requirements form part of quality education that fosters critical thinking, problem-solving, creativity, and innovation. For instance, for the effective alignment of curricula with the

environmentally sustainable development agenda in the Caribbean, one recommendation is a combination of theoretical frameworks that can be considered. Specifically, using the Backward Design framework, the curriculum alignment process can be structured, Experiential Learning activities can be integrated to provide hands-on experiences, and Transformative Learning principles can be incorporated to encourage critical reflections and perspective change.

### **Conclusion, Recommendations and Future Directions**

This study investigated the importance of integrating environmental sustainability into curricula and academic programmes within the Caribbean region. By incorporating developments, characteristics, and trends, an emerging picture of an interdisciplinary academic field can be formed, which has the potential to profoundly impact policy and practice in the years to come. The SDGs recognize the critical role that education plays in achieving sustainable development, and this can be a powerful tool in reducing poverty.

The study also examined existing efforts to incorporate environmental sustainability into the Caribbean. Given its vulnerability to climate change, the Caribbean region has recognized the importance of education for sustainable development. There have been multiple integrations into primary, secondary, and higher education institutions that promote and reinforce basic literacy of sustainable development. Numerous environmental campaigns and initiatives have been established and have played an integral role in public awareness, information dissemination, and environmental sustainability education.

Based on the above findings, this research suggests that higher education institutions play a pivotal role in cultivating graduates who possess both technical proficiency and are socially responsible. The literature suggests that higher education institutions play a critical role in (1) preparing informed citizens; (2) as role models demonstrating the feasibility and benefits of sustainable approaches; (3) driving innovation and research in sustainable technologies, practices, and policies; and (4) fostering community engagement and partnerships, thereby engaging the public to become more involved and environmentally aware.

Some practical applications of tailoring education for sustainable development within a Caribbean context by integrating the theoretical frameworks above are as follows:

- Applying Backward Design, a course on sustainable tourism in the Caribbean could be structured by first identifying the desired outcomes, such as students' ability to develop sustainable tourism strategies. Assessments may include creating a sustainable tourism plan for local communities. Learning experiences can then be designed to support these outcomes, such as guest lectures from local tourism experts, case studies of successful sustainable tourism initiatives, and field trips to eco-friendly resorts.

- Applying Experiential Learning to community-based learning in agriculture. For instance, an agricultural science programme may incorporate experiential learning by having students work on local farms that practice sustainable agriculture. Through hands-on activities, such as planting, harvesting, and implementing water conservation techniques, students can cycle through Kolb's stages of learning: having concrete experiences, reflecting on these activities, conceptualizing the broader implications for food security and sustainability, and experimenting with new ideas in their practices.
- Transformative Learning Theory can be applied practically with critical reflection on environmental policies. To illustrate, in a course on environmental policy, students could be encouraged to critically reflect on the effectiveness of Caribbean environmental regulations and their preconceptions about these policies. Activities may include reflective journals, debates on policy effectiveness, and discussions on environmental issues. By challenging their assumptions and engaging in discourse, students might experience transformative learning, gaining new perspectives on how to advocate environmental policy changes.

In addition, promoting values such as social responsibility, ethical behavior, and cultural sensitivity will add to the Caribbean landscape as equitable and sustainable societies.

A variety of future research opportunities could be identified in order to extend the strategies to align curricula with the SDG's, as such these include the following considerations:

- Limited studies have tracked how different teaching methods affect students' engagement with sustainability issues, their retention of knowledge, and the translation of that knowledge into sustainable behaviors over time.
- There is a need for comparative research to determine which pedagogical approaches yield the best outcomes for fostering sustainability literacy and practice among Caribbean students.
- Research is needed to understand how these pedagogical approaches can be adapted to the specific environmental, social, and economic contexts of the Caribbean nations to maximize their effectiveness.

Addressing this research gap will provide policymakers, curriculum developers, and educators with empirical evidence on the most effective ways to teach sustainability in the Caribbean. This can lead to more informed decisions, better resource allocation, and, ultimately, a greater impact on fostering a culture of sustainability in the region. By identifying pedagogical strategies, this research will contribute to the development of future leaders equipped to tackle the pressing environmental challenges facing the Caribbean.

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## **Expanding the Role of Information Literacy in the Age of Artificial Intelligence**

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### **Abstract**

The use of artificial intelligence has become increasingly common in higher education. While artificial intelligence has significant benefits for the educational sphere, academic librarians worry about its use. These concerns do not justify banning the technology altogether, but they must be addressed. As more students gravitate toward this technology, institutions must facilitate proper, responsible use. Improper use of artificial intelligence in academia can create academic integrity issues – including plagiarism and information misuse. However, librarians can minimize this problem by introducing ethical use of artificial intelligence into information literacy training. Librarians may reduce unethical AI use by teaching students how to authenticate sources, analyse data, and identify bias and misinformation. By focusing on information literacy, university libraries can help students stay abreast with the changing technological landscape while preserving academic integrity. This research sets out to investigate major roles librarians can play to support the use of artificial intelligence in a higher education setting. A content analysis of academic literature supports this qualitative study. The thematic analysis shows that artificial intelligence has greatly impacted academia, particularly information access, suggesting that librarians should help students develop the skills needed to navigate this new era. Technology has changed education, prompting a critical review of information literacy in the digital age. Universities cannot hope to prevent its use altogether but must focus on utilizing skilled librarians to improve information literacy and boost student outcomes.

*Keywords: Artificial intelligence, information literacy, higher education, academic librarian*

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## **Introduction**

As artificial intelligence (AI) advances, its integration into the education system has become inevitable. Increasingly, diverse forms of AI are effortlessly infiltrating our lives. Considering basic applications like predictive text, we can observe the continual and often subtle incorporation of AI into daily routines. Though AI can influence students' learning experiences, it also highlights the significance of librarians' expertise in assessing and contextualizing material within the digital deluge. In this regard, information literacy (IL), delivered with intention and mindfulness of current circumstances, remains essential across all educational levels to equip students for a future in which AI will be integral to their personal and professional lives.

In order for students to take advantage of the significant opportunity for success that exists with AI, librarians must assume a pivotal role. Librarians have consistently served as a conduit for researchers and students, providing researchers with the resources necessary for information literacy, which plays a vital role in academic integrity. Librarians ought to enhance information literacy sessions by incorporating AI literacy training. Expanding IL to include AI literacy may serve as a strategy to prevent violations of academic integrity. Academic librarians can develop modules to instruct students on the proficient utilization of AI technologies by categorizing the various types of AI, analyzing the characteristics of paid versus free AI tools, and elucidating the proper citation of AI materials, among other topics (Artificial Intelligence (AI) in Education Policy, UG, 2023, p. 19).

AI literacy is a contemporary notion that transcends traditional digital and media literacy, born of the necessity for the academic community's evolution to keep up with AI technologies. AI literacy fundamentally encompasses the skills and abilities necessary for the effective and efficient utilization of AI technology and applications in many contexts. AI literacy should be seen not

merely as an additional subject, but a component of a comprehensive education in the 21st century. AI literacy should serve to help students with the knowledge and skills they need to navigate an increasingly AI-driven society. It fosters critical thinking, problem-solving, and digital literacy skills, and is a lifelong learning skill. AI literacy can extend to educate users to view these AI technologies such as ChatGPT critically, to understand their context, and to question their design and implementation. Users of such technologies must be able to discern the benefits and challenges of AI while making informed decisions about its use in academia to avoid any form of academic misconduct.

### **Statement of the Problem**

Although AI has emerged as the foremost technical innovation in the global information landscape, it is now being approached with caution by librarians in Guyana. Being insiders, the researchers who have worked in an academic library setting for over two decades felt that their current information literacy programme was insufficient to help learners navigate among artificial intelligence. It is the view of the researchers that Guyanese librarians must urgently assume a role in the implementation and integration of artificial intelligence within the higher education sector. According to Ali et al., (2020) the role of librarians becomes increasingly relevant due to AI. This research aims to examine the significant responsibilities librarians can assume to facilitate the utilization of AI. The findings may interest academic librarians and provide a framework and strategy for local librarians to establish a forward trajectory.

### **Objectives**

The objectives of this study are to:

- Ascertain whether the scope of IL covers the emerging age of AI
- Ascertain the potential roles that IL training can play in mitigating the challenges raised by the use of AI for academic student work.

### **Literature Review**

#### **Theoretical Underpinning**

Information literacy is the capacity to identify information deficiencies and to address them through assessment. The Association of College and Research Libraries (ACRL) offers a framework including various competences essential for information literacy. Additionally, a pertinent theory to support this research is the Information Search Process (ISP) established by Carol Kuhlthau (2004). The ISP theory provides a detailed understanding of how individuals seek information and the stages they go through during this process. Kuhlthau's model comprises six stages: initiation, selection, exploration, formulation, collection and presentation.

Further, the ISP model emphasizes the cognitive dimensions of information seeking. This model places emphasis on the importance of supporting users through each stage to enhance information literacy skills. As it relates to AI in academia, the ISP model is relevant to addressing the emotional and cognitive challenges users face when interacting with AI tools and technologies. It supports the use of IL training sessions for students to easily navigate and break down any cultural resistance barrier that they may face.

### **AI in Academia**

In recent years AI has become a crucial driver in transforming the educational landscape. AI has impacted all sectors of higher education bringing about significant changes in how education is delivered, accessed, and personalised (Reiss, 2021). The academic library is not exempt from the integration of AI. Folorunso and Momoh (2020) predicted that AI would become an important tool for libraries. Cox (2022) gave reference to the growth of AI in academic libraries and stressed the need for librarians to be prepared for the changes. With the extensive use of AI, universities created policies to address the abuse of the tool in academia. For example, the University of Guyana's AI policy emphasises responsible and ethical use of AI, which aligns with the University's strategic goals outlined in the Blueprint 2040. The policy covers ethical and societal concerns; promotes responsible use of AI in teaching, learning and administrative processes; supports the use of technology and online resources responsibly; and commits to provide students and lecturers with the opportunity to learn more about the use of AI tools.

AI offers numerous benefits in higher education, such as automated grading systems, adaptive assessments, curriculum planning, and gamification. Automated grading helps in providing quick and impartial assessments (Kim & Araujo, 2021). AI-driven adaptive assessments personalise learning experiences, making education more effective (Swiecki et al., 2022). Curriculum planning and gamification engage students and enhance their learning experiences (Murillo-Zamorano et al., 2021).

Despite its benefits, AI poses significant challenges, particularly concerning academic integrity. The irresponsible use of AI can lead to plagiarism and the misuse of information. Robinson (2020) as cited in Ng et al (2021) emphasizes the need for students to differentiate between ethical and unethical AI use, while Steinbauer et al. (2021) underscore the importance of equipping students with the skills to navigate an AI-driven environment responsibly. Tiernan et al. (2023) highlighted that AI use posed significant challenges for learners in information seeking that only IL strategies could solve. Additionally, there are concerns that over-reliance on AI might reduce students' critical thinking and problem-solving skills, as they might depend too much on AI for answers, potentially diminishing their self-reliance and creativity (Holmes et al., 2019). It is important that AI tools are leveraged effectively to advance scholarship and learning within the institution (Tomar & Verma., 2021). To ensure its effective use, it is important that AI instruction become an

important, if not, mandatory part of the higher education curriculum (Southworth et al., 2023) possibly through information literacy training.

### **Interplay between AI and Information Literacy**

Generative AI tools can be inherently biased and if students rely too heavily on AI without critical evaluation, this reliance can compromise the quality of their work and lead to the dissemination of misinformation (Zhai et al., 2024). The relationship between IL and AI is becoming more significant as more learners rely on AI; therefore, there is a need for them to develop abilities to identify, evaluate and responsibly use information. Lung & Wang (2023) posits that librarians' role become prominent in developing AI literacy as part of broader IL training sessions. By adapting to the current technological advancements, librarians can assist students to use AI tools responsibly.

With the changes and challenges faced by students, Ng et al. (2021) suggests that enforcing an understanding of AI in academia, including their ethical use, is crucial to enhance the knowledge of students and faculties on AI literacies which can be achieved by expanding information literacy instruction. "Information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning" (ACRL, 2016, p. 8). Including AI ethics in the teaching of information literacy will enhance students' critical thinking skills. They will learn to evaluate AI-generated content for accuracy, reliability, and ethical implications which empowers them to be discerning consumers and creators of information.

According to Teaching and Learning Resource Center (n.d.), IL training provides the necessary tools and equipment needed to teach students how to utilize information responsibly and without any difficulties. With the advancement of technologies and the introduction of AI tools, IL training must adapt and include how to effectively use AI in research. Such training must aim to prevent any misconceptions of the use of AI as a student. Expanding IL to include AI literacy can help mitigate ethical concerns associated with AI use. Librarians can provide professional development through interactive sessions and create modules or crash courses on the use and abuse of AI tools. Librarians need to establish an effective curriculum for IL with the inclusion of AI literacy. This helps to sensitize the students on the current policies related to the use of AI at the library and ensures that students use AI and cite correctly (Cox & Tzoc, 2023). According to Lo (2023) there is a need for new methods of information literacy (IL) instruction which will consequently lead to AI literacy. James and Filgo (2023) posit the Framework for Information Literacy for Higher Education as a useful framework to expand IL instruction to cater for the emergence of AI tools in the use of information gathering and utilisation. It is the highest used information literacy framework in the field of academic librarianship (Hsieh et al., 2021).

## **Methodology**

This study adopts a qualitative approach. Qualitative research is well-suited to exploring complex concepts like these, as it allows for an in-depth examination of meanings, experiences, and perspectives through the collection of non-numerical data (Creswell, 2013). The content analysis technique was used to explore the intersection of information literacy (IL) and artificial intelligence (AI) in academia. According to Krippendorff (2004), content analysis is “a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use” (p. 18). Content analysis is a research method used to systematically examine and evaluate documents to draw conclusions.

The data collection process involved searching the library databases and Google Scholar for relevant articles by using the following keywords: "information literacy and higher education", "artificial intelligence use in academia", "frameworks for teaching information literacy", and “information literacy training”. The initial search which was conducted during the period September to October 2023 yielded 570 results across various sources, which were filtered based on relevance, peer-review status, and the publication during the years 2020 to 2024. To ensure the quality and relevance of the selected articles, inclusion criteria required that the articles: focused specifically on either information literacy or AI in educational settings, were peer-reviewed and published in scholarly journals, and provided full access to the text. Abstract-only works and non-scholarly publications were excluded from the content analysis. Following this process, 18 articles were selected for detailed content analysis based on their alignment with the study’s objectives (Table 1).

The content analysis research method allows for themes to be used for the interpretation of the data as well as other aspects of the research topic (Braun & Clarke, 2006). This study utilized a thematic analysis which allowed for identification of key patterns and themes within the selected literature. This method provided insight into the overarching trends in the intersection of IL and AI, supporting the study’s goals of identifying how IL frameworks can incorporate AI literacy for the benefit of both students and librarians.

**Table 1**  
*Summary of Search Results and Article Selection*

Keywords	Source	Results (# of Articles)	Articles Selected	Inclusion Criteria
Information literacy and higher education	Google Scholar	150	5	
Artificial intelligence use in academia	Library Database	200	7	
Frameworks for teaching information literacy	Google Scholar	100	3	Scholarly articles, peer reviewed and available in full-text
Information literacy training	University Library DB	120	3	

### Findings and Discussion

Eighteen scholarly articles were included in content analysis of this qualitative research. The findings of this study revealed three overarching themes: **AI has infiltrated academia; there is a relationship between IL and AI; and there is scope for IL to aid in AI literacy.**

Several authors have concluded that **AI has infiltrated academia** (Cox, 2002; Ng et al., 2021; Reiss, 2021; Tomar & Verma, 2021; Southworth et al., 2023). The educational landscape has changed and so too are the related services and experiences (Folorunso & Momoh, 2020). The use of AI in academia derives both benefits and challenges. AI enhances educational accessibility and efficiency while supporting adaptive learning platforms that cater to diverse student needs. The many significant benefits of AI have the propensity to revolutionize the educational experience particularly through personalization and data-driven insights (Kim & Araujo, 2021; Murillo-Zamorano et al., 2021). The adoption of AI in academia does not come without its challenges. Despite the exceptional opportunities that can be derived from the application of AI in academia, there are some significant implications and ethical concerns that must be addressed (Holmes et al., 2019; Ng et al., 2021; Steinbauer et al., 2021). Artificial intelligence tools have impacted the information landscape which has a direct connection to the academic library, and librarians should not be apprehensive in embracing its use. Reference services, circulation processes, cataloguing processes, as well as dissemination of information have all been impacted by AI.

**The relationship between information literacy (IL) and artificial intelligence (AI)** lies in the fact that currently, AI plays a significant role in the shaping and processing of information. Students' information seeking behaviour is affected now more than ever because of AI. Information is no longer generated and provided only by humans. Machines using large generative language models such as ChatGPT are generating text that flows naturally and resembles human language. There is a significant relationship between IL and AI whereas AI technologies improve the search process by making data gathering faster and probably making more information available, IL provides the skills to evaluate and use the information. Tiernan (2023) posited that IL tools and frameworks could help students develop competencies to deal with AI in the information context. As such, there is a need for IL modules or curriculum that links IL and AI literacy for students.

**There is scope for IL to aid in AI literacy.** The rapid advancement of AI has introduced new challenges and opportunities in the realm of information literacy, particularly in understanding the ethics of using AI-generated text. As AI-generated content becomes more prevalent, university students must develop the skills to critically evaluate and use information generated by AI systems responsibly. The academic library can be leveraged to support students in using AI tools in such a way as to avoid negative consequences by expanding IL instruction to include ethics related to AI-generated text. The Framework for Information Literacy for Higher Education (ACRL, 2016) can be useful for repurposing information literacy instruction to incorporate AI literacy instruction (James & Filgo, 2023). The ACRL Framework is based on the following six tenets or frames which help students to use information responsibly: "Authority is constructed and contextual; Information creation as a process; Information has value; Research as inquiry; Scholarship as conversation; and Searching as strategic exploration" (ACRL, 2016, p. 2). According to Hsieh et al. (2021) the Framework does not have to be used in its entirety to remodel information literacy teaching. Of the six frames, four can be utilized to repurpose IL instruction to bring awareness to the fact that AI produces biases in information; it hallucinates; and to ensure that the academic voice should not give way to AI.

'Authority is Constructed and Contextual' is a frame that encourages learners to delve deeply into the construction of authority and its connection to truth and expertise (Rose-Wiles, 2024). Such a frame can be customized to teach learners the importance of critical thinking and evaluation of generative AI so as to be able to identify biases and gaps in the information. The 'Information has Value' frame aims to get students to think about the origin and value of information (Gross, et al., 2022) and as such can be used to teach learners the importance of citing sources as well as verification of accuracy of citations to help negate inaccuracies in citations that may be generated from AI tools. This frame can also be used to provide guidance on how to properly cite AI-generated text in academic and professional contexts. The 'Scholarship as Conversation' frame explains that "research in scholarly and professional fields is a discursive practice in which ideas are formulated, debated, and weighed against one another over extended periods of time" (ACRL,

2016, p. 8). This frame is therefore applicable to build a module to help learners realise that AI tools should not be used to replace their ability to contribute to scholarship through their academic voices. According to ACRL (2016) flexibility enhances the search process making it more effective. Librarians can therefore conduct training to provide search strategies and evaluation techniques for students to use as a guide along with ChatGPT using the ‘Searching as Strategic Exploration’ frame.

The three themes above have been able to respond positively to the objectives of this study as follows:

- **To ascertain whether the scope of IL covers the emerging age of AI.** In the dynamic landscape of information literacy, the traditional scope of IL has the capacity to navigate the complexities of the introduction of AI in higher education. As AI grows and can be applied to all aspects of life, so too can IL be expanded to cover AI literacy in its teachings. Librarians, as stewards of information dissemination and education, should play a vital role in bridging the gap by incorporating AI literacy into existing IL frameworks.
- **To ascertain the role that IL training can play in mitigating the challenges raised using AI for academic student work.** Integrating IL training to mitigate the challenges raised by using AI for academic student work would be beneficial for librarians, lecturers and students. AI tools like ChatGPT offer benefits such as enhanced learning and assisting with grammatical errors. However, the tool can also provide incorrect information and if used incorrectly, students can plagiarize by not citing correctly. This research highlights the role that AI training can play to mitigate these challenges.

The ISP model theorizes that information seeking is a process of construction (Kuhlthau, 2004). The findings of this study proves that AI can contribute and enhance that process as it can potentially offer personalised search results and make it easier for relevant and precise information to be found.

The implications of this study affect practice and further research. The implication for practice that has emanated from this study is the need for training. Librarians’ training in AI and machine learning education is very important. It equips them with the knowledge and skills needed to integrate AI literacy into their IL teaching. To effectively teach AI literacy, librarians and educators need to become AI literate. Further research on AI and IL is crucial in today’s digital age, where the proliferation of information and the sophistication of AI systems are rapidly increasing. Such research can possibly focus on best practices for educating learners on AI literacy.

The main limitation of this research was the methodological weakness of content analysis which was applied in the study. While useful for systematically analysing communication, the researchers

relied on subjective interpretation in selection of the materials to be included in the study. Additionally, the small sample of scholarly communication which was examined may affect the generalizability of the findings.

### **Conclusions**

Undoubtedly, AI technology has made its impact on the education sector, especially in higher education. Its integration offers benefits and opportunities as well as challenges that require the application of caution. Librarians have always embraced technological advancements in the field, such as automation and digitization. Similarly, there is also a place for the involvement of library professionals in artificial intelligence. Incorporating insights from the findings and discussion, it is evident that librarians play a pivotal role in enhancing AI literacy through information literacy training for the development of critical thinking skills. Although libraries may not serve as the primary locus of AI development, librarians possess adept skills to educate patrons on emerging technologies and their ramifications concerning information retrieval, ethical considerations, and the potential biases inherent in search results. As librarians, our niche in the learning process is the shaping of responsible practices for students through our information literacy instruction. Librarians must endeavour to help students to navigate the challenges of AI generated content. It is absolutely necessary that learners become information and AI literate enough to navigate the information landscape. AI literacy is more than gaining professional competencies, it is about critical thinking and understanding the world around us which is technologically driven. In this new era, it is important that librarians continue to help learners to develop abilities that will help them to make informed decisions about the information they consume, cite, and share. The importance of ethical responsibility in the use of information must remain a main area of focus. Understanding the ethics of AI-generated text is essential to avoid issues related to plagiarism, misinformation, and bias. Students should be aware of the ethical considerations surrounding the use of AI tools for content creation and dissemination.

Academic libraries and suitably trained librarians can support the development of these competencies by virtue of their specialty and involvement in information literacy. Information literacy can be complementary to AI literacy. Teaching information literacy and ethics in the context of AI-generated text is essential for university students in today's digital age. By equipping students with the knowledge and skills to critically evaluate and responsibly use AI-generated content, educators can empower them to navigate the evolving information landscape with integrity and discernment. Therefore, by expanding IL to include AI literacy, students will be taught how to develop a strong understanding of evaluating information and to make calculated decisions based on the facts presented before them. Having these necessary skills are critical to functioning in an information ecosystem that continues to see an increase in advanced internet technology including large language models. Through a combination of theoretical understanding,

practical exercises, and ethical discussions, students can become informed, ethical users of AI-generated text, contributing to a more responsible and informed digital society. Higher education institutions must be open to embrace and provide the necessary infrastructure to support IL and AI instruction.

### Recommendations

Building on the existing literature and the findings of this study, the authors recommend firstly, that a critical avenue for exploration lies in understanding the impact of AI technologies on information-seeking behaviours and cognitive processes within academic settings. Investigating how students interact with AI tools in libraries, especially concerning ethics and responsible use, can provide valuable insights for developing comprehensive IL training programmes. Furthermore, research should delve into the integration of AI literacy into existing IL curricula, assessing the effectiveness of educational modules in enhancing students' digital competencies and critical thinking skills. Additionally, studying the role of librarians as facilitators of AI literacy and ethical AI use in educational environments can shed light on best practices and interventions to promote responsible information. By delving into these realms, future studies can not only enrich the discourse on IL in the context of AI but also offer practical recommendations to enhance information literacy training programmes in higher education institutions, ensuring students are well-equipped to navigate the complex information landscape effectively.

Secondly, it is recommended that expanded IL which includes AI literacy should inculcate practical and interactive methods to avoid passivity in the instruction. This method should allow for hands-on activities that include the use of AI tools and technologies in undertaking research assignments. Some strategies that may prove effective for this type of instruction are as follows:

- i. *Hands-On Exercises*: Engage students in practical exercises where they interact with AI-generated text. Have them evaluate AI-generated articles, create content with AI assistance, and cite AI-generated content correctly.
- ii. *Case Studies*: Present real-world case studies that highlight ethical dilemmas related to AI-generated text. Encourage students to analyse these cases, discuss the ethical considerations, and propose solutions
- iii. *Debates and Discussions*: Organize debates and discussions on topics related to AI ethics and information literacy. This strategy encourages critical thinking and allows students to explore different perspectives on AI-generated text.
- iv. *Continuous Learning*: Information literacy and AI ethics are evolving fields. Encourage students to stay informed about developments in AI and related ethical considerations throughout their academic and professional careers.

Thirdly, measurement and evaluation in higher education are crucial for ensuring the quality and effectiveness of the teaching and learning processes. To examine the effectiveness of the use of IL to promote AI literacy in the academic library there must be periodic evaluation to ensure that objectives are being met particularly as it relates to equipping students with the necessary skills to navigate AI-driven environments responsibly. Robust metrics play an intricate role in assessing students' competency in navigating in the digital world. It gives an insight into how much students face challenges and need assistance from librarians. The implementation of comprehensive assessment tools like the use of surveys before and after AI literacy instruction sessions will help determine how much a student learnt from the session. It will also speak to the effectiveness of providing the training sessions and address ways to better the services of the academic library. Metrics should encompass a diverse range of criteria, including the ability to critically analyse sources, synthesize information, and apply findings to real-world scenarios. Further, institutions can tailor assessment criteria to address ethical considerations and ensure students grasp the nuances of utilizing AI tools responsibly.

In examining the long-term effects of information literacy education, it is crucial to consider the lasting impact on students' academic and professional endeavours. The proverb by the Chinese Philosopher Lao Tzu said, "Give a man a fish and you feed him for a day. Teach him how to fish and you feed him for a lifetime." This proverb helps the researchers to understand the importance that proper training in information literacy and the use of AI not only enhances students' ability to access, evaluate and utilize the information correctly and effectively, but also fosters a lifelong learning mindset. The student will be able to apply the knowledge in his/her studies and everyday interactions with the internet (if need arises). Integrating AI literacy into information literacy training can empower learners to ethically engage with AI tools; thereby, instilling a sense of responsibility and critical thinking.

This study presents an urgent call to action for expanding information literacy in the age of artificial intelligence. As AI tools become more prevalent in higher education, it is imperative for librarians to incorporate AI literacy within their information literacy training sessions. By equipping students with the skills to critically evaluate and ethically use AI technologies, academic institutions can mitigate risks associated with academic misconduct, such as plagiarism. Librarians play a vital role in fostering AI literacy among students, enabling them to harness the benefits of AI for enhanced learning experiences while addressing ethical considerations. The integration of AI literacy in information literacy training represents a crucial step towards preparing students to effectively engage with AI tools in academia and beyond.

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## **Maintaining and Enhancing Blended and Online Teaching and Learning: Lessons Learnt from Student Experiences of Select Programmes During the Pandemic Period**

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### **Abstract**

This paper explores the teaching and learning experiences of students from selected programmes offered by the University of the West Indies, St. Augustine Campus during the period of Emergency Remote Teaching (ERT) and the early return to face-to-face teaching. The students' experiences are assessed in relation to the Community of Inquiry (CoI) Framework, which promotes a combination of teaching, cognitive, and social presence for an effective educational experience. A survey approach was used to gather both quantitative and qualitative feedback on the aspects of online, hybrid, and in-person teaching and learning, the aspects of the programmes most valued and most disliked by students, and areas for improvement. Findings suggest that the blended and online environment requires intentional integration of teaching, cognitive, and social presence to ensure effective educational experiences online. Useful and diverse course content that built focus and awareness, had real-world applicability, and exposed students to new topics and outlook essential to students. The need for, and use of practical applications and experiences that linked theory to practice, were also emphasized and students required access to readily available and easy to navigate resources that support their learning online. To maintain and enhance students' online and blended learning experiences, universities must be able to productively regulate teaching and learning through course design and instructor facilitation, set an effective climate for constructive instructor-student dialogue, and support discourse through peer interaction and engagement efforts. The institution should provide infrastructure, and support appropriate training for faculty and other staff, and should prepare guidelines and policies on maintenance of quality in the online and blended environment.

*Keywords:* quality in online and blended learning, transitioning from ERT, Community of Inquiry Framework

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## Introduction

In response to the challenges presented by the Covid-19 pandemic, teachers and their students were left working and learning from home and separated from each other, many for the first time. No longer was there physical contact between these groups, posing a potential threat to the ability of many schools and universities to effectively deliver and regulate teaching and learning at a distance. Successful online teaching and learning is dependent on a combination of factors including specific attention to course design (Zimmerman et al., 2020), adequate technology, financial resources, skilled and motivated human resources, institutional support and effective use of the appropriate technology (Thurab-Nkhosi, Maharaj & Ramadhar, 2021). As such, the rapid migration to the virtual realm required educators to promptly adopt new methods and techniques to facilitate emergency remote teaching (ERT) during the pandemic (Hodges et al., 2020). Lessons learnt during this period can guide universities in their approach to maintain rigour and deliver quality online, and blended teaching, post-pandemic. This paper seeks to explore the experiences of students during the delivery of ERT and following the initial return to in-person teaching at The University of the West Indies (UWI), St Augustine.

## Context

The 75-year-old UWI, is ranked among the top five percent of the best universities in the world by the Times Higher Education (THE) World University Rankings (The University of the West Indies, Mona, 2018). The institution has five campuses: Mona, Jamaica; St Augustine, Trinidad; Cave Hill, Barbados; Five Islands, Antigua and Barbuda; and the Global Campus (formerly the Open Campus). Serving 18 English-speaking countries in the region, The UWI must make every effort to ensure continuous quality improvement, therefore an exploration of student experiences as teaching modalities evolve is imperative.

The focus of this study is the St Augustine Campus of The UWI. It is important to note that prior to the Covid-19 Pandemic, St. Augustine Campus (STA) primarily delivered its programmes and

courses in the traditional face-to-face classroom setting. For about thirty-four percent of the courses on the campus, the student learning experience was supported by online tools and resources facilitated by the Moodle learning management system, branded “myeLearning” by the institution (Thurab-Nkhosi, 2018). This study is based on the feedback received from students of various programmes offered by the Departments, Institutes, Schools, Centres, Units and Sites (collectively known as 'DISCUS'), at STA, in preparation for Quality Assurance Reviews (QARs) facilitated by the Quality Assurance Unit (QAU). Although STA switched to ERT from Semester 1 of the academic year 2020/2021 (i.e. from August 30, 2020), this research is based on data collected during the period March 7, 2022 – March 31, 2023. Student feedback was collected from surveys specifically designed by the QAU to ascertain their experiences of online, blended, and in-person teaching and learning. The students’ experiences are assessed in relation to the Community of Inquiry (CoI) Framework, which promotes a combination of teaching, cognitive, and social presence for an effective educational experience.

### **Issues to be Explained**

In this regard the issues to be explored are reflected in the following research questions, which guided the study:

- Using the CoI model, what are the implications of the students’ online, blended and in-person experiences, during and immediately following the Covid-19 pandemic, for maintenance and enhancement of quality?
- How familiar were students with using online platforms prior to the pandemic?
- What aspects of the online environment were rated most highly by the students?
- What aspects of the online environment were disliked by the students?
- How do students feel online teaching could be improved on the campus?
- How do students rate online classes compared with blended and in-person classes?

The first section of the paper explores the definitions of blended and online learning as they pertain to this study, and describes the CoI framework, which provides the context and conceptual framework for the paper.

## **Literature Review**

### **Blended and Online Learning**

Over the past decade, the rise in technological advancement has sparked interest and opportunity for universities and other teaching institutions to offer students online and blended teaching and learning experiences (Allen & Seaman, 2007; Diaz-Infante et al., 2022). The surge in demand for online and blended programmes, and the rise in competition for students, came however, as a result of the challenges presented by the Covid-19 pandemic. World-wide health restrictions forced traditional universities with little to no online teaching capacity to resort to instances of ERT where the courses were not intentionally designed prior to the pandemic for online delivery

(Hodges et al., 2020). Post-pandemic, these institutions must now focus on developing and enhancing intentional strategies of online and blended teaching and learning to remain competitive and meet the demands of their growing diverse student population. Prior pandemic, however, there seemed to be varying interpretations of the terms blended learning and online learning. The term “blended learning” in particular was defined in different ways in the literature and was used interchangeably with “mixed mode learning,” “hybrid instruction,” and “technology-mediated/enhanced learning” (Wang et al., 2015). Within recent times, new terms have emerged as well, such as multi-access, co-modal and hyflex learning. Since the pandemic, researchers have noted that there seems to be less confusion about the terms, and an understanding that they all describe the various ways institutions can deliver learning experiences to students (Amenduni & Ligorio, 2022; Johnson et al., 2022). While there may appear to be a lack of consensus about the definitions of these terms, research indicates that there is general agreement on the basic characteristics of the learning modes (Johnson et al., 2022). It seems clear that the most basic definition of blended learning is “a combination of face-to-face instruction and computer-mediated instruction” (Graham, 2006, p.5), however it is acknowledged that blended learning exists on a spectrum, with in-person teaching at one end and fully online teaching or what would be considered distance learning using the Internet, with no in-person interaction, at the other.

It is important for institutions to recognize the complexity of the variations of blended and online learning as they consider transitioning since these variations require different affordances to ensure quality in teaching and learning. The deliberate and complex nature of online and blended teaching challenge traditional approaches and demand the fundamental rethinking of the educational experience to include the role of the instructors, student interactions and meaningful ways of learning (Garrison, 2009; Vaughan et al., 2013). Therefore, to produce an effective and productive online learning environment, careful considerations of these elements and the collaboration of online instructors and students must be done (Shea & Bidjerano, 2009).

For the purposes of this study, online teaching and learning is conducted entirely online and involves courses which have been intentionally designed so that all instruction takes place using technology. There are no requirements for in-person classes. Hybrid teaching, also referred to as blended teaching in this paper, involves “the organic integration of thoughtfully selected and complementary face-to-face and online approaches and technologies” (Garrison & Vaughan, 2008, p. 148).

Researchers have indicated the importance of building in different types of “presence” in online and blended learning environments (Martin et al., 2022). Frameworks, which highlight this idea of presence that need to be considered for maintaining and enhancing quality blended and online teaching and learning, include the Community of Inquiry Framework (CoI) and the Technological Pedagogical Content Knowledge Framework (TPACK). However, for the purposes of this paper

the focus will be on the CoI framework since the research addresses the perception of students and the CoI is concerned with enhancing the educational experiences. TPACK focuses on integrating technology effectively with pedagogy and content knowledge in teaching and learning. So, while important for quality, it is a consideration that will be useful for a focus on teachers more so than learners.

### The CoI Framework

The Community of Inquiry (CoI) framework (Garrison, et al. 2001) provides an approach to designing learning experiences for the online environment. It is one of the more popular models, which draws on a constructivist perspective to pinpoint the community as a major element in effective online teaching and learning. Applying the CoI theoretical framework, Garrison et al. offer the view that student learning in online and blended learning environments occurs within a community of inquiry composed of social, cognitive, and teaching presence. The CoI framework identifies these three interdependent elements as critical to the educational experience as seen in

**Figure 1**

*The Community of Inquiry Framework*



Note. From Community of Inquiry: An Online Teaching Framework by A. Steele, 2019, Educational Technology @ HCT <http://edtech.hct.ac.ae/2019/04/12/community-inquiry-online-teaching-framework/>.

### **Social Presence**

According to Garrison (2009), social presence relates to the human experience of online learning, the “ability of participants to identify with the community, communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities” (p. 352). As seen in Figure 1, social presence constitutes three categories listed as affective expression, open communication, and group cohesion, with emotions, risk-free expression, and encouraging collaboration as indicators (Garrison & Arbaugh, 2007). As a foundation to a productive CoI, the framework emphasizes the importance for online students to be seen as “real people” while also recognising the challenge this presents in a non-traditional classroom environment (Garrison et al., 2000). Vaughan et al. (2013) believes that creating opportunity for social interaction strengthens students’ engagement and builds trust and familiarity such that social presence may emerge; this is central to setting the climate for rigorous debate and discourse and collaborative activity. The authors believe that pushing beyond social interaction to academic interaction and critical discourse moves the community from social presence to cognitive presence and into deep and meaningful learning (Vaughan et al., 2013).

### **Cognitive Presence**

Another element of the CoI framework, cognitive presence, is defined “as the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry” (Garrison et al., 2001, p. 11). It has been operationalized through the developmental phases of inquiry – a triggering event, exploration, integration, and resolution.

### **Teaching Presence**

Teaching presence can be considered the “glue” intended to bring together social presence and cognitive presence by creating the parameters for interaction. Garrison et al. (2000) describe teaching presence as the “design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes” (Garrison & Arbaugh, 2007, p. 163). Teaching presence encompasses three components: (a) instructional design and organization, (b) facilitating discourse (originally called “building understanding”), and (c) direct instruction (Arbaugh, 2008).

### **Critiques of CoI**

Though the framework has been referenced by thousands of authors (Bektashi, 2018), there have been criticisms questioning its utility, especially since online learning has been evolving at a rapid rate. Annand (2011) argues that social presence is overstated and that “students do not attach much value to the group-based influences of social presence” (p.41). He also opines that although the CoI is developed within the constructivist paradigm, “CoI research has for the most part morphed into quantitative analysis” (Annand 2019, p. 5). Annand sees this as somewhat of a contradiction. Responding to Annand (2011), Garrison (2012) points out that the construct of social presence

requires more refining but expressed the view that Annand's critique reflects a misunderstanding of the basic assumptions of the CoI framework.

The CoI framework has been described as presenting too much of a simplified view of online learning. While this simplicity can be helpful for conceptualizing online learning environments, it may not fully capture the complexity and messiness of online interaction. While interaction is important, the framework might also not fully consider other aspects of online learning, which could be disorganized (Xin, 2012). It is also important to note that it is a challenge for researchers to get a comprehensive understanding of the inter-dependence of the three presences. The three elements of: selecting content/regulating learning, supporting discourse, and setting climate overlap within all three presences (Xue et al., 2023). To address the complexities, some researchers suggest that more "presences" or constructs should be added to the framework such as learner presence, (Bektashi, 2018). Kovanović et al. (2018) suggest adding three sub-components to the three constructs, namely: course organization and design (a sub-component of teaching presence), group affectivity (a sub-component of social presence), and resolution phase of inquiry learning (a sub-component of cognitive presence).

While the Community of Inquiry (CoI) framework has some limitations, it provides useful considerations for the creation of meaningful online and blended learning experiences.

## **Methodology**

### **Research Design**

For this study, a survey approach was used to gather both quantitative and qualitative feedback on the aspects of online, hybrid, and in-person teaching and learning, the aspects of the programmes most valued and most disliked by students, and lastly areas for improvement. Student data and contact information were collected using The UWI's Argos Enterprise reporting tool. A convenience sample was utilized to gain feedback from a total of 902 respondents of the 4,695 students enrolled in programmes offered by the various DISCUS targeted by the QAU for quality assurance review between 2021 and 2022. An overall response rate of nineteen percent was achieved. While this response rate is low, the data can be used to inform further research, in tandem with other sources of information, to guide action on blended and online learning developments. The names of the DISCUS have been replaced to ensure confidentiality of the information.

### **Sample Population**

While ERT was implemented between March 7, 2022 and November 25, 2022, the QAU surveyed 3,832 students enrolled in the programmes of seven DISCUS, which for the purposes of this study have been renamed ERT 1-7. Feedback was received from 659 respondents on the aspects of online and hybrid teaching and learning.

Following the return to physical classes in September 2022, students were also surveyed between February 27 and March 31, 2023 on aspects of hybrid teaching and learning. The QAU surveyed 863 students enrolled in the programmes of three DISCUS, which for the purposes of this study have been named BL 1-3. Feedback was received from 243 respondents on the aspects of physical teaching and learning.

### **Data Collection**

To capture the varying context of the students' online and blended learning experiences, the study used two survey instruments developed by the QAU and distributed and monitored via SurveyMonkey. The first student feedback questionnaire contained 15 closed-ended items to reflect quantitative data and six open-ended items to reflect qualitative data. The survey targeted students online during the period of ERT. The second survey contained 20 closed-ended items, which reflect quantitative data and 10 open-ended items to reflect qualitative data. This survey was developed to gain feedback from students who experienced blended learning in the period of early return to in-person teaching. Both surveys included several 5-point Likert Scales measuring students' perceptions of the quality of their programme and resources, the application of the key attributes of the UWI graduate, and their perceptions of their learning experience. The scales used were coded: strongly disagree, strongly agree, poor and excellent. The statistical measure Cronbach Alpha, a common measure of internal consistency or reliability, was used as part of the data analysis to determine the consistency of responses among the respondents. It is most used when there are multiple Likert questions in a survey/questionnaire that form a scale or subscale, and one may wish to determine if the scale is reliable. Data relevant to the research questions were derived from the surveys and entered into the IBM Statistical Package for the Social Sciences (SPSS) software. Frequency tables were generated for information regarding the demographic characteristics of participants and Microsoft Office Word 2016 was utilized for the generation of charts and graphs. Student responses to the open-ended questions: aspects of the programmes most valued, aspects of the programme most disliked and areas for improvement, were also recorded and coded based on themes emerging from the responses. These themes were then further categorised according to the CoI framework. Percentages pertaining to the frequency of the themes were obtained and compared. Data from the responses were used to answer the specific research questions for this study identified in the Introduction.

### **Ethical Considerations**

To ensure anonymity and protect the confidentiality of participants, the seven DISCUS were coded as ERT 1-7. By removing all identifying information, the study avoided revealing the identities of the DISCUS and deterred any link to the study's results, protecting them from any potential stigma that may arise from their connection in the research.

## Limitations

This study was limited to a convenient sample of students enrolled in programmes during a period of ERT and early return to in-person classes in The UWI St Augustine Campus and may present two possible limitations. The first is linked to representativeness as feedback gained from students may not reflect the fully online student population who experience intentional online and hybrid teaching strategies such as asynchronous sessions. Secondly, a low response rate of only nineteen percent was achieved from a sample size of nine hundred and two respondents. Ideally, a higher participation rate would have allowed for more diverse opinions to be reported. Yet, students were self-selecting in participation lending credit to the validity of the results gained and though the response rate is low, the data can be used to inform further research, in tandem with other sources of information, to guide action on online and blended learning developments.

## Findings

### How familiar were students with using online platforms prior to the pandemic?

Thirty-three percent of all respondents surveyed on the aspects of online and hybrid teaching and learning indicated that they were familiar with using some online learning platforms prior to the pandemic. While twenty-seven percent of undergraduate respondents indicated using online learning platforms before the pandemic, only six percent of postgraduate respondents indicated a similar experience (Table 1).

**Table 1**

*Student Respondents Familiar With Using Online Learning Platforms Prior to the Pandemic*

Respondents	Frequency	Percentage
Undergraduates	1048	27%
Postgraduates	218	6%
Total	1266	33%

### What aspects of the online environment were rated most highly by the students?

Students were also asked to respond to questionnaire items, based on their perception of aspects of their online teaching and learning experience. The following categories were used:

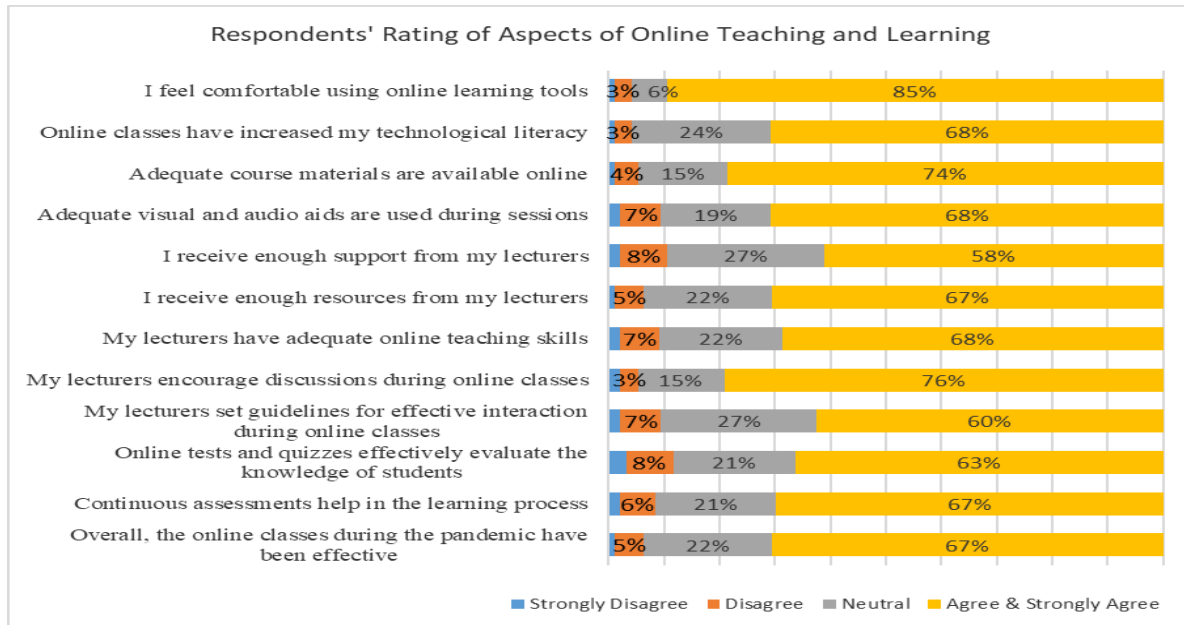
- I feel comfortable using online learning tools.
- Online classes have increased my technological literacy.
- Adequate course materials are available online.
- Adequate visual and audio aids are used during sessions.
- I receive enough support from my lecturers.
- I receive enough resources from my lecturers.

- My lecturers have adequate online teaching skills.
- My lecturers encourage discussions during online classes.
- My lecturers set guidelines for effective interaction during online classes.
- Online tests and quizzes effectively evaluate the knowledge of students.
- Continuous assessments help in the learning process.
- Overall, the online classes during the pandemic have been effective.

Most respondents positively rated the aspects of online teaching and learning (Figure 2), the mean rating was “agree”. Almost all the respondents agree and strongly agree with the statement “I feel comfortable using online learning tools” and sixty-eight percent felt that online classes had increased their technological literacy. Seventy-four percent of respondents believed that adequate course materials were available online and sixty-eight percent stated that ample audio and visual aids were used during sessions. Fifty-eight percent of respondents indicated that they received enough support from their lecturers and sixty-seven percent stated that they had received enough resources from their lecturers. Sixty-eight percent of respondents believed that their lecturers had adequate teaching skills; seventy-six percent stated that their lecturers encouraged discussions during online sessions and sixty percent stated that their lecturers set guidelines for effective interactions during online sessions. Regarding the statement “online tests and quizzes effectively evaluate the knowledge of students” sixty-three percent of respondents agree and strongly agree. Sixty-seven percent of respondents indicated that continuous assessments help in the online learning process. Sixty-seven percent of respondents also agree and strongly agree with the statement “overall, the online classes during the pandemic have been effective.”

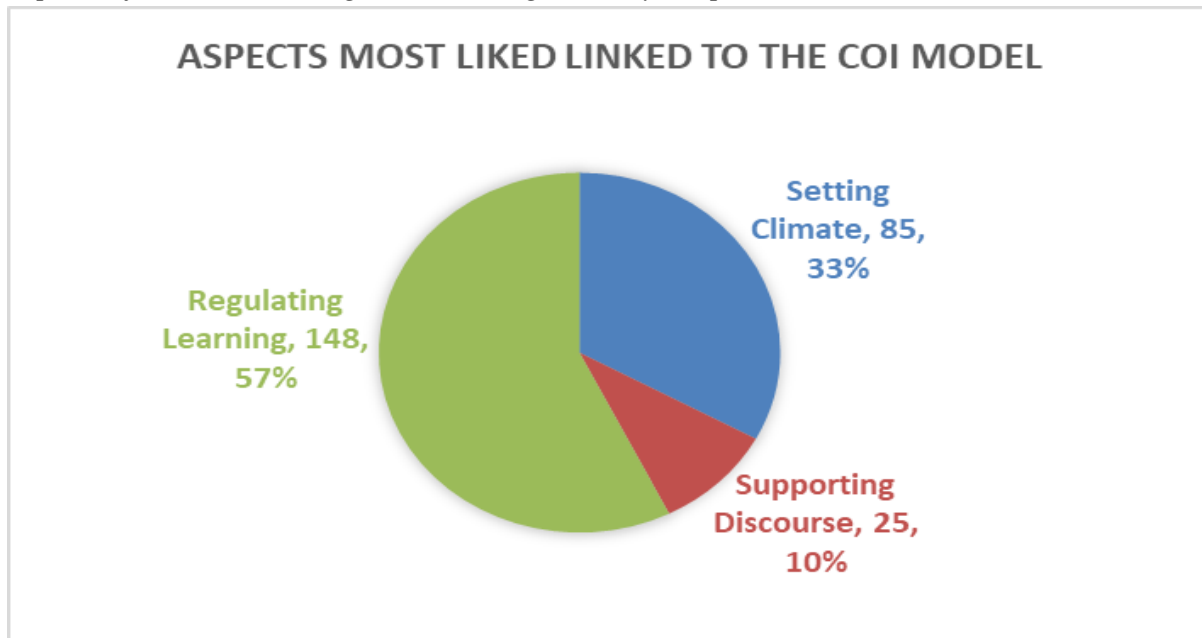
The survey instrument also sought to gather qualitative data on the aspects of online teaching and learning that respondents valued the most. Open-ended feedback received was coded based on themes emerging from responses and were further broken down to reflect the various features described by respondents (Table 2). These were then linked to the presences identified in the CoI framework. Most frequently, respondents indicated course content, dedicated lecturers, knowledge and skills developed, peer and classroom interactions and physical and online resources as being the most valued aspects of online and hybrid teaching and learning. Practical applications and experiences, lecturers’ feedback and communication, online sessions, assessment methods and teaching methods were some other aspects also identified as most valued by respondents.

**Figure 2**  
*Aspects of Online Teaching and Learning Rated by Respondents*



The aspects of online teaching and learning most valued by respondents were linked to cognitive, teaching and social presence of the CoI framework, and the intersecting aspects identified in the framework as “regulating learning”, “setting climate” and “supporting discourse” respectively (Figure 3). The focus was on these intersecting areas linked to educational engagement.

**Figure 3**  
*Aspects of Online Teaching and Learning Liked by Respondents*



**Table 2**

*Aspects of Online Teaching and Learning Most Valued by Respondents*

Themes	Sub-Themes	Frequency	CoI Elements	CoI Features
Course Content	Topics build focus and awareness Useful Real-world issues/applicability Availability of content Level and depth of knowledge Connections to other aspects/ courses in degree Diverse fields Exposure to new ideas/outlooks	74	Cognitive and Teaching Presence	Selecting content/ Regulating Learning
Knowledge and Skills Developed	Knowledge gained Critical thinking Leadership skills Communication skills Confidence	31		
Physical and Online Resources	Readily available Easy to use/navigate Class recordings/lecture notes My eLearning	20		
Practical Applications and Experiences	Theory linked to practice World of work connections Expands knowledge New skills and experiences gained Hands on approach to learning	16		
Assessment Methods	Continuous assessments /100% coursework Coursework/exam split Effective evaluations	7		

Dedicated Lecturers	Support Willingness Passion Knowledgeable Kindness Patience & Effort Teaching Skills Helpful Guidance Mentoring	63	Teaching and Social Presence	Setting Climate
Lecturers' Feedback and Communication	Guidelines for assignments Requirements for tasks Quick response times	8		
Online Sessions	Access and opportunity Effectiveness Convenience Cost effective Offers flexibility Time management and scheduling skills	9		
Teaching Methods	Fosters desire to learn Techniques and tools Peer learning opportunities Interactive learning activities	5		
Peer & Classroom Interactions	Interactions with peers Interactions with teachers/tutors Verbal communication Engagement Conversations/discussions Community/ connections Collaborations Problem solving Idea creation/generation	22		

Lecturers' Feedback and Communication	Student–lecturer dialogue	3		
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### What aspects of the online environment were disliked by the students?

Respondents were also asked to provide feedback on the aspects of their online teaching and learning experience they most disliked. Feedback was coded based on themes emerging from the responses and were further broken down to reflect the various features described by respondents (Table 3). Heavy workloads and assignments, the lack of online and physical resources, and poor course content and delivery were themes most frequently identified by respondents as the aspects of online teaching and learning most disliked. Other aspects most disliked included unsupportive lecturers, online delivery, poor teaching methods, poor feedback and communication, rigid class schedules, the lack of internships and employment opportunities, the lack of practical applications and experiences, poor academic advising, and poor administration. When linked to the CoI framework, aspects of online teaching and learning most disliked by respondents most frequently related to regulating learning, followed by setting climate and supporting discourse (Figure 4).

**Table 3**

*Aspects of Online Teaching and Learning Most Disliked by Respondents*

Themes	Sub-Themes	Frequency	CoI Elements	CoI Features
Heavy Workloads and Assignments	Overwhelming number of assignments Unrealistic deadlines Heavy course load Fast-paced learning	62	Cognitive and Teaching Presence	Regulating Learning
The Lack of Online and Physical Resources	Limited content online	29		
Poor Course Content	Unclear course outlines Limited exposure to content	29		
The Lack of Internships and Employment Opportunities	Poor job opportunities in the field Lack of internships to gain work experience	4		

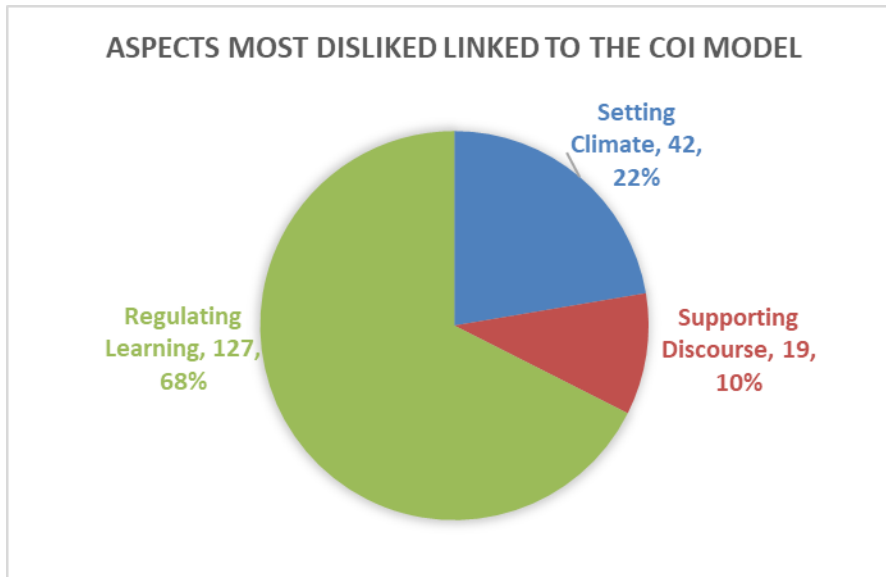
The Lack of Practical Applications and Experiences	Limited enhancement of skills	3		
Unsupportive Lecturers	Poor support and guidance	18	Teaching and Social Presence	Setting Climate
Poor Teaching Methods	Poor teaching skills Not enough explanations Lack of engagement	13		
Poor Feedback and Communication	No feedback on assignments/opportunity for correction Unclear guidelines and requirements for tasks Poor response times	11		
Poor Academic Advising	Inadequate advising resources available Lack of support in navigating the system	2		
Poor Administration	Disorganised Poor communication	2		
Online Delivery	Lack of physical learning environment Isolating Limited interactions online Practical skills and labs lost	15	Social and Cognitive Presence & Teaching and Social Presence	Supporting Discourse & Setting Climate
Rigid Class Schedules	Late night sessions	4		

### How do students feel online teaching could be improved on the campus?

Respondents were given the opportunity to voice their recommendations for improvements to the delivery of online teaching and learning. Coded based on emerging themes, the responses were as follows: more online/hybrid sessions, review workload and assessments, diverse and practical course content, more practical experiences, improved teaching methods, and more support from lecturers and supervisors. These themes were further broken down to reflect the various features described by respondents (Table 4).

**Figure 4**

*Aspects of Online Teaching and Learning Most Disliked by Respondents*



**How do students rate online classes compared with blended and in-person classes?**

Overall, the aspects of physical and blended teaching and learning were positively rated by respondents; the mean rating was “agree”. When compared with blended and in-person classes, it was found that respondents rated aspects of online teaching and learning more favourably (Figure 5). These aspects include the amount of course materials available during sessions, the amount of visual and audio aids used, the level of support and resources received from their lecturers, their lecturers’ teaching skills, whether discussions were encouraged during sessions, and the overall effectiveness of teaching and learning.

**Using the CoI model, what are the implications of the students’ experiences for maintenance and enhancement of quality?**

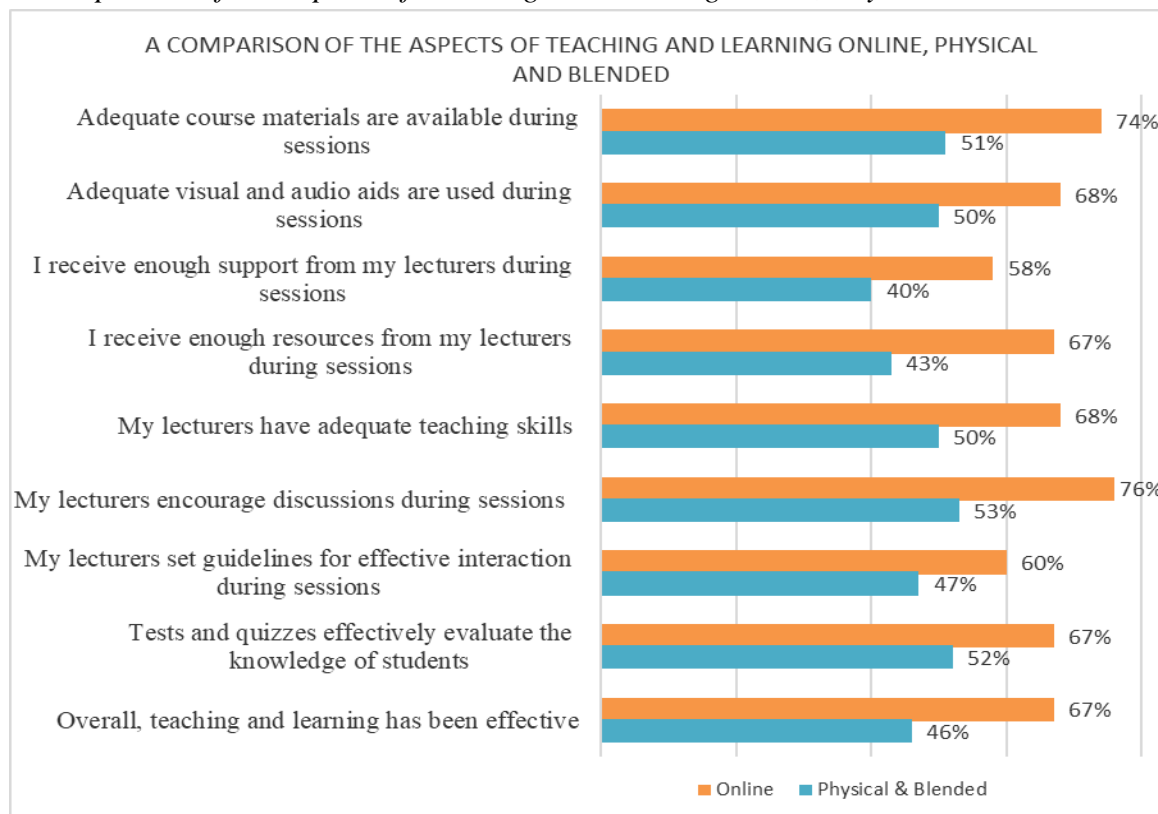
To confirm maintenance and enhancement of quality, students’ online and blended learning experiences were explored in relation to teaching presence, social presence and cognitive presence as indicated in the CoI framework. Findings suggest that the blended and online environments require intentional integration of these presences to ensure effective educational experiences online. Creating and enhancing cognitive, teaching, and social presences require an innovative approach by teachers during planning, implementing, and evaluating their online courses (Gogus, 2023).

**Table 4**

*Recommendations for Improved Online Teaching and Learning*

Themes	Sub-Themes	Frequency	CoI Elements	CoI Features
Review Workload and Assessments	Continuous assessments More time to complete physical exams Practical assessments vs theory based	20	Cognitive and Teaching Presence & Teaching and Social Presence	Regulating Learning & Setting Climate
Diverse and Practical Course Content	Range of materials Real-world connections Exposure to new ideas Useful in the world of world	18	Teaching and Social Presence	
More Practical Experiences	Real-world experience Internships Hands-on approach to learning Connecting theory to practice	13		
More Online/Hybrid Sessions	Technologically enhanced teaching Convenience Better scheduling	20	Social and Cognitive Presence & Teaching and Social Presence	Supporting Discourse & Setting Climate
Improved Teaching Methods	More interactions/discussions Group activities More explanations	9	Teaching and Social Presence	Setting Climate
More Support from Lecturers and Supervisors	Encouragement Guidance Timely feedback Mentorship	8		

**Figure 5**  
*A Comparison of the Aspects of Teaching and Learning Online, Physical and Blended*



### Regulating Learning – Teaching and Cognitive Presences

Results reveal that students most valued aspects of online learning related to regulating learning, a mix of teaching and cognitive presences. Aspects such as course content, knowledge and skills developed, online resources, practical application and experiences, and assessment methods were essential to maintaining and enhancing their online learning experience. The students' comments in relation to instructional design and course organization are well aligned with teaching presence. These online aspects identified also credit the exchange of information and connecting and applying new ideas as important to student engagement and are therefore also linked to cognitive presence. Directly tied to the knowledge and skill they developed, and key in their online education, students indicated having useful and diverse course content that built focus and awareness, had real-world applicability, and exposed them to new topics and outlook. The need for and use of practical applications and experiences that linked theory to practice was also emphasized as it enables students to apply and expand the knowledge they gained in the classroom to world-of-work and further enhance their skills and confidence. Students also required access to readily available and easy to navigate resources that support their learning online, well-paced course loads with realistic expectations and learning outcomes, and manageable evaluations that effectively assess their knowledge. Researchers such as Kucuk and Richardson (2019) found that a dominant determinant of student satisfaction in the online environment is teaching presence.

Further supporting these findings, Hosler and Arend (2012) in a study on student perceptions of the relationship between teaching presence and cognitive presence, found that critical thinking was positively influenced when an instructor designed an organized course with clear goals and relevant assignments. Likewise, Shea et al. (2003) examining students' perceptions of teaching presence online, found that the instructional design and organization component correlated most highly with student satisfaction and reported learning. Given the importance of teaching presence, it is crucial for instructors to undertake intentional preparation when designing and co-ordinating learning activities, with clear expectations for "classroom norms" (Baker & Taylor, 2012), ensuring the infusion of teaching presence and offering foundation for cognitive presence online. In this way, the "grand design" of the course is evident (Garrison et al., 2001) and importantly, supports critical thinking and meaningful learning (Garrison et al., 2000), thereby regulating learning.

The lecturers' ability to set the climate for teaching and learning in the online environment was also rated highly by students. There is general consensus that online classes can often be impersonal. Such classes can lack the simple but meaningful verbal and nonverbal cues and the overall social presence and immediate response-time that permeates traditional, face-to-face classrooms (Cunningham, 2015). In this regard, it is vital for instructors and course designers to integrate aspects of teaching presence to reflect the social presence of lecturers online, to ensure productive online instruction, engaged and motivated students, and overall success in class (Jones-Roberts, 2018). The data suggest that by setting clear guidelines for effective interactions, encouraging discussions, and having adequate teaching skills to foster the desire to learn online, lecturers were able to construct and maintain social presence. Teaching methods used also supported interactive learning online and fostered student engagement, critical for the exchange of information. Additionally, students saw their lecturers as being knowledgeable, supportive, and helpful. Their passion, willingness, patience, and kindness were also emphasized as valuable in the students' learning online as it created an environment of trust and openness (Garrison, 2009). Yet, it is likely more important for the instructor to simply be available for students through a well-structured course (Preisman, 2014). Supporting this claim, findings reveal students' dissatisfaction with the poor levels of feedback and communication received from lecturers online. Particularly in relation to their assignments and opportunities for correction. From the data, students indicated that lecturers needed to respond to their concerns and queries in a more frequent and timely manner. Frequent and timely interaction and communication with students online offer the perception of "being there", bridging one of the many gaps of the non-physical environment. Dunlap and Lowenthal (2018) also reported that contact between students and faculty in and outside of class is critical for student engagement because it influences student motivation and involvement which underpin cognitive presence.

### **Supporting Discourse – Social and Cognitive Presences**

Students identified aspects of teaching presence as important to engagement in the online environment but clearly indicated a dislike for the isolation of online learning. To achieve engagement in online education, teaching and learning must be regulated in an effective climate and supported by functional discourse. Closing the loop, it is vital for lecturers to set the stage for purposeful and collaborative learning processes and activities as indicated by the perceived relationship between social and cognitive presence (Garrison et al., 2000). While the instructor's presence is "seen" through course design and instruction, students' social presence is facilitated and encouraged in relation to a sense of being and belonging in a course (Picciano, 2002).

Findings reveal that students valued their peers and the interactions they shared in and outside of the classroom setting. Verbal communication, opportunities to share opinions and engage with each other and their lecturers online created a sense of community and connection. This led to students feeling more engaged and encouraged to collaborate, share ideas, and problem-solve. Such engagement and collaboration support critical thinking and therefore integrate the workings of the combined triad of presence. Supporting findings were reported by Hosler and Arend (2012) as critical thinking was positively influenced when an instructor designed an organized course with clear goals and relevant assignments, provided direct feedback that was encouraging, timely, and specific, and actively facilitated discussions that kept everyone focused and participating at a meaningful level. In this way teaching and learning online was intentionally planned for and designed to combine the presences and accommodate successful online learning experiences.

### **Practical Application and Future Direction**

Results from this study support the previous reports that advise the careful consideration and integration of the teaching, social, and cognitive presences required for successful online education (Akyol, 2009; Gogus, 2023; Voegele, 2013). Findings are based on a period of ERT and the early return to in-person teaching. Insights gained from students' experiences adds value in such context. Centred on the aspects of online and blended teaching and learning most valued, and those disliked, along with recommendations for improvement, key results endorse the following:

- Lecturers have a key role in blended and online teaching and learning to ensure the course is well organised, clear, and they communicate frequently and in a timely fashion. This requires intentional planning and organising, and adequate follow-up and academic student support.
- Climate setting, which allows for collaboration, and removes feelings of isolation is critical to student engagement in the online environment. This also requires proper planning and investment of the institution, to select the right platforms and to have adequate technical and emotional support for students.
- The ability to practice competencies, through internships and other practical experiences, remain crucial in either online or blended environments. In this regard collaboration with

employers and planning to facilitate authentic assessments and or competency-based activities in the online environment will also be critical.

The key results of this study support the existing literature and suggest that for the maintenance and enhancement of quality in online teaching and learning institutions need to ensure that preparation for blended and online learning is intentional, and integrates the presences, as identified by the students. The features most liked by students, those disliked and their recommendations in this study, give some indication of the affordances that may be required depending on the context.

In addition, these findings suggest the role of the institution in providing infrastructure, supporting appropriate training for faculty and other staff, and preparation of guidelines and policies on maintenance of quality in the online and blended environment. Existing quality assurance rubrics such as the Quality Matters (QM) rubric for higher education can serve as a useful framework, along with findings from internal studies. Orientation and continuous, robust, support for students is also critical to ensure there is mutual understanding of roles and responsibilities, and there are realistic expectations.

To maintain and enhance students' online and blended learning experiences, universities must be able to productively regulate teaching and learning through course design and instructor facilitation, set an effective climate for constructive instructor-student dialogue, and support discourse through peer interaction and engagement efforts. In this way teaching, social and cognitive presences work in tandem to produce quality educational experiences online.

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## Exploring Synergies Between Employers and Educators: Towards Graduate Effectiveness

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### Abstract

The idea for this study originated from the University Council of Jamaica's 2023 webinar hosted as one of the events for its annual Quality Assurance in Higher Education Week. The theme under consideration was *Strengthening Quality in Teaching and Learning Practices in Higher Education: The Graduate Effectiveness Imperative*. The webinar highlighted the need for consistent practical exposure to the field/industry, the importance of non-technical skills, work ethics and values, and the need for greater synergy between academia and employers. This paper focuses on the importance of graduate effectiveness in higher education; the quality assurance systems used in higher education to strengthen graduate effectiveness; and possible strategies to improve graduate effectiveness in the workplace. Given the concerns expressed and the strategies shared, an exploratory sequential design mixed methodology was used to explore the articulated gap that exists between the graduates' skills and competencies and the employers' needs and expectations. Data derived from the employers' themes from the webinar; the survey responses from the purposively selected higher education institutions (HEIs); and document analysis of selected UCJ Standards were analysed for patterns, trends and relationships. The findings indicate that there are both HEI and employer-related barriers which impact the technical and non-technical preparation of students for the world of work. This suggests that there is scope for employers and HEIs to engage in strategic partnerships towards the strengthening of the graduates' effectiveness.

*Keywords:* Employability, employability skills, graduate effectiveness, employer engagement, non-technical skills, higher education institutions

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## **Introduction**

The University Council of Jamaica (UCJ) Quality Assurance (QA) Week 2023 Webinar addressed the theme *Strengthening Quality in Teaching and Learning Practices in Higher Education: The Graduate Effectiveness Imperative* and shared views on the involvement of employers in programme development towards building synergies between Higher Education Institutions (HEIs) and the employers. The presenters were Dr Michaela Martin, Programme Specialist and Interim Deputy Director; International Institute for Educational Planning - UNESCO; Professor Shermaine Barrett, Dean, Faculty of Education & Liberal Studies, University of Technology, Jamaica; Mr Lenworth Kelly, President, The Incorporated Masterbuilders Association of Jamaica (IMAJ); and Mrs Carla McIntosh-Gordon, Group Chief Strategy Officer, VM Group.

In setting the context, Martin (2023) shared that there has been a rapid expansion of enrolment from 2000 to 2020 in HEIs worldwide. Data shared from the World Bank reveal that between 2007 and 2013 there was an increased number of unemployed persons with tertiary education suggesting that there is a mismatch between skills required in the labour market and graduates' profiles (Martin, 2023). To correct this mismatch, Martin (2023) expressed that there is more pressure on HEIs to adapt their education and training to labour market needs. Employability is currently seen as a major outcome of higher education (HE), and there is a need to develop Internal Quality Assurance (IQA) processes that are directed towards the enhancement of graduate employability. However, Martin (2023) also emphasized that HEIs should navigate the existing tension between educating for the future versus meeting short term needs.

Barrett (2023) continued the discussion on quality, stating that quality education is a right for all individuals at all levels; quality education must be responsive to its context and valued by stakeholders such as students and employers. She further stated that a quality curriculum is fit for purpose and should be holistic. Barrett (2023) emphasized that education must aim for the development of the individual's technical/work-related skills and non-technical skills. Education should also facilitate personal growth and transformation; ultimately promoting the development of a fully functioning and humane society.

Martin (2023) also shared findings from the International Institute of Educational Planning (IIEP) Research Project *Internal quality assurance: Enhancing higher education quality and graduate employability*. The research established that context matters; there are different views among universities and among faculties on the role of the university regarding employability. The priority of employability and the priority of academic quality are influenced by strategic orientation (for

example, national policy context and the level of unemployment), type of institution and the orientation of the academic offer. According to the research shared, IQA plays a role in enhancing employability as the IQA practices enhance the university's reputation and graduate employability; and consequently, IQA also helped to build strong interaction between academics and labour market representatives (Martin, 2023). The findings from the research indicated three effective IQA tools and processes for employability: graduate tracer studies, job market analysis and employer involvement in programme development and revision (Martin, 2018, 2023).

Kelly (2023) and McIntosh-Gordon (2023) expressed that both technical and non-technical/soft skills are critical to the preparation of graduates who are effective in the workplace. Kelly (2023) and McIntosh-Gordon (2023) opined that the performance of the graduate is more influenced by non-technical skills including adaptability, critical thinking, problem-solving, the ability to communicate, and a teachable spirit as described by Kelly (2023). The employers emphasized that new graduates enter the workplace with theory, in need of experience and practical exposure to the world of work. As such the employers invest in and subsidize the graduates until they are sufficiently experienced to add value to the organization (Kelly, 2003 & McIntosh-Gordon, 2023).

Given the articulated gap between HEI graduates' skills and competencies and the needs and expectations of employers, this study aimed to explore the synergy between HEIs and employers towards graduate effectiveness. The study sought to: identify perceived barriers to the HEIs development of employability skills and the engagement of employers in the preparation of graduates for the workplace; identify the perceived barriers to teaching employability skills and to engaging employers in this process; and possible strategies for the further engagement of employers in the preparation of graduates for the workplace.

The study sought to identify the strategies that HEIs used to prepare the graduates for the world of work and how HEIs engaged employers in the preparation of the graduates for the workplace. The following research questions were used to guide the study:

- What are the strategies that are used by HEIs to prepare work ready graduates?
- What are the perceived barriers to the development of employability skills in students in HEI programmes?
- What are the perceived barriers to the engagement of employers in the development of the work-ready graduate?
- How do HEIs engage employers in the development of the work-ready graduate?

## **Literature Review**

The literature reviewed provides an understanding of the key concepts to be explored when examining the synergies between employers and educators that should result in effective graduates.

It presents employability as a complex multidimensional concept, understood by employers and HEIs as critical to graduate preparedness for the world of work; the barriers that exist between employers and HEIs; and the role the external quality agency plays in fostering the synergy between them.

### **Employability**

According to Yorke (2006), employability derives from complex learning and is a concept of wider range than those of 'core' and 'key' skills. Employability has many facets which range from understanding of one or more subject disciplines to 'soft skills' (such as working effectively with others; the ability to reflect productively on experience) (Yorke, 2006). Yorke (2006) further defines employability as a set of achievements – skills, understandings and personal attributes – that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy (Yorke, 2006).

Employability is defined by the International Labour Organization (ILO) as relating to:

portable competencies and qualifications that enhance an individual's capacity to make use of the education and training opportunities available in order to secure and retain decent work, to progress within the enterprise and between jobs, and to cope with changing technology and labour market conditions...Individuals are most employable when they have broad-based education and training, basic and portable high-level skills, including teamwork, problem solving, information and communications technology (ICT) and communication and language skills...This combination of skills enables them to adapt to changes in the world of work. (ILO, 2013, p. 1)

Higher education institutions, employers and quality assurance agencies have found it useful to specify employability skills that are not usually related to a particular job, an academic discipline or area of knowledge, but can be used in a wide variety of situations and work settings, and which employers value in changing environments (UNESCO, 2014). These non-technical or employability skills are also referred to as transversal skills, 21st century skills, soft skills, higher-order skills, non-academic skills, non-cognitive skills, and generic skills. Examples of these include critical and innovative thinking, interpersonal skills, interpersonal skills, global citizenship and media and information literacy (UNESCO, 2014).

The UCJ Standards refer to general education courses which provide this broad-based educational experience to enhance the learner's ability to acquire information, reason clearly, and communicate effectively. The Standards recommend that the general education curriculum content should give students opportunities to gain the knowledge, skills, attitudes and values in order to meet the demands of an increasingly complex and diverse global society. The Standards also indicate that the general education component is often not directly related to a student's area

of specialization but is a common foundation for all areas of study. General education courses serve to address that facet of employability skills popularly described as the soft skills and are intended to impart common knowledge, intellectual concepts, and attitudes that every educated person should possess (UCJ Bachelor of Education Standards, 2018, pp.11-12).

An effective graduate is therefore an individual who in their outlook and operation utilizes both the technical and non-technical skills to adapt to changes in the workplace and to make a meaningful and productive contribution to society.

### **Employer engagement**

Hogarth et al. (2007) are of the view that active forms of employer engagement include significant levels of partnership with the employer which adds to the learning process in the HEI educational process. Examples of such engagement include funding; work placements; standard setting; course design; assessment, involvement in/contribution to teaching, lecturing or workshops; and releasing staff for workforce development activities (Hogarth et al., 2007, p.8). This type of engagement varies from passive HEI engagement in which employers “purchase the products and services of HEI” and are involved in the recruitment of graduates, career days and job fairs (Hogarth et al., 2007). Whilst active engagement is more desired and is the focus of this study, it is acknowledged that the latter may act as a pathway to a more effective engagement.

### **Barriers to employer engagement and employability skills in the curriculum of HEIs**

Barriers to employer engagement with HEIs may originate from both the HEI and the employer. Suleman, Videira and Araujo (2021) report from the perspective of employers, that the barriers from the HE systems seem to be structural, indicating as an example, that HEIs have curricula and pedagogical methods that are not readily changed, and as such are less responsive to the employers and students’ needs.

From the employer’s perspective, one of the barriers to an ongoing HEI-employer engagement relates to a dependence on “interpersonal relationships that were vulnerable to staff turnover so that it was difficult to maintain links even where they had been established” (Hogarth et al., 2007). Suleman, Videira and Araujo (2021) found that while some employers believed that personal contacts through faculty and alumni were adequate ways to engage with HEIs (p.10), there was research that indicated that such engagement becomes inconsistent and irregular if processes are not institutionalized (Suleman et al. p.14).

This raises the question of an overall institutional strategy to employer engagement within institutions, as a feature of their internal quality systems. In highlighting the importance and role of libraries, and the increasing trend to produce Library Employability Guides by HEIs in the United Kingdom, Mawson and Haworth (2018) cite Cole & Tibby (2013) view that

*...employability is a university-wide responsibility...requires combined effort, working in partnership with other institutional services and departments, e.g. all schools of study,*

*careers centre, enterprise and business departments, placement support, students' union, student support services, library and information services, etc. (p.12)*

Asonitou (2015) reported that accounting teachers identified multiple barriers to the introduction of employability skills in accounting courses, including those that originated with HEIs management, missing policies, the teachers, and students (Asonitou, 2015)

### **External Quality Assurance Agency (EQAA) engagement with employers**

The Association of Specialized and Professional Accreditors, ASPA (2017) survey of 62 programmatic accreditation agencies in over 100 disciplines reported that 90% of its members had requirements for accredited programmes to be engaged with employers. The mechanisms in place for engagement were primarily in the areas of community and employer involvement in curriculum design, employer satisfaction surveys, advisory boards/councils and practical placements for students. These were evident in 100% of ASPA member accreditors of programmes whose mission is linked to employment. ASPA (2017) also stated that the programmatic accreditation agencies directly engaged with employers and that more than one method of engagement was used. The areas of involvement were chiefly standard development and review, employer participation on decision-making bodies, job practice analysis to inform accreditation standards, employer surveys, and employer/industry councils.

Other areas of involvement were reported which sought to include “employers’ perspective of the nature of the practice and employment in the field to inform the accreditation process and establish competencies” (ASPA 2017, p.5). Employers were also reported by ASPA to be engaged in the self-study report preparation and the site visit interviews, a position supported and recommended by The UCJ in its programmatic and institutional accreditation. The UCJ’s Standards and Guidelines reviewed as a part of this study also outline requirements for Jamaican HEIs to engage with employers and to facilitate the development of employability skills.

## **Methods**

This inductive study used an exploratory sequential design mixed methodology. The sources of data were The UCJ Quality Assurance in Higher Education Week March 2023 Webinar recording, survey results from a sample of HEIs, and a sample of The UCJ Standards. Data were derived from multiple sources and analysed. Each data source is further discussed.

The established outcomes of the Webinar were to reflect on the importance of graduate effectiveness in higher education; identify the quality assurance systems used in Higher Education to strengthen graduate effectiveness; and commit to adopting possible strategies/solutions to improve graduate effectiveness in the workplace.

The Webinar recording was reviewed and analysed for significant patterns and the critical themes voiced by the presenters. It was distilled and words, phrases and sentences representing employability and engagement themes were highlighted. The excerpts from the audio transcripts were shared with the presenters for feedback regarding possible errors or misrepresentations.

The main themes identified from the employers' presentations were used to design a 16-item survey "*Graduate Effectiveness/Employability*" with a combination of open-ended and objective type questions (See Appendix 1). The survey, designed using Google Forms, was shared with a purposively selected sample; 11 of the 47 Jamaican HEIs that have been quality-assured using The UCJ's accreditation standards and guidelines. The anonymous responses provided by 46% of the targeted HEIs were analysed. They were also checked to ensure that they did not inadvertently include words or phrases that could reveal the identity of the participants or the institution.

The third component of the data collection involved reviewing and analysing a sample of The UCJ Standards and Guidelines to explore HEIs' employer engagement and employability skills requirements of programmes and institutions. The Standards reviewed were Guidelines for Programme Accreditation, Standards for Institutional Accreditation, Standards for the Bachelor of Education, Standards for the Occupational Associate Degree and the Standards for the Generic Bachelor's Degree Programmes.

The themes from the employers, findings from the HEI survey, and the analysis of The UCJ Standards were examined for patterns, trends, and relationships. These were then further analysed and discussed.

The study's ethical considerations emphasized obtaining participants' consent and ensuring their confidentiality by using pseudonyms.

## **Results**

In this section the findings from the employers' presentations; the document analysis of the sample of The UCJ's standards and guidelines; and the Graduate Effectiveness/Employability survey are shared.

### **Employers' presentations**

The following themes were identified from presentations by the employers, LK and CMG.

### ***Gender***

The theme of gender was introduced in a preliminary comment by CMG in relation to the format used by webinar presenters. This comment raised thoughts about institutions' consideration of gender in terms of placements during internship, work experience or summer assignments as applicable, or other partnership engagements with employers.

### ***Non-technical/Soft Employability Skills- A Paradigm Shift in Employment Focus***

The employers, LK and CMG agreed on the type of employability model that ought to inform the preparation of graduates. While not downplaying the importance of the technical skills, the stated emphasis was on the importance of non-technical/soft/employability skills for the work-ready graduate. Such a graduate, according to LK, and also supported by CMG, was seen to be “*trainable, having a teachable spirit*” with an understanding of the culture and ethos of the workplace and the employer/industry. CMG indicated that this resulted in a paradigm shift in the recruitment and employment of graduates with “*less focus on the technical competencies*” that graduates bring to the workplace.

### ***Disconnect***

The employers emphasized the “disconnect” between the skills demanded by the workplace and the skill set of the new graduate. CMG referred to the “*disconnect with how our organization understands the emerging generation and how they think, their values, their attitudes and their beliefs*”. Both employers opined that graduates are not able to apply crucial skills such as critical thinking and problem-solving in the world of work.

LK highlighted the “*lack of summer employment*” and “*... placements in the field*” which occurred more routinely in the past. LK also expressed that “new graduates are totally lost... have no appreciation of the field”. This supports the view of CMG who addressed the importance of learning from experience versus learning from others versus learning in structured settings. CMG stated that the HEI programmes are not meeting the needs of the employers.

### ***Proactive HEI Sector-Information Sharing***

Employer LK indicated that the findings of HEI's tracer studies, and other related research pertaining to the graduates should be shared with employers. LK also stated that the higher education sector should be proactive in forecasting the demands of industry/employers, adjusting the training to meet the needs and not just relying on the standard curriculum. As a country, Jamaica should prepare graduates for the global labour force.

### ***Bridging the Divide Through Partnership***

Both LK and CMG argued for the need to implement strong partnerships between employers and HEIs. The employers alluded to what they viewed as the “employers subsidizing the graduate,

building the graduate while they work” until they can add value to the workplace. The employers reported that this leads to a loss of efficiency in the workplace.

CMG argued for strategic partnerships to bridge the divide between the employability skills which employers need and the HEI graduate, indicating that there were various strategies which when implemented, result in an “exponential growth in the mind-set change” of the graduate and how they lead.

*Internships sustained assigning of mentorships; coaching; use of organizational hurdles as case studies for agile, faster, more meaningful learning; introduction to transformational leadership; partnered research and funding; partnerships.... Earlier involvement of the graduate in voluntary activity, corporate social responsibility and environmental, social and governance... [CMG]*

### **Early and Consistent Engagement**

The employers suggested that there would be greater efficiency with an earlier engagement with work-related concepts that assist in developing the required skills and competencies. LK shared that the student should be consistently exposed to practice in order to develop a real appreciation of what exists in the world of work; and that academic work should include significant exposure to the practices of the industry in which employment is desired.

*Greater synergy is necessary between academia and industry; to facilitate industry presenting to students; ...professionals sharing each week on aspects of industry... professionals share ethics, integrity ... failures/ malpractices in the industry... creates an appreciation of what is out there... what is not on paper... not academics or field trips... [LK]*

CMG also pointed to the attitude and skills required of the graduate. CMG emphasized the importance of understanding change management; workplace culture; and the focus on innovation, team, and maximizing the use of technology.

### **Document Analysis**

The focus of the document analysis was to identify words and phrases in The UCJ Standards which represent HEIs’ engagement of employers and the development of employability skills in HEIs’ students. Five UCJ Standards were analysed. These included:

- The overarching standards which govern the two forms of accreditation practiced by The UCJ, namely: the Guidelines for Programme Accreditation and the Standards for Institutional Accreditation. The analysis is presented in Table 1 under section headings including governance and management; quality of the programme (*teaching, learning and assessment*); students; students support services; faculty; and resources.
- A sample of the supporting discipline-specific and programme-level standards, namely the Bachelor’s Degree in Education, Standards for Occupational Associate Degree Programmes and Bachelor’s Degree Programmes Generic Standards. The analysis is

presented in Table 2 under the section headings including the process to develop the standards, the graduate profile, curriculum and programme management and quality assurance.

In Table 1, the governance and management standard recommends engagement with employers by obtaining their feedback, sharing improvement processes with employers, and involving them in planning and monitoring activities. The quality of the programme (*teaching, learning and assessment*) standard includes elements of feedback from external examiners, a role played by some employers, and its implementation towards continuous improvement. The inclusion of employability skills is evident in the requirement to ensure that programmes include general education courses and adequate practical components to include field experiences.

The standards pertaining to students urge HEIs to document and analyse statistics related to the graduates' employment patterns to inform programme improvement, whilst strengthening the competencies in areas such as oral and written communication. In relation to student support, the standards outline the need for HEIs to coordinate work/study arrangements and other interventions to develop students' employability skills. Included among these interventions is the opportunity for students to participate in HEI's governance and operations, which provides early development opportunities for skills needed in the workplace. Faculty standards require that as relevant to the programme, contact with industry is ongoing through a range of mechanisms including study tours, furloughs and workshops.

In Table 2, the three discipline specific standards were reviewed according to the four major subsections of the standards: preface/background, graduate profile, the curriculum and programme management and quality assurance. A review of the preface/background subsection revealed that engagement of the employers was a recurrent theme in all three standards; development/review of programmes in these areas should consider the employers needs and standards from relevant international bodies. The graduate profile for each standard describes the expected outcomes, these include the knowledge, skills and attitude that individuals should possess both as professionals and as individuals and are reflected as employability skills such as communication, work ethics and life skills. The input from employers and professional associations were recommended for curriculum development and review. The programme management and quality assurance section of the standards notes that formal procedures for developing, approving, implementing, monitoring, reviewing and maintaining the quality of the programme should include feedback from all stakeholders, including the employers.

**Table 1**

*A Review of Employer Engagement and Employability Skills in Two Overarching UCJ Accreditation Standards/Guidelines*

Accreditation Standards and Guidelines headings	Sample of findings	
	Employer engagement	Employability skills
Introductory sections	Employer feedback used for on-going improvement (PAG, p. 6).	
Governance and management	Regular feedback from stakeholders (employers, students, faculty) facilitated (PAG, p. 19). Needs analyses, market research, industry liaison, review of national priorities, professional requirements (SIA, p. 2). Improvement processes are shared with stakeholders (SIA, p. 3).	To enhance the communities served by HEIs; the objectives, goals are relevant to society's needs. (SIA, p. 1).
Quality of the Programme, Assessment/ Teaching and Learning	Students feedback evidenced by improvement strategies (SIA p. 22). Examiners' feedback implemented (SIA, p.23).	Adequate practical component Laboratory/Clinical Work/Field Experiences (PAG, p. 21); Effective relationship between curricular content and current field practices (PAG, p. 39)
Students	Graduation statistics; performance of graduates captured and analysed (PAG, p. 24).	Competence in communication skills (PAG, pp. 24 & 47). Career and graduates' employment patterns analysed to inform improvements (PAG, p. 23; p.25).

Accreditation Standards and Guidelines headings	Sample of findings	
Student support services	Employer engagement	Employability skills
Faculty	Evidence of work/study arrangements and career guidance (PAG, p. 29); (SIA, p. 25).	Career guidance, work/study (PAG, p. 29). Students participate in the institution's governance (SIA, p. 24).
Resources	Maintain and report on business/professions/industry/ contact (PAG, p. 25).	Evidence of relevant industry furlough, study tour, workshops; technology training (SIA, p. 18).
	Access information in a variety of formats so that they can continue life-long learning (PAG, p. 41).	Cooperative arrangements with other organisations, information resources and services (SIA, p. 23; p.30)

*Note: PAG -Programme Accreditation Guidelines; SIA -Standards for Institutional Accreditation*

**Table 2**

*A Table Showing that Employability Skills (ES) and Employer Engagement (EE) are in Selected Discipline-specific/programme-level UCJ Standards*

Accreditation Standards Sub-Sections	Sample findings		
	The UCJ Standards: Bachelor's Degree in Education	The UCJ Standards: Occupational Associate Degree Programmes	The UCJ Standards: Bachelor's Degree Programmes Generic Standards
Preface/Background	<b>EE:</b> “taking into account the needs of ... employer (p. i); respond to accountability demands by ..., employers, (p. 3)	<b>EE:</b> incorporates a work-based experiential learning component (p. 3)	<b>EE:</b> ...taking into account the needs ... employers (p. i)
Graduate Profile	<b>ES:</b> communication, self-management (pp. 4, 5 & 6)	<b>ES:</b> work ethics (p. 9)	<b>ES:</b> life skills (p. 2)
The Curriculum	<b>EE:</b> employers reflect the expectations of professional associations (p.11); <b>ES:</b> prepare <i>student teachers</i> for lifelong learning and responsible citizenship (e.g., p.17)	<b>EE:</b> involve employers - achieve the intended employers' requirements; Appoint an Occupational Advisory Committee... to ensure that programmes are relevant to employers (p. 20). <b>ES:</b> The programmes must ensure ... work ethics ... (p. 9); Includes courses in General Education... English and Communications (p. 21)	<b>EE:</b> ...include external evaluators such as employers... in periodic programme reviews. <b>ES:</b> The curriculum... comprises four parts: general education courses...
Programme Management (PM) and Quality Assurance (QA)	<b>EE:</b> ...shall include ... the use of feedback from ...employers for continual improvement (pp. 28 -29).	<b>EE &amp; ES:</b> ...nine listed standards and requirements to be satisfied (pp. 25 - 26) and these include #3 incorporate current job market information in its programme delivery through the involvement of employers	<b>EE:</b> ...Of the ten elements listed #9 refers to “Obtaining feedback from ...employers ... for continual improvement. (pp. 21 & 25).

*Note.* The table reflects relevant phrases/words/terms which represent employers' engagement (EE) and employability skills (ES) as described in the three standards which were reviewed.

Cotton (1993) categorizes employability skills into three groups: basic skills, for example communication; higher order thinking skills such as problem solving and decision making; and affective skills and traits such as dependability, motivation and self-management (Cotton, 1993). These are consistent with those expected outcomes identified by the graduate profiles in the selected standards reviewed.

The curriculum as outlined in the standards comprises the learning outcomes, the instructional strategies, the learning experiences and the assessment activities used within a programme. The curriculum for the programmes should reflect the philosophy and approach adopted in the programme structure. Institutions are encouraged to have a clearly defined process which outlines how the curriculum is developed, reviewed and monitored. The sampled standards not only identified that content should be technical or field specific, but they also pointed out the need for content that is non-technical and attitudinal, the employability skills (Table 2). These are introduced in general education courses such as communication courses and through other interventions and include work ethics, working collaboratively, self-assessment and career management. All the standards sampled address the curriculum being developed, reviewed, and monitored. This task, though owned by the institution, should incorporate feedback from other stakeholders such as other HEIs, students and employers (Table 2).

Programme Management and Quality Assurance refers to ensuring that academic standards are being maintained and enhanced in the programme and by the HEIs- developing, approving, implementing, monitoring, reviewing and maintaining the quality of the programmes. The processes must emphasize consistency, openness, standards and outcomes and shall include among other processes, the feedback from employers for continual improvement as stated by the Bachelor's in Education and the Generic Bachelor's Degrees Standards. The Associate Degrees Standard uses the involvement from the employers to incorporate current job market information in its programme delivery. Employer engagement is therefore identified as an important internal quality assurance tool to enhance quality and ensure fitness of purpose of the programme.

### **Graduate Effectiveness/Employability Survey Results**

The five HEIs that responded to the survey represented both the rural and urban areas of the island. Four HEIs described their funding as public/government funded and one as privately funded.

### ***HEIs Engagement of Employers in the Development of Technical Skills***

The HEIs stated that students are involved in practicum and/or work experience/internship in their area of specializations. These included teaching, agriculture, and health sciences. Other strategies that engaged students in consistent, practical exposure to a particular field/industry aligned to the programme of study included field trips; the use of labs and other hands-on activities; research projects; seminars; workshops and guest speakers in the areas of specializations. In addition, students engaged in other areas of service to the community through social outreach programmes.

The HEIs agreed that the technical preparation for the specified job at the identified HEI is sufficient for graduates to be effective in the workplace.

### ***HEIs Non-Technical Preparation of Students***

HEIs reported that the course of study for the programmes included non-technical preparation such as non-academic skills, work ethics and values.

In response to the question “what opportunities are in place for students to practise the non-technical, non-academic skills required to succeed in the particular field?” HEIs reported the following:

- *In presentations, group work and role plays non- technical skills are identified and students have opportunities to demonstrate how to apply these skills. Staff and other students will provide feedback on identified (exposed) behaviours. This activity provides the basis for monitoring these behaviours during the practicum/internship experiences. (HEI1)*
- *Soft skills are explored in professional development courses, sporting activities, debates, and other student-led activities/initiatives such as the Student Council and student affairs. (HEI2)*
- *Academic Advisement facilitates professional development; advisors are assigned to each programme, and they meet with students; Work Experience leader (dean/coordinator) along with team members visit students in industry and where weaknesses are identified they are addressed; Students Services and Guidance Department also provide support in this area, e.g. they facilitate mock interviews. (HEI3)*
- *Mandatory courses in Communication Skills and Ethics; Students voluntarily participate in health camps, career days at schools, and public health education events. (HEI4)*
- *Students engage in a business expo where they market their development and services learned from the course requirements; Presentations and workshops in identified non-technical areas. (HEI5)*

Seventy-five percent (75%) of the respondents indicated that the non-technical preparation provided by the HEI is sufficient for the graduate to be effective in the workplace; twenty five percent (25%) said it was not sufficient.

### ***HEIs Engagement of Employers***

The HEIs engage employers in curriculum development and review and the delivery of the content to students.

### **Curriculum Development and Review**

The HEIs indicated that they engaged employers in the process of curriculum development and review through advisory committees/boards and other mechanisms which facilitate employer feedback during the review process. Twenty percent of HEIs reported that the internship programme provides a channel for employer feedback to the HEI. Twenty percent of the HEIs

reported that the employer engagement feedback was only applied to some programmes within the institution but not to others; indicating the need for a consistent institution-wide approach.

Concerning the frequency of the interaction between the employer and the HEI, one HEI volunteered that semesterly meetings were held by an advisory board inclusive of employers, which suggests that a structured, consistent and operationalized mechanism is in place to review the curriculum and receive employer recommendations. Twenty per cent of the HEIs referred to the role of their governing bodies which “engage and contract employers to be a part of curriculum development along with academic staff”.

### **Curriculum Delivery**

The HEIs reported that employers are engaged in the delivery of the curriculum as guest lecturers. Other methods of employer engagement in curriculum delivery were field trip involvement (40%); laboratory support (20%); and one HEI reported that employers assessed students' projects.

### ***HEIs' Proposed Strategies for Further Engagement of Employers***

The HEIs proposed a range of strategies to support further engagement of employers in the preparation of the graduate for the world of work. The HEIs reported that having regular meetings and receiving feedback from employers would underscore the importance of the partnership and improve employer interest (20%). They pointed to the need to establish more partnerships, by introducing the co-operative education concept into programmes; and to have the industry partners keep them updated with the evolving technologies, as well as involvement in work experience and internship programmes (60%). They also suggested increasing involvement in mock interviews and hosting more employment fairs (20%); the use of more guest lecturers (40%); a mentorship programme with industry partners (20%); more involvement in curriculum development and review (40%); revenue sharing programmes (20%); showcasing success stories of our graduates to employers (20%); and involvement in talks at workshops and seminars (20%) as strategies to further employer engagement.

### ***Barriers to HEIs' Development of Employability Skills and Engagement of Employers***

The HEIs reported that barriers to more opportunities for the technical preparation of the graduates were: the limited number of sites at which students can do work experience; rural location which provided less opportunities; the location of some employers far from students' place of residence; an insufficient number of employers who are willing to accept trainees or interns; an inability to keep abreast of the technologies which change faster than they are able to upgrade the programmes; the programme being mostly geared for progression to higher level programmes; and limited funds.

In response to the question on “perceived barriers to your HEI providing more opportunities to non-technical preparation for the world of work” the HEIs identified multiple barriers at each institution. The barriers identified again highlighted the unwillingness of some employers to accept trainees or interns while other barriers generally fell into the categories of

implementation, financial constraints, time constraints and location. Table 3 outlines the responses from the HEIs.

**Table 3**

*Barriers to Providing Opportunities for Non-Technical Preparation for the World of Work*

HEIs	Barriers to Providing Opportunities for Non-Technical Preparation for the World of Work
HEI#1	<i>This is clearly outlined in the Policy; facilitators should ensure that activities are in place to practice these skills. [implementation]</i>
HEI#2	We have financial constraints. [ <i>financial limitations</i> ]
HEI#3	<i>Students' failure to participate as required in professional development activities; Advisors not participating in sessions as scheduled.[implementation]</i>
HEI#4	<i>safety concerns; intensity of the academic programme coverage [time constraints]; resources [financial limitations]; rural location [location]</i>
HEI#5	Limited funds [ <i>financial limitations</i> ]; insufficient employers willing to accept trainees or interns; some employers are located far from students' place of residence [ <i>location</i> ].

*Note:* Information italicised in square brackets [] are the interpretation of the authors.

All the participants identified barriers to involving employers in the development, review and delivery of curriculum in their HEI. Sixty percent (60%) of the respondents identified employers' time constraint/unavailability. Twenty percent (20%) also mentioned the employers' unwillingness as a barrier. Other barriers (20%) stated include: a lack of compensation for guest lecturers; the institutional process for securing guest lecturers and organising field trips; and [*lack of/need for more*] institutional planning for this area [development, review and delivery of curriculum].

## Discussion

### HEIs Development of Employability Skills

All HEIs surveyed indicated that the technical preparation of the students is sufficient. However, forty percent (40%) of HEIs agreed that there was a gap in preparing students with non-technical skills. Martin (2018) refers to this as a mismatch; although the number of graduates from HEIs was increasing, there was a gap between the labour market needs and graduates' profiles. This has resulted in an increased number of unemployed people with tertiary education.

The HEIs revealed that technical preparation involved students' participation in work experience and internship opportunities which would take place in the workplace. However, the non-technical preparation opportunities shared by HEIs did not include any employers' interventions. Research supports that active engagement of employers in the development of

the students' preparation may be more effective than if the employers were not engaged (Hogart et al., 2007; Suleman et al., 2021).

While the survey did not explicitly explore early and consistent engagement with employers, the webinar presenters emphasized that early exposure to work-related concepts, ethos and culture is important to strengthen students' employability skills before entering the workforce. For example, the use of the findings of tracer studies and other related research about the graduates to inform the preparation of students for the world of work. Martin (2018, 2023) identified tracer studies as one of the effective IQA tools and processes used by the eight HEIs case studies in a previous research project.

The UCJ Standards present a balanced approach to the need for both technical and field-specific content as well as non-technical and attitudinal, employability skills. As it relates to employability skills, both the programmatic accreditation guidelines and the discipline-specific standards urge HEIs to incorporate stakeholders, including employers in the development, monitoring, reviewing and maintaining the quality of the programme; the incorporation of job market information from employers in the programme delivery; and the use of such feedback for continual improvement.

### **HEIs Engagement of Employers**

The five HEIs surveyed reported active engagement of employers in curriculum development and review processes by way of advisory committees/boards or other mechanisms that provide employer feedback. This implies that HEIs have a structured and operationalized mechanism in place to review the curriculum and receive employer recommendations; in contrast to passive engagement where the employers simply receive the graduates produced by the HEIs. The HEIs surveyed demonstrate that the employers have "significant levels of engagement involving situations in which employers contribute to the learning process in educational institutions" (Hogarth et al. 2017, p. 8).

The HEIs listed guest lecturer, laboratory support, project assessment, and field trips as methods of employer engagement. They also reported that employers were actively engaged in the curriculum development, review and delivery processes. Although this study did not confirm that formal arrangements were in place with the employers in the delivery of the curriculum, research such as Suleman et al. (2021) expressed concerns about the use of informal arrangements to engage employers and questioned the efficiency of engagement strategies to address the skills gap (p. 11).

HEIs responses suggest that they are also concerned about informal arrangements; expressing that there is a need to have established partnership between HEIs and employers as employers further engage in preparing graduates for the world of work. Examples of partnerships identified included regular meetings to receive employers' feedback, mentorship programmes with industry partners and involvement in work experience and internship programmes.

Suleman et al (2021) and the responses of the HEIs support the employers' (LK and CMG) reasons for the implementation of strong and strategic partnership to bridge the divide between employers and HEIs.

### **Barriers to the Synergy between HEIs and Employers**

The five HEIs surveyed reported several barriers to HEI - employer engagement, which were either employer - related or HEI - related. Financial limitations, time constraints/unavailability of employers to participate in the curriculum development and review processes, implementation of institutional processes, and geographical proximity were among the top barriers identified by the HEIs. Other HEI - related barriers included: institutional processes, for example, securing and compensating guest lecturers, organizing field trips; and the need for more institutional planning. Employer - related barriers identified included: the limited number of sites available for work experience; an insufficient number of employers' who are willing to accept trainees or interns; and the location of employers.

Suleman et al. (2021) reported on employers' view that geographical proximity enhanced the relationship with HEIs. Institutional plans and programmes should maximize all the attendant advantages associated with geographical proximity and minimize any disadvantages.

The failure to participate in the required professional development activities on the part of both students and professional development staff in some HEIs was highlighted as a barrier. This brings into focus the importance of both students and staff in achieving the objectives of established HEI - employability initiatives. Dacre Pool and Sewell (2017) also support the use of professional development activities in HEIs to enhance employability. They state that personal development activities play a role in strengthening students' employment related skills and self-awareness; and help them to apply those skills to different environments. Dacre Pool and Sewell (2007) in their CareerEDGE employability model, highlight students' self-reflection and evaluation of learning experiences as essential elements towards developing employability skills.

Based on the responses it appears HEIs should address these barriers through strengthened and strategic engagement with employers to prepare graduates for the world of work.

### **Conclusion**

The HEIs in this study have actively engaged employers in curriculum development and review, which was identified by Martin (2018; 2023) and supported by The UCJ Standards as an effective IQA tool for the development of employability skills. This type of engagement improves the synergy between employers and HEIs and is achieved through a number of strategies used by the institutions as they seek to prepare effective graduates.

However, barriers exist that affect the synergy between HEIs and employers. Chief among these are financial limitations, time constraints/unavailability of employers to participate in the curriculum development and review processes, implementation of institutional processes, and geographical proximity.

The UCJ Standards encourage HEIs to develop and deliver programmes that prepare graduates to meet the needs of employers, by engaging the employers during curriculum development and review; and incorporating current job market information in its programme delivery through the involvement of employers.

Informed by the employers' perspectives, The UCJ Standards should prove useful to HEIs in the process of building synergies with employers. They provide guidance through the criteria stated and the prompts to engage with employers in the process of developing employability skills; curriculum development and review; and the delivery of the curriculum.

HEIs should consider implementing a strategic and institutional-wide approach to facilitating employability skills and employer - engagement, towards eliminating or limiting barriers to the synergies between HEIs and employers.

### **Limitations of the Study**

This is an exploratory study that did not consider the impact (face-to-face, online, hybrid) of the Covid-19 pandemic and how this affects HEI-employer engagement and the development of employability skills. Participation in the study was limited to presenters in the webinar, (two employers from the private sector, a higher education administrator, and a global quality assurance expert); and to those HEIs who completed the survey.

The UCJ's quality assurance review processes - the submission and review of the institution's documentation, selection of the evaluation team, the site-visit meetings and the visit reports were not included in this research.

### **Future Studies**

1. Expanded research including the students who are beneficiaries of the partnership between HEIs and employers is suggested.
2. Inclusion of focus groups within institutions to obtain data from several perspectives, including gender; and from wider stakeholder groups including administrators, faculty and students.
3. Public and private sector employers' perspectives on bridging the graduates' employability skills gap could also be explored.
4. The importance of graduate effectiveness in higher education:
  - a. the quality assurance systems (EQA/IQA) used in Higher Education to strengthen graduate effectiveness; and
  - b. possible strategies/solutions to improve graduate effectiveness in the workplace.

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## Appendix A - Graduate Effectiveness/Employability Survey

### Graduate Effectiveness/Employability

One of the UCJ's 2023 Quality Assurance Week Webinars explored **Strengthening Quality in Teaching and Learning Practices in Higher Education: The Graduate Effectiveness Imperative**. As the UCJ continues its collaboration with Higher Education institutions we are asking that you take 15 - 20 minutes of your time to complete this instrument. The shared information will not be used to identify any specific institution. The findings will assist institutional stakeholders to enhance graduate's skills and competencies to meet the needs and expectations of employers as identified by the employers and other experts at the QA Week 2023 Webinar on Graduate Effectiveness.

**We would appreciate receiving your feedback on or before Aug 14, 2023.**

Thank you!

*\* Indicates required question*

1. Identify the type of institution which you represent by selecting the most appropriate response from the options below. \*

*Tick all that apply.*

- College
- Training Institution
- University
- University College

2. Select the most appropriate response from the options below to identify the location of your institution \*

*Tick all that apply.*

- Rural
- Urban

3. Which of the following best classifies your institution? \*

*Tick all that apply.*

- Privately funded
- Public/Government funded
- Mixed

4. How does your institution ensure that students engage in consistent, practical exposure to a particular field/industry aligned to the programme of study? \*  
Please separate response items with semicolons.

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5. Do you believe that the technical preparation for the specified job is sufficient for the graduate to be effective in the workplace? \*

Mark only one oval.

- Yes  
 No  
 Not applicable

6. What do you perceive are the barriers to your institution providing more opportunities for technical preparation in the field of study? Please separate response items with semicolons. \*

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7. Do you include non-technical preparation (non-academic skills, work ethics and values, teachable spirit/trainable) in the programme of study? \*

Mark only one oval.

- Yes  
 No

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Graduate Effectiveness/Employability

8. If answer to question above is "Yes", what opportunities are in place for students to practise the non-technical, non-academic skills required to succeed in the particular field? Please separate response items with semicolons.

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9. Do you believe the non-technical preparation identified above is sufficient for the graduate to be effective in the workplace?

Mark only one oval.

- Yes  
 No

10. What do you perceive are the barriers to your institution providing more opportunities for non-technical preparation for the world of work? Please separate response items with semicolons.

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11. Do you engage employers in curriculum development and review? \*

Mark only one oval.

- Yes  
 No

12. If answer to question above is "Yes", how are employers engaged in curriculum development and review? Please separate response items with semicolons.

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13. Do you engage employers in the delivery of the curriculum? \*

Mark only one oval.

- Yes  
 No

14. If answer to the question above is "Yes", how does your institution currently involve employers/industry in curriculum delivery? Please separate response items with semicolons.

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15. What do you perceive are the barriers to involving employers/industry in the development, review and delivery of curriculum in your institution? Please separate response items with semicolons.

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Graduate Effectiveness/Employability

16. How can your institution engage or further engage employers/industry in the preparation of the graduate for the world of work? Please separate response items with semicolons. \*

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