Transforming Computer Science Education through the use Microcredentials in Computer Networking: Teachers and Lecturers Perspectives

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ABSTRACT

One of the most important requirements for any teacher or lecturer is the possession of macrocredentials, such as diplomas and degrees. Short courses with a narrower and concentrated focus can be completed promptly and are also highly beneficial for the instruction and acquisition of computer science. In order to keep up with the ever-evolving field of computer science, it is essential to engage in constant learning to stay abreast of the latest technologies and approaches. Microcredentials serve as a valuable tool in this regard, aiding individuals in keeping pace with technological advancements. Microcredentials also facilitate personalized learning pathways and enable the recognition of specific talents in a professional, flexible, and accessible manner. The study aimed to investigate the utilization of Microcredentials by teachers, along with the associated difficulties and prospects of employing microcredentials in education. The researchers utilized the interpretivism paradigm and the qualitative approach to gain insights on the utilization of Microcredentials. Face-to-face interviews were conducted to obtain comprehensive insights into the phenomena being studied. The results were analyzed thematically. The study found that microcredentials are effectively closing the disparity between traditional degrees and the current educational requirements. The study also found that microcredentials provide teachers with a greater emphasis on practical knowledge rather than theoretical information. Despite its increased flexibility, the program encountered difficulties due to limited resources, particularly in terms of reliable internet access. Additionally, seeking leave days to attend the practical boot camps posed a hurdle.

Keywords: Computer Science, Computer Science Education, Microcredentials, Computer Networking

INTRODUCTION

Numerous authors provide varying definitions of microcredentials. A microcredential is often seen as a certification of evaluated learning that is supplementary, alternative, or complementary to a formal aspect of a formal qualification (Oliver, 2019). Microcredentials can be viewed as a flexible and focused means to assist individuals in acquiring the information, skills, and competencies necessary for their personal and professional advancement (UNESCO, 2022). Weller (2023) characterises microcredentials as qualifications for short term educational experiences that augment knowledge, skills, and competences for personal and professional advancement. In the same light NZQA (2025) regards microcredentials as compact, independent certifications with defined learning objectives. They acknowledge the abilities, experience, or knowledge of learners, while addressing the needs of employers, industry, and communities (NZQA, 2025). In contrast to microcredentials, macrocredentials are comprehensive qualifications, including degrees (e.g., bachelor's, master's, or doctorate) or diplomas, demanding a prolonged commitment (e.g., years) and encompassing a diverse array of knowledge domains (Wheelahan & Moodie, 2021). Table 1.1. Summarises the difference between microcredentials and macrocredentials.

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Table 1.1 Summary of differences between Macrocredentials and Microcredentials

Aspect	Macrocredentials	Microcredentials	Source
Definition	Traditional, comprehensive qualifications such as degrees or diplomas.	Short, focused certifications or badges for specific skills or competencies.	Oliver, 2019; Kato et al., 2020
Duration	Typically takes years to complete (e.g., 2–4 years).	Shorter time commitment, ranging from a few hours to several months.	Kato et al., 2020
Delivery Mode	Often in-person or hybrid (online and offline).	Primarily online, though some may offer in-person components.	Kato et al., 2020
Scope	Broad and general, covering a wide range of subjects and skills.	Narrow and specific, targeting particular skills or areas of knowledge.	Wheelahan & Moodie, 2021
Examples	Bachelor's degree in Computer Science, Master's in Education.	Python programming certificate, digital marketing badge.	Wheelahan & Moodie, 2021
Pathway to Further Learning	Serves as a prerequisite for advanced studies (e.g., master's or doctoral degrees).	Can stack into larger qualifications (e.g., microcredentials forming a degree).	Wheelahan & Moodie, 2021
Flexibility	Less flexible, with rigid schedules and institutional timelines.	Highly flexible, often available online and self-paced.	Oliver, 2019

The Table 1.1 highlights the major difference between macrocredentials and microcredentials. The differences mainly lie in the duration or the time it takes to complete each, the deliver mode used, the scope of each, the degree of flexibility and how each fits into the pathway to further learning. Microcredentials are becoming more and more popular because they help with focused, skill-based learning. Their effects can be seen most clearly in computer science education, where technologies are changing quickly and require students to constantly learn new skills and specialise.

Microcredentials are being pursued in many fields. Hollands and Kazi (2019) surveyed students who completed microcredential programs in business and finance, social science, computer science, information science, and business and management" from renowned providers. The learners pursued credentials in finance (16%), information technology (10%), business management and administration (9%), science, technology, engineering, and mathematics (9%), marketing, sales, and service (8%), teaching or education research (7%), education administration (6%), and non-profit management and administration (6%). In another study, a research by Kässi and Lehdonvirta (2024) investigated the impact of digital microcredentials on worker remuneration in a labour market. The results indicated that persons who obtained supplementary microcredentials enjoyed an average income gain of 8.9%. This indicates that microcredentials may alleviate employer confusion about employee competencies, therefore improving employability and earning potential.

The use of microcredentials as evidence of specific abilities is becoming increasingly popular among employers. According to the findings of a survey conducted by UPCEA and Collegis Education, ninety-five percent of organisational executives believe that having staff who hold microcredentials is beneficial, particularly because it demonstrates a commitment to the professional growth and initiative of the employees UPCEA (2023). A systematic study conducted by Varadarajan, Koh, and Daniel (2023) highlighted the fact that although microcredentials have the potential to improve employability, there are problems regarding their

validity and trustworthiness that institutions need to address in order to guarantee that they are effectively integrated into

formal education. In order to successfully integrate microcredentials into formal systems, alignment with certification standards comes into play. In Europe, Microcredentials have been proposed to be aligned with the European Credit Transfer and Accumulation System (ECTS), according to a recommendation made by the European Commission (2025), which emphasises the necessity of standardised credit equivalence.

Computer Science Education entails the analysis and design of curricula that prioritise students in introductory computer science courses, employing heuristics to facilitate course redesign (Starks, Reeves, Rickert, Li, Couch & Millunchick, 2024). Similarly, Zendler (2015) contends that Computer Science Education emphasises the teaching and learning of computer science, incorporating methods and practices that enhance comprehension of computational concepts and skills. While Computer Science Education gives an overview of the teaching and learning of Computer Science, Computer Networking Education focuses on the more concentrated area of the teaching and learning of Computer Networking.

Computer Networking Education aims to provide students with the competencies required to design, develop, and oversee intricate network systems, responding to the dynamic requirements of the digital era (Liu, Yang, Shang, and Jia, 2024). Wang and Zhao (2019) argue that Computer Networking Education seeks to augment students' comprehension using project-based cooperative learning methodologies, hence improving their theoretical and practical skills. The diagram below shows the relationship between Macrocredentials, Microcredentials, Computer Science Education and Computer Networking education.

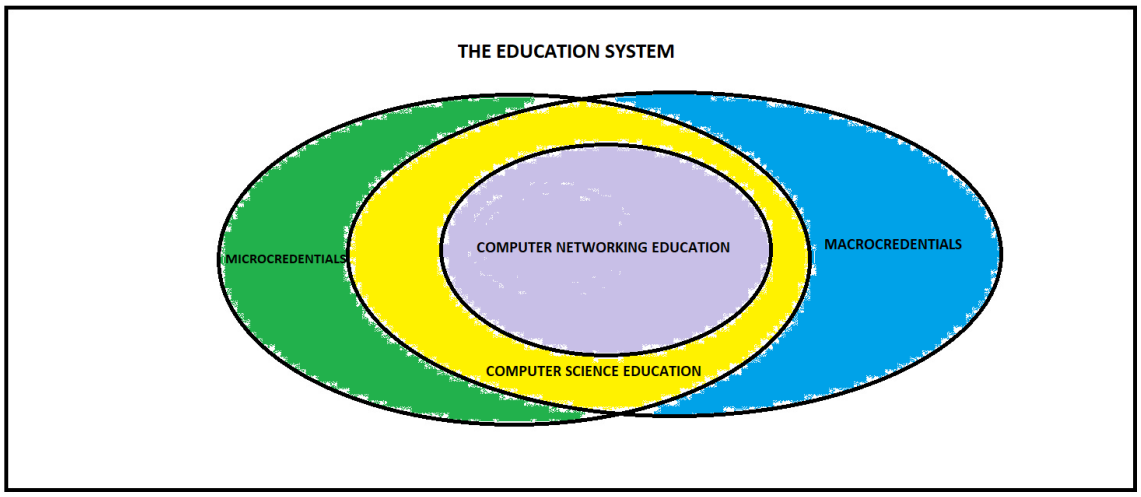

Figure 1.1 The Relationship between the education system, microcredentials, macrocredentials, computer science education and computer networking education,

The Figure 1.1. depicts a summary of the concepts discussed above. Microcredentials and macrocredentials both fall under the education system; Computer Science Education includes and is made up of both aspects of microcredentials and macrocredentials. Computer networking education is a subset of Computer Science Education.

Background to the study

Through the use of an online skills profile tool, Ward, Crick, Davenport, Hanna, Hayes, Irons, Miller, Moller, Prickett, and Walters (2023) explore the possibility of incorporating microcredentials into higher education courses. The study reveals how this strategy connects educational achievements with industry-required abilities, so allowing personalised learning and boosting employability. The study focusses on degree programs in the United Kingdom that are connected to computers. According to the findings, including microcredentials into standard curriculum has the potential to bridge the gap between academic learning and the practical job abilities that are required in the workplace. In yet another research, Lim and Hassan (2020)

investigate the function of microcredentials in Malaysia, specifically with regard to their support of emergency remote teaching. Despite the fact that the study was conducted in a context that was not part of the Global North, the findings offer lessons that are relevant all over the world. In particular, the findings reveal insights into the quick adoption of digital credentials to upskill instructors and ensure educational continuity amid disruptions. The research highlights the potential for microcredentials to improve teaching abilities in the field of computer science education.

Within the African context, a study was conducted to explore the function of microcredentials in Tanzanian educational institutions. The findings of the study demonstrated that microcredentials provide students with adaptable learning possibilities, which enable them to gain specialised skills that are in line with the requirements of the market. According to Ghasia, Machumu and DeSmet (2019), the research highlighted the potential of microcredentials to supplement traditional education and fill skill shortages in the context of Tanzania for the purpose of addressing the situation. Another study was conducted to examine the function of microcredentials in the context of higher education in South Africa. According to Jones (2024), the findings suggested that these novel means of recognition have the potential to overcome structural challenges that are present in conventional degree programs, therefore providing students with educational routes that are more adaptable and inclusive. The importance of the adoption and collaboration with employers to integrate microcredentials into broader qualification frameworks was found to improve youth employment prospects in a study that was conducted on the innovation of microcredentials in enhancing the recognition of non-formal skills among African youth in South Africa, Uganda and Burundi (UNICEF, 2024). The study was conducted in order to determine how microcredentials can be used to improve unemployment rates among young people.

Through programs such as Africa Code Week, the Girls in STEM Trust has been a significant contributor to the improvement of digital literacy in Zimbabwe. Through the provision of training in coding and programming to over 2,000 learners and 200 teachers, the organisation makes it possible for young Zimbabweans, particularly young females, to acquire microcredentials that enable them to actively engage in the digital economy (Mrewa, 2021). Free 12-month boot camps in Zimbabwe are provided by Uncommon, a non-profit technology organisation (Zihonye, 2024). These boot camps focus on web development, user interface and user experience design, and digital marketing. According to Zihonye (2024), the purpose of these initiatives by Uncommon is to help bridge the digital divide by providing young people living in areas with lower incomes with the fundamental digital skills that will increase their employability in the technology business. ISOC (Internet Society), collaborated with BECSA (Blended Education College of Southern Africa) to provide training in the process of creating and establishing computer networks. The goal of this effort was to provide teachers and students with hands-on experience in computer networking, which is in line with Zimbabwe's Education 5.0 strategy (Mpofu, 2024). Table 1.2 gives a comparative analysis of 6 computer science microcredentials

Table 1.2 Summary of Common Computer Science certifications as microcredentials

	Computer Science Field	**Example**	**Description**	**Source**
1	Artificial Intelligence	Hewlett Packard Enterprise Data Science Institute (HPE DSI) Micro credential in Artificial Intelligence	Designed to equip students with specialized AI skills, including deep learning, large language models, and other advanced AI topics.	HPEDSI (2025)
2	Software Development	Apple's Swift Developer Program	This is a course that provides mastering Swift, Apple's programming language	Cornellier (2022)
3	Cybersecurity	CompTIA Security+	CompTIA Security+ is a global certification that validates the baseline skills necessary to	Madden (2024)

			perform core security functions and pursue an IT security career	
4	Web Design	Responsive Web Design Certification	Emphasizes skills in creating mobile-friendly websites using HTML, CSS, and JavaScript.	Coursera (2025)
5	Database Management	Oracle Database	Focuses on SQL query writing, database design, and administration tasks.	Oracle (2025)
6	Computer Networking	Cisco Certified Network Associate (CCNA)	This course provides comprehensive networking skills which allows individuals to be competent in both hardware and software.	Madden (2024)

The table above summarizes major fields of computer science and examples related microcredentials. The fields discussed are Artificial Intelligence, Software Development, Cybersecurity, Web Design, Database Management, Computer Networking as these fields make are some of the prerequisite fields for many Computer Science and ICT degree programs. Descriptions also follow highlighting the contents of the certifications. These certifications go a long way in enhancing competence of individuals

Computer Networking Microcredentials.

The CCNA certification is a fundamental program including a wide array of networking principles, such as IP addressing, routing, switching, and network security. It is esteemed in the industry and offers a robust foundation for further networking courses. CCNA courses emphasise practical competencies, equipping students to configure and troubleshoot Cisco networking gear. This certification is significant as it is a widely acknowledged certificate that signifies a degree of networking expertise (Lammle, 2016). CompTIA Network+ is an internationally acknowledged certification that certifies the fundamental knowledge and abilities required to build, setup, maintain, and troubleshoot both wired and wireless networks (Madden, 2024). Similarly, CompTIA Network may be seen as a certification that encompasses the competencies required for IT assistance. It certifies the technical competencies required by IT workers to safely configure, sustain, and resolve issues inside networks across many platforms, focussing on network security and cybersecurity best practices (COMPTIA, 2024). AwsAmazon (2025) characterises its Advanced Networking course as a credential that assists organisations in identifying and cultivating talent with essential skills for executing cloud initiatives. Obtaining an AWS Certified Advanced Networking certification validates expertise in designing and maintaining network architecture across the spectrum of AWS services.

The Fundamentals of Deploying and Designing Computer Networks course is intended for students with a foundational knowledge of computer hardware and software, as well as familiarity with personal computers. It starts with instruction on the principles of networking, Ethernet, and Wi-Fi technologies. The course progresses from foundational concepts to the planning, design, and implementation of basic LANs, addressing prevalent methods for connecting a LAN to the Internet, including Mobile Internet, ADSL, and Fibre, as well as the procedures for establishing these connections. Furthermore, the course addresses prevalent maintenance challenges and their corresponding solutions. The training will have both theoretical and practical elements (Internet Society, 2024).

The Problem and its context

The problem in the Zimbabwean context is rooted in four areas which are the rapidity in the change of technology, the need for capacity building for Zimbabwean teachers and lecturers in computer networking, the high cost of formal higher education learning in Zimbabwe and the low internet penetration rate in Zimbabwe. First, the field of computer networking is marked by a remarkably rapid rate of technical advancement, propelled by elements such as the exponential increase in data traffic, the widespread emergence of connected

devices, and the ongoing development of cybersecurity risks. This dynamic requires networking experts to pursue continuous learning and adaptation to maintain expertise in implementing and operating advanced network systems (Mallick & Nath, 2024). For example, Computer networking has advanced rapidly due to principles like Software-Defined Networking (SDN) and Network Function Virtualisation. Decoupling control methods from hardware has made network administration more flexible and efficient in traditional network topologies. Computer networking is dynamic, requiring adaptive solutions to handle and incorporate new technologies. (Li, 2024). Second, Mukeredzi (2016) underscores the fact that there is a need for capacity building in Zimbabwe as a significant number of teachers in rural secondary schools in Zimbabwe are either untrained or under-qualified, which brings about a detrimental influence on the quality of education. In addition, Dudu and Mashoko (2024) propose that in order for teachers to strengthen their technical pedagogical topic expertise, they should undergo specialised training. Thirdly, there are a number of significant problems that students in Zimbabwe face when attending higher education institutions, both private and state-run equally. Some of these challenges include exorbitant tuition fees and relatively high costs of housing (Mukabeta, (2023). Similarly, Kabonga, Chipamaunga, & Zvokuomba (2020) argue that in Zimbabwe with high inflation in Zimbabwe, students face challenges and an inability to pay their tuition fees and accommodation. Lastly according to Statista (2025) the Internet penetration in Zimbabwe is estimated to amount to 35.67% in 2025 and the number of households with internet access at home in Zimbabwe is forecast to amount to 2.83m in 2025.

Research Questions and Methodology

The study aimed to address the main research question which was "How are teachers and lecturers making use Computer Networking Microcredentials (specifically Fundamentals in Deploying and Designing Computer Networks) in Computer Science Education"

The Sub research question which was followed were

1. Which teaching methods are you currently using in Computer Networking Education
2. What is the importance and what are the challenges of Computer Networking Microcredentials?
3. How is DDCN aligned with industry needs and curriculum

The study followed the interpretivist paradigm. The researchers chose the interpretivist paradigm to explore the perspectives of students and educators in educational contexts. By comprehending the personal significances and interpretations individuals ascribe to their educational experiences, researchers may discern aspects that affect learning outcomes and formulate treatments that cater to the requirements of learners (Rehman & Alharthi, 2016). A qualitative research approach was utilised as it is effective in exploring emerging topics without predetermined preconceptions. This adaptability is crucial since it facilitates appreciation of participants' personal narratives, hence informing more effective interventions (Hammarberg, Kirkman and Lacey, 2016). The case study facilitated a comprehensive examination of the phenomena, yielding detailed insights (Merriam, 2009). The data was collected using semi structured interviews. The population consisted of 52 participants and sample consisted of 25 participants which were purposively sampled from Cohort 1 and 2 for the program. The data was analysed thematically because according to Nowel, Norris, White and Moule (2017) thematic analysis is an effective approach for exploring the viewpoints of various study participants, emphasising both similarities and contrasts, and producing unforeseen findings.

RESULTS

In response to the question "Which teaching methods are you currently using in Computer Networking Education" the teachers and lecturers responded as follows:

LC0020- "*Group work, presentation and class discussion."*

TR01- "*Lecture class discussions question and answer as well presentations."*

TR010- "*Discovery, problem-based approach and exposition"*

LC017- *"Online and blended methods*

LC017- *"simulation tools like Packet Tracer, and project-based learning to teach computer networking. These methods help bridge theoretical knowledge with practical applications, ensuring students gain a comprehensive understanding of the subject.*

In response to the question "What is the importance and what are the challenges of Computer Networking Microcredentials (DDCN)" the teachers and lecturers responded as follows:

LC008- "*They enhance the skills of educators, improve student learning outcomes, and ensure curricula remain competitive in a rapidly evolving technological landscape."*

LC015- *"The equip us with more detailed information on the practical side of such courses like DDCN they enable teachers and learners to specialize and become competent"*

TR026- *"Motivates learners to be eager to get more knowledgeable on other aspects of computers and appreciate the role of ICT in our daily lives"*

LC017- *"Computer science is a broad subject which has a wide syllabus coverage, it will be very time consuming to cover all the computer science syllabus using micro credentials."*

LC09- *"Micro credentials may not yet be widely recognized by employers or educational institutions compared to traditional degrees or certifications."*

LC026- "*internet expenses cost as some modules are conducted online"*

In response to the question "How is DDCN aligned with industry needs and curriculum" the teachers and lecturers responded as follows:

LC024- "DDCN *approach aligns well with computer science curricula at various educational levels due to its emphasis on computational thinking, problem-solving, and digital communication."*

TR012- "*DDCN is quite aligned with Computer science curriculum as it covers most of the content under computer networking which is quite relevant to the field*"

LC012- "*It's partly aligned especially on one topic"*

LC01- "*DDCN is highly aligned with industry needs, focusing on practical, hands-on skills in computer networking that are directly applicable in the workforce. It emphasizes real-world competencies that employers prioritize, making it a valuable asset for both educators and students seeking improved employability in the tech sector."*

TR012- "*It's partly aligned especially on one topic*"

DISCUSSION

Based on the results of the research, it has been found that there are several methods that may be utilised when it comes to teaching computer networking. Group work, presentations, in-class discussions, online methodology, problem-based approaches, mixed methodologies, and simulation were some of the methods that were cited by the participants. Prvan and Ožegović (2020) agree with the findings of the study as they suggest that in order to implement problem-based learning (PBL) in the teaching of computer networks, a way is to present students with a network design that contains defects. The students are then tasked with determining the reason for the network failure and finding solutions to the problem. In addition, Riley (2012) also agrees that simulations can be used in the teaching and learning of computer networking. The study also

found that microcredentials are very important when it comes improving specific technical skills and meeting the needs of the industry. This is also in line with the arguments of Varadarajan, Koh & Daniel (2023) who suggest that microcredentials offer flexibility and accessible learning opportunities that closely correlate with industry requirements, facilitating quick upskilling and reskilling to meet the evolving demands of the twenty-first-century labour market. UNESCO (2022) also mentions that microcredentials are adaptable and accessible educational possibilities that closely correspond with industrial requirements. They provide swift upskilling and reskilling, responding to the evolving requirements of the twenty-first-century labour market. This is similar to the findings of the study.

It is also worth noting that in Zimbabwe, unlike Education 3.0 which focused on Teaching, Researching and Community Service, Education 5.0 added two more pillars of Innovation and Industrialisation (MHTESTD,2019). The thrust is on provision of goods and services. Computer Networking has the potential to address all the pillars of Education 5.0. The first pillar is Teaching and Learning. Mastery of the subject (Computer Networking) is essential for the teaching process to impart appropriate and pertinent skills, knowledge and attitudes. The DDCN curriculum has enhanced the expertise of the average educator. Furthermore, technology-facilitated education, including synchronous and asynchronous modalities conducted on platforms such as ZOOM and Microsoft Teams, need well-structured and operational networks. The second pillar is Research. During and after the Covid pandemic, universities provide virtual research conferences as an alternative to in-person research conferences. Essential to this is reliable internet access, enabling a presenter to disseminate a presentation over video conferencing. The DDCN training imparts the necessary skills to facilitate that. Moreover, the key requirement for research is access to platforms like EBSCO host, which provides published publications from publishers such as Emerald, Taylor & Francis, and Science Direct, necessitating internet connectivity. Pillar 3 pertains to Community Service. Zimbabwean people, particularly in marginalised neighbourhoods and isolated regions, have significant connection challenges. ISOC Zimbabwe is advocating for the initiative "let us connect the unconnected" (ISOC, 2024). The DDCN program certifies individuals with the skills to serve these marginalised communities in terms of designing and deploying community networks. The fourth pillar is Innovation. Creativity is highly advocated in tackling global issues. Courses such as the DDCN enable individuals to create appropriate and tailored networks. In June 2022, the Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) solicited ideas from interested parties for the establishment of Community Networks in all provinces of Zimbabwe. The DDCN program equips individuals with the skills necessary to develop unique project ideas. Pillar 5 pertains to Industrialisation. Industrialisation pertains to the automation of existing conditions. The Fourth Industrial Revolution, or Industry 4IR, explores the swift transformation of technology, industries, and societal structures in the 21st century, driven by enhanced interconnection and intelligent automation. Closely associated with industrialisation is the of the Internet of Things and cloud computing. Industries will not advance or develop without properly planned, installed, and maintained computer networks. Consequently, the Internet Society, via the DDCN course, has empowered individuals to establish the foundational infrastructure of the business, specifically a dependable computer network, to facilitate its modernisation.

CONCLUSION AND RECOMMENDATIONS

The study concludes that in terms of teaching methods are currently being used in Computer Networking education include group work, discussion, Q and, Online, Online Learning, blended learning, simulations, presentations, discovery and exposition. The study also concludes that the importance of Computer Networking microcredentials like DDCN include improving skills with current trends, motivation, specialization, and challenges include lack of recognition and internet costs to do online programmes is expensive. Lastly, the study also concludes that Computer Networking microcredentials like DDCN has content that is aligned with primary, secondary and higher education curricula and has skills that are relevant to the industry needs.

The study recommends that in terms of teaching methods teachers and lectures obtain Networking microcredentials like DDCN to improve their outdated skills and for a practical emphasis. The study also recommends that universities partner with institutions offering micro credentials and other strategic Public Private Partnerships (PPP) to make their skills recognizable and for the programmes to be up scaled so that

more educators can have access to them. Lastly, the study recommends that teachers enrol for micro-credentials like DDC which are free and are in line with curricula and industry needs Lastly, the study recommends policy adoption and formulation by the Zimbabwe National Qualifications Framework (ZNQF) and Ministry of Higher and Tertiary Education Innovation, Science and Technology Development (MHTESTD) of Zimbabwe on Microcredentials. Including microcredentials in the ZNQF will recognize the certifications as reliable credits which can be used and trusted by institutions and the formal education body at large. Micro credentialing organisations will therefore have a frame work that they can design modules that will be accepted and recognised by employers' and academic institutions.

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