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The Use Of Information And Communication Technologies (ICTS) For Multimodal Representation Of Information In Teaching Processes And Implications For Learning

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Abstract: In this era of information overload, teachers are expected to teach not only subject matter but also teach students using information and communication tools in order to equip them with tools needed for self-directed inquiry and other student-centred pedagogies that place learners at the centre of learning thereby equipping them with tools for problem solving in the digital economy and global village. Digital teachers are better placed to innovate and curate student learning with digital tools using differentiated lesson activities onsite and online with their learners. This study sought to identify pathways for facilitating teacher integration of ICTs in teaching processes to improve on student learning. Three specific research objectives were generated to guide the study which were, to find out the extent to which the use of ICTs for information sourcing in teaching processes can enhance the development of learning, to investigate the extent to which the use of ICTs for multimodal representation of information in teaching processes can enhance the development of learning and to examine the extent to which the use of ICTs for content creation in teaching processes can enhance the development of learning. Data were collected from one school in Buea, Fako Division. Simple random sampling was used to draw participants for the study. The hat and draw method was used to select 30

Lower sixth students and 20 of their teachers, making a total of 50 participants. A quasi – experimental was set up using 50 participants from the same school; 30 students and 20 teachers. 15 students were randomly assigned to the experimental group and 15 to the control group. 10 teachers were also randomly assigned to the experimental group and 10 to the control group. They all took a pre – test before the intervention. The experimental group participants were exposed to The UNESCO Digital Teacher English Course for 5 weeks. After which they took the post – test. The same as the pre – test taken before the intervention. Interviews were carried out after the post – test to capture qualitative data that could not be gathered using the questionnaire. The instruments used in collecting data were questionnaires, interview guides and observation guides. The findings showed that with respect to teachers' knowledge of ICTs for information sourcing, progression was higher in the teacher experimental group with a value of 07.5% whereas a slight drop of -0.7 was observed in the control group. The student experimental group had a value of 11.4% whereas a drop of -2.9 was observed in the control group. Students were more engaged with technologies for information sourcing than teachers were for teaching purposes. With respect to teachers' knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group, paradoxically, progression was higher in the control group with a value of 11.2% as compared to of 3.8% for the experimental group. With respect to students' knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group, progression was higher in the experimental group with a value of 13.9% as compared to 4.3% for the control group. In relation to teachers' knowledge of ICTs for content development and the development of creative problem, progression was higher for the experimental group with a value of 11.1% as compared to a drop of equal magnitude for the control group. With respect to students' knowledge of ICTs for content creation and the development of creative problem-solving, progression was higher in the experimental group with a value of 3.9% as compared to a drop of -4.3% for the control group. It was recommended that practical hands-on trainings be done in addition to existing online courses to equip teachers with practical skills on how to use ICTs for information sourcing, multimodal representation and content creation in order to enhance student learning.

Keywords: Information and Communication Technologies (ICTs), Multimodal Representation, Teaching Processes and Implications for Learning.

Introduction:

Information and communication technologies (ICTs) refer to computers, mobile phones, digital cameras, satellite navigation systems, electronic instruments and data recorders, radio, television, computer networks, satellite systems or almost everything that handle and communicate information electronically. ICTs include both the hardware (the equipment) and the software (the computer programs in the equipment), (UNESCO ICTCFT, 2018). Three categories of ICT usage in teaching processes were the focus of the study following the three broad categories identified in the UNESCO competency framework (UNESCO ICTCFT, 2018). They are: ICTs for knowledge acquisition, knowledge deepening and knowledge creation. This article conceptualized ICT use in terms of ICTs for multimodal representation in teaching and implications for learning.

ICTs for multimodal representation of information refer to ICTs used to present teaching and learning content in more than one sensory modality; vision, touch, hearing, olfaction, speech and gestures. The multimodal representation refers to the ability to use laptops, projectors, phones, images, audios, infographics, and videos for synchronous and asynchronous lesson delivery. How to vary learning content into different formats to match diverse learning stills in the teacher's audience. They help engage and sustain learner interest, ace understanding thereby facilitating memory processes (ETSI, 2003).

Examples of different modes in which learning content can be represented include; text documents, lesson plans, worksheets, animations, infographics, blogs, websites, image and videos, create podcasts, computerized assessments, project quizzes, games, e-books, summaries of topics taught, videos of classroom activities, PowerPoint slides, podcasts for listening activities, generate images as teaching aids for different kinds of topics. Teach using different mediums including video conferencing, YouTube channels to disseminate

professional knowledge, developing digital content, integrating and re-elaborating Digital content, adjective that indicates that at least one of the directions of a two-way communication uses more than one sensory modality; vision, touch, hearing, olfaction, speech, gestures, copyrighting and licensing, creating digital products. Creative use of digital technology, identify digital competency gaps, developing computational thinking (UNESCO ICTCFT, 2023).

According to Daniels (2002), ICTs have become one of the basic building blocks of modern society. Many countries now regard understanding ICTs and mastering basic skills and concepts of ICTs as part of the core components of education just like literacy and numeracy. Using ICTs as a tool to support teaching and learning can enhance the quality of education. The Use of ICTs enable teaching and learning to continue even in the absence of physical contact or even during socio-political crises. Teaching is a variety of activities engaged to enhance the process of learning (Tchombe, 2009). It is the combined processes where an educator assesses learning needs, establishes specific learning objectives, develops teaching and learning strategies Implements plan of work and evaluates the outcomes of instruction (Sequeira, 2017). Learning is a relatively permanent change brought about intentionally by developing new skills, understanding scientific laws, or attitudes. Teaching and learning go together. When we teach, we do so for our learners to learn. The traditional concept of a teacher differs from the present role of a teacher. In time past, the teacher was considered the custodian of knowledge. The current role of the teacher varies from this philosophy.

The modern teacher is a facilitator in the teaching and learning process. He or she provides guidance to learners. Teaching and learning in modern times is learner-centred. The learner is at the centre of activities, actively participating, carrying out projects, or cooperating with others in peer groups, actively co-constructing knowledge with the teacher and peers. At times learning goes on asynchronously, that is without any physical contact or synchronously in the same physical location or time. Learning is also individualized to suit individual requirements and abilities (Sequeira, 2017). In this article, the focus on teaching processes and learning lie in the abilities of both teachers and learners to be able to engage the other in the course of the lesson using technologies or content accessed through technologies in or out of the classroom in different modalities to enhance memory processes that enable deep level processing and remembering. The end result of teacher input is to facilitate learner acquisition of knowledge in subjects, cognitive, soft skills and other life skills that enable adaptation to their environment and wholesome development. Learners are expected to be able to retrieve and use knowledge acquired to solve everyday problems in the real world and contribute their own quota to their communities (Sternberg, 1999).

The outbreak of Corvid 19 and its forceful closure of schools pushed educational systems around the world to the digital space. The effect of the Anglophone crisis and the global shutdown due to the Corona Virus are recent examples of situations that necessitate a shift in pedagogic practices to remain on the cutting edge. Emergency solutions such as lesson delivery through CRTV Radio and television channels. The MINESEC distance learning platform was developed as a long term project to make lessons for all secondary level classes and subjects. Learning is still to recover in certain localities making such initiatives a necessity for those who can access such content. This need was reinforced by the sporadic nature of teaching and learning during the socio-political crisis. Further Information and Communication technologies (ICTs) have changed the practices and procedures of all professions.

Literature Review

Conceptually, there are four main concerns in the teaching and learning process: the student and his or her characteristics, the teacher and his or her characteristics, the teaching strategies or methods and the content or subject matter (Springthall et al., 1994). This implies that for quality and efficient teaching and learning to take place, the content or subject matter needs to be well structured and delivered using the best delivery methods possible or teaching materials. Mackey, (1982) enumerate eight qualities of an efficient teacher. One of these qualities is his or her ability to work with technological tools.

The teaching process has undergone a lot of transformations in the past decades. To be an effective teacher requires a blend of skills and abilities. The concept of teaching is now basically learner-centred with the teacher playing the role of a facilitator of the learning process. Teachers are caught in the web of not only mastering their subject content and pedagogy.

Pedagogy on its part has also undergone a lot of metamorphoses. Digital pedagogy or the ability to integrate digital technologies at different stages of a lesson is a skill all teachers must now acquire. The ability to teach students using projects is also a much recent concept teachers must also learn and incorporate in the course of shifting more responsibility of the learning process to the learners. Problem based learning is another practice that requires teacher development to be able to apply. The classroom teacher needs continuous professional development to be able to keep abreast with the constant change in 21st century teaching and learning. 21st century trends place high standards not only on teachers but also learners. Learning is more learner-centred. Learners are expected to be active co-constructors of knowledge in and out of class, synchronously and asynchronously.

The information processing theories of Atkinson and Shiffrin (1968), Baddeley (1966) Craik and Lockhart (1972) provide models that elaborate the centrality of ICTs in enhancing the acquisition of knowledge, memory processes and creative problem-solving skills in learning. The information processing theories help us to understand how information is encoded, stored and retrieved in the human memory (Schacter, 2001). Thinking of memory in terms of encoding, storage and retrieval, ICTs are powerful tools used to facilitate selective attention, perception, memory, image formation, concept formation, and problem-solving that are critical skills in every lesson. The focus was on the basic information processing skills involved in acquiring information from the environment and how information is manipulated, processed and organized in memory during learning.

Brunner's cognitive constructivist theory is another model that was used to shed light on the ways in which information is represented in the mind in the process of learning. He put forward three concepts that explain three different stages or modes in which information is represented in the mind. They are the enactive (muscular memory), iconic (visual and auditory representation) and symbolic modes (Symbolic thought permits the storage of information in terms of symbols such as the words of language or numbers in mathematics). These modes develop in order and allow a learner to think in a more sophisticated manner. Adult thinking maintains all three modes. Symbolic representation of thought facilitates information manipulation. With the use of ICTs, learning content can be represented to learners in the form of text, images, videos, infographics and activities so that learners of different modalities can access learning in the way they best understand. Multiple modes of representation from multiple sources also simplify concepts thereby facilitating understanding, memory and remembering for problem solving. ICTs are very useful tools for multimodal representation of information that address diverse learning needs and levels of support in a classroom. A cognitively rich lesson should engage learners in physical activities, visual and auditory images and symbolic thought activities.

Barbe, (1979) proposed three learning modalities often identified by the acronym VAK. His theory states that learners learn best when the teacher's teaching style matches with their learning style. The three learning styles are visual, auditory and kinesthetic. Visual learners understand best when the teacher uses texts, pictures, videos, shapes, sculpture, paintings and other things that can be visualised. Auditory learners need listening, rhythms, tone and songs, lectures, explanations. Recordings and any materials that appeal to the sense of hearing. Kinesthetic learners learn best from gestures, body movements, object manipulations, and other activities that require them to act upon the learning content like field trips, laboratory experiments and practical hands - on activities, group work and other learner activation tasks that engage in practical, physical or manual activities. These learning modalities can occur individually or in combinations in learners.

Students learn in different ways and paces from one another based on their characteristics, interests, needs and the context. Learning design needs to cater for these differences. ICT tools provide different types of engaging activities. Teachers can provide multiple engaging options for learning activities within the curriculum to reach out to all students. Digital technology offers more options and flexibility to address learner variability when compared with traditional methods. Teachers need to strive for mastery in developing experts at learning. Teachers can create expert learners by teaching their learners how to manage their strengths and challenges to meet learning goals. Developing 'expert learners' should be at the heart of designing learning experiences. Expert learners is a concept used in the UNESCO Digital Teacher English to refer to students apt in digital citizenship and digital

competencies that permit them solve both local and global problems; creative and productive learners capable of using ICTs to foster their own learning processes through self-directed enquiry. ICTs allow excellent presentation in both video, audio, text modes and also provide some tactile feedback through the use of keyboards. They can be used as facilitators of knowledge construction and meaning-making on the part of learners and teachers alike (Kozma, 1994). With the use of ICTs, all the different types of learners learn in one or more of the learning preferences.

A survey carried out by UNESCO in 2018 to update the global framework of reference on digital literacy skills of member states had as indicators of digital or ICT literacy, six areas of competency for evaluating the level of digital literacy of member states. The first level was identified as competency in hardware (device) and software operations. Then, information and data literacy, interacting through digital technologies, developing digital content, copyright and licenses, protecting personal data and privacy and identifying digital competency gaps. It was observed that browsing, searching and filtering data, information and digital content had the highest mapping especially in low income countries where sub-Sahara Africa falls. Competences for broad social concerns and higher levels of problem-solving received lower attention from high income nations and were less specified compared to basic technical skills.

Research carried out on the practical application of ICT use in teaching in Cameroon can be seen in Nalova, (2018) on the use of ICTs in teaching critical thinking skills in secondary schools in the South West Region of Cameroon. It examines the use of videos in enhancing critical thinking skills such as analysis, evaluation and creativity. Participants consisted of 224 students and 8 teachers from three government secondary schools in Fako. The study made use of observation guides and focus group discussions. Findings revealed that the use of videos in teaching enhanced critical thinking skills in learners. Amah 2016 investigated the role of ICTs in enhancing English Language teaching and learning in Cameroon secondary schools. She sought to assess the level of application of ICTs in English language teaching of final year students in Anglophone Cameroon. She also examined the role of ICTs in ameliorating teaching and learning. Findings revealed that ICTs were not used by most teachers. They therefore recommended the application of ICTs in teaching and learning.

Ngongba and Ngwa, (2024) investigated the integration vis-à-vis teaching and learning practices in Cameroon secondary schools. To achieve this objective, the exploratory method was adopted, which is both qualitative and quantitative. Using a purposive sampling technique, 532 teachers were selected for the study. The Statistical Package for Social Sciences (SPSS) was used for data analyses and the following results were obtained: digital pedagogies on teaching/learning practices in Cameroon secondary schools were positively significant. This was based on the fact that the level of significance was 0.00 thus lesser than 0.05 which is the alpha; standard error margin. Alternatively, the correlation coefficient (0.07) is a positive value and is situated within the normal range. The results revealed that digital pedagogies significantly influenced teaching and learning practices in Cameroon secondary schools. Even though effort to digitalize teaching and learning became an emergency due to Covid19 shutdown, teachers increasingly feel the need to integrate ICT into their practices to ensure quality learning (Valverde-Berrocoso, Fernández-Sánchez, Revuelta Dominguez & Sosa-Díaz, 2021).

In another study, the interest shown by teachers though practices remain very limited (Ngwa, 2023) indicating an ardent need to tailor ICT integration to specific classroom activities. Teachers are expected to use technology in teaching and learning in meaningful ways that engage, motivate, and inspire learners of all ages, adjust what and how to teach to meet learner needs and how, where and when they learn. The pending question is how can teachers provide learners with effective instruction ICTs? According to the National Educational Technology Plan (2010): The challenge for our education system is to use technology to create relevant learning experiences that mirrors our students' daily lives and the reality of their futures. In line with the above statement, Cameroon Educational Plan 2013 to 2020 on the professional development in expanding the use of ICT in education and training of teachers arrived at the following solutions: Education and training will be modernized through the integration of ICT; It will strengthen the capacity of teachers and support staff to use computer tools.

A study by Agbor, (2024) on assessing the challenges in using digital technologies in teaching and learning in

state universities in Cameroon had as objective to find out the challenges faculty and students face in the use of digital technologies in teaching and learning in state universities in Cameroon. Four specific research questions guided the study; what challenges do faculty and students face in the use of learning management systems (LMS) in state universities in Cameroon? What challenges do faculty and students face in the use of Video Conference Platforms in state universities in Cameroon? What challenges do faculty members face in the use of Microsoft PowerPoint in teaching in state universities in Cameroon? What challenges do faculty and students face in the use of smart devices in state universities in Cameroon? All this ICT software mentioned in this review fall under the use of ICTs for multimodal representation in teaching and learning. Even though the focus here was for universities, similar challenges appear in the use of these same tools in secondary education and would be minimized if teachers are trained to harness them.

Some trainings are theoretical while others are practical with hands-on projects. Female Voices by the British Council, Africa ELTA Female Mentorship program, Fulbright TEA Alumni workshops, national teacher association annual conferences, and Regional pedagogic seminars provide task- based trainings to enable teachers use ICTs for specific classroom activities. The specific training of teachers has not been adequately explored. There is a significant gap with regard to the training of teachers in the use of ICTs. The COVID-19 pandemic highlighted the urgent need for adequate training to enable teachers to use ICTs effectively to teach synchronously and asynchronously.

A study on adopting smart devices in teaching for the acquisition of 21st century employability skills by students in State Universities in Cameroon conducted by Oben, et al., (2023) aimed at finding out the extent to which the use of smart devices in teaching could enhance the acquisition of 21st-century employability skills by students in state universities in Cameroon, used two research questions; to what extent the use of smart phones in teaching were effective in enhancing the acquisition of 21st-century employability skills by students and to what extent the use of laptops in teaching was effective in enhancing the acquisition of 21st-century employability skills in students. The research design used was the exploratory sequential research design in a mixed-method. 406 participants from professional faculties in five of the eight state universities were selected to make up the sample size of 386 final-year undergraduate students, and 20 teachers. Stratified purposive sampling, and purposive sampling techniques were used for the study. Online Google forms, paper questionnaire, and an interview guide constituted the study instruments. The findings showed that, smart devices did not only help students in information sourcing but also enhanced their communication skills, critical thinking and problem-solving skills, creativity and team working skills.

Methodology

The study used an embedded mixed-method design whereby a quasi-experiment was set up to test the impact of teacher use of ICTs for multimodal representation in teaching processes and the implications on aspects of learning such as the acquisition of knowledge, memory and creative problem-solving skills. The UNESCO Digital Teacher English course was used as the research intervention during a period of 5weeks. The quasi-experiment was followed by an interview to capture participant experiences during the course. Observations were taken in the course of the training to better understand teacher and student engagement with ICT tools. A total sample of 50 participants took part in the study selected by hat and draw simple random sampling. 30 students were involved; 15 for the experimental group and 15 for the control group. 20 teachers were involved; 10 for the experimental group and 10 for the control group. The target population of the study was 350 lower sixth students and their teachers. Lower sixth students were chosen because high school is a pre-university level and a critical stage for the acquisition of ICT skills highly needed for university education. Their being in a non-examination class made them more available for the study than upper sixth students. The population distribution can be seen on the table below.

Table 1: Target population, accessible population and Sample size

S/N	Trade	Student Target population	Student Sample size	School student population	School Teacher population	Teacher sample size
1	Electrical Power Systems	53	05	3500	305	02
2	Electronics	16	02			02
3	Building and Construction	43	04			02
4	Clothing Industry	41	04			02
5	Woodwork	10	01			02
6	Plumbing	13	02			02
7	Moto Mechanics	35	03			02
8	Home Economics	23	03			02
9	Accounting	32	03			02
10	Secretarial Administration	23	02			01
	Marketing	02	01			01
	Total	**309**	**30**			**20**

Quantitative and qualitative strands of data were collected. Quantitative data was analyzed using paired T-test. Both the quantitative and the qualitative data were collected and analysed sequentially. Both strands were then merged at the level of interpretation. Quantitative data was analysed using paired T-test while qualitative data was analyzed using thematic analysis to show recurrent themes.

The instruments used for data collection were a questionnaire, interview guides and observation checklists. The questionnaire was constructed using the indicators and indices of the independent variable; ICTs for information sourcing, ICTs for multimodal representation of information, ICTs for content creation and the implication of their use on indicators of dependent variable, learning such as; the acquisition of knowledge, memory and creative problem-solving. The intervention used for the quasi-experiment was the UNESCO Digital Teacher English course built by Mahatma Ghandi Institute of Education for Peace and Sustainable Development (MGIEP).

Participants were assigned to experimental and control groups by hat and draw method. Four (4) WhatsApp groups were created to facilitate the different groups. Group 1 was used for the teacher experimental group. Group two (2) was for the teacher control group. Group three (3) was used for the student experimental group and group four (4) was for the student control group. Instructions and links for the study were shared in the different WhatsApp groups. WhatsApp groups were chosen as the means of communication because of its prevalence among all age groups in our immediate community. The research questionnaire was converted to Google forms to facilitate filling and submission and also to reduce data entry tasks since the excel sheet was generated automatically. Google forms were also used because it is a free application commonly used in our social context. It is familiar. The control groups were only exposed to the training after they had submitted the post-test Google forms. So that they also benefit from the same training as the experimental group. The intervention period was 6 weeks.

A pilot study was done using 10 students and 5 teachers from NABESK Comprehensive College Bonduma and Salvation Technical College Checkpoint. It was a paper and pen test. Some corrections were affected after the pilot test before it was converted to Google forms and administered to the research participants.

Table 2: Reliability analysis for the teacher experimental group

Conceptual components	Test level	Cronbach's Alpha reliability coefficient	Variance	Ncases	Nitems
ICTs for Information	Pilot	0.489	1.001	8	10

Sourcing and the acquisition of knowledge	Pre-test	0.689	1.151	8	10
	Post-test	0.797	0.681	8	10
	IVM (Pre-test and post-test)	0.625	0.541	8	20
ICTs for multimodal representation of information and the development of memory	Pilot	0.398	0.425	8	10
	Pre-test	0.676	0.448	8	10
	Post-test	0.782	0.805	8	10
	IVM (Pre-test and post-test)	0.638	0.354	8	20
ICTs for content creation and the development of creative problem-solving skills	Pilot	0.421	0.209	8	9
	Pre-test	0.562	0.248	8	9
	Post-test	0.719	1.463	8	9
	IVM (Pre-test and post-test)	0.571	0.463	8	18
Overall IVM	Pilot	0.400	0.612	8	29
	Pre-test	0.695	0.770	8	19
	Post-test	0.740	0.777	8	19
	IVM (Pre=test and post-test)	0.519	0.444	8	38

During the pilot study, the internal consistency assumption was violated (Alpha=0.400). Several items were rephrased. The number of questions under each objective had to be harmonized too. As for the study proper, Alpha reliability coefficients ranged from 0.519 to 0.797 which was good. The overall IVM indicated relatively high variances, closer to 1, thus implying teachers were likely to be diversified in their performances.

Table 3: Reliability analysis for teacher control group

Conceptual components	Test level	Cronbach's Alpha reliability coefficient	Variance	Number of cases	Number of items
ICTs for Information Sourcing and the acquisition of knowledge	Pre-test	0.510	0.301	8	10
	Post-test	0.461	0.201	8	10
	IVM (Pre-test and post-test)	0.430	0.161	8	20
ICTs for multimodal representation of information and the development of memory	Pre-test	0.363	0.310	8	10
	Post-test	0.401	0.218	8	10
	IVM (Pre-test and post-test)	0.479	0.208	8	20
ICT for content creation and the development of creative problem-solving skills	Pre-test	0.461	0.261	8	9
	Post-test	0.452	0.215	8	9
	IVM (Pre-test and post-test)	0.456	0.231	8	18
Overall IVM	Pilot	0.432	0.187	8	29
	Pre-test	0.301	0.225	8	19
	Post-test	0.403	0.300	8	19
	IVM (Pre-test	0.412	0.178	8	38

	and post-test)				

Alpha reliability coefficients ranged from 0.301 to 0.510 with only one falling above the acceptable threshold of 0.5 that is 0.510. The variances were relatively low, generally close to 0, thus implying that the performances of students were likely to be skewed either toward low or high. Also, unlike the experimental group, no improvement in the reliability was observed from pre-test to post-test.

Table 4: Reliability analysis for student experimental group

Conceptual components	Test level	Cronbach's Alpha reliability coefficient	Variance	Number of cases	Number of items
ICTs for Information Sourcing and the acquisition of knowledge	Pilot	0.503	1.345	7	10
	Pre-test	0.479	1.111	7	10
	Post-test	0.693	0.320	7	10
	IVM (Pre-test and post-test)	0.637	0.123	7	20
ICTs for multimodal representation of information and the development of memory	Pilot	0.498	0.145	7	10
	Pre-test	0.536	0.136	7	10
	Post-test	0.689	0.301	7	10
	IVM (Pre-test and post-test)	0.600	0.345	7	20
ICTs for content development and the development of creative problem-solving skills	Pilot	0.561	0.189	7	10
	Pre-test	0.551	0.202	7	10
	Post-test	0.639	1.189	7	10
	IVM (Pre-test and post-test)	0.661	0.230	7	20
Overall IVM	Pilot	0.503	0.156	7	30
	Pre-test	0.613	0.265	7	20
	Post-test	0.787	0.211	7	20
	IVM (Pre-test and post-test)	0.713	0.302	7	40

During the pilot study, the internal consistency assumption was not violated (Alpha=0.503) though some adjustments were done on the evaluation instrument, and the main one was the harmonization of the number of questions under each objective. As for the study proper, Alpha reliability coefficients ranged from 0.479 to 0.713 with only one falling below the acceptable threshold of 0.5 that is 0.479. The variances were relatively low, generally close to 0, thus implying that the performances of students were likely to be skewed either toward low or high.

Table 5: Reliability analysis for student control group

Conceptual components	Test level	Cronbach's Alpha reliability coefficient	Variance	Number of cases	Number of items
ICTs for Information Sourcing and the	Pre-test	0.310	0.391	7	10
	Post-test	0.269	0.300	7	10

acquisition of knowledge	IVM (Pre-test and post-test)	0.299	0.311	7	20
ICTs for multimodal representation of information and the development of memory	Pre-test	0.200	0.413	7	10
	Post-test	0.501	0.358	7	10
	IVM (Pre-test and post-test)	0.178	0.269	7	20
ICTs for content creation and the development of creative problem-solving skills	Pre-test	0.451	0.201	7	10
	Post-test	0.355	0.310	7	10
	IVM (Pre-test and post-test)	0.166	0.211	7	20
Overall IVM	Pre-test	0.208	0.315	7	20
	Post-test	0.540	0.527	7	20
	IVM (Pre-test and post-test)	0.355	0.257	7	40

Alpha reliability coefficients ranged from 0.269 to 0.540 with only one falling above the acceptable threshold of 0.5 that is 0.540. The variances were relatively low, generally close to 0, thus implying that the performances of students are likely to be skewed either toward low or high. Also, no consistent improvement was observed in the reliability from pre-test to post-test.

The Excel sheet downloaded from Google form responses carrying the quantitative data was input into Epi Data Version 3.1 (Epi Data Association, Odense Denmark, 2008) for coding. The Excel sheet was then imported in the Statistical Package for Social Sciences (SPSS) Standard version, Released 21.0 (IBM Inc. 2012) and explored for outliers using box plot. Descriptive statistics was used to present the mean scores, frequencies, percentages and standard deviation of the variables. Paired T-test method of inferential statistical test used to analyse the data since it was comparing mean scores the teacher and student experimental and control groups at pre-test and post-test to see if they differed from each other significantly. Findings were presented in means, frequencies, percentages and standard deviation. Progression chats were also used to show the difference between pre-test and post-test score where significance was below 0.05 P value.

Findings

With respect to students' knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group, progression was higher in the experimental group with a value of 13.9% as compared to 4.3% for the control group. This showed that when teachers used ICTs to represent learning content in different modes students learn better. On the other hand, the use of multimodal that not significantly benefit teacher learning.

At post-test, with respect to teachers' knowledge of ICTs for multimodal representation of information and the development of memory, comparing between experimental and control group, there was no significant difference in performance for all the scales (P>0.05).

Table 6: Teacher's knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group

Test level	Status	Experimental group	Control group
Pre-test	Right	55.0% (44)	51.3% (41)
	Wrong	45.0% (36)	48.8% (39)
Post-test	Right	58.8% (47)	62.5% (50)

	Wrong	41.3% (33)	37.5% (30)
Progression (right)		3.8%	11.2%

With respect to teachers' knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group, paradoxically, progression was higher in the control group with a value of 11.2% as compared to of 3.8% for the experimental group. At pre-test, with respect to students' knowledge of ICTs for multimodal representation of information and the development of memory, comparing between experimental and control group, there was no significant difference in performance for two scales ($P<0.05$).

Table 7: Students' knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group

Test level	Status	Experimental group	Control group
Pre-test	Right	62.9% (44)	57.1% (40)
	Wrong	37.1% (26)	42.9% (30)
Post-test	Right	76.8% (53)	61.4% (43)
	Wrong	23.2% (16)	38.6% (27)
Progression (wright)		13.9%	4.3%

With respect to students' knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group, progression was higher in the experimental group with a value of 13.9% as compared to 4.3% for the control group. This showed that when teachers used ICTs to represent learning content in different modes students learn better. On the other hand, the use of multimodal that not significantly benefit teacher learning.

Research hypothesis: There is no significant relationship between the use of ICTs for multimodal representation of information in teaching and learning in terms of memory.

This hypothesis was rejected only for students thus implying that this intervention significantly impacted but students, while among the teachers, paradoxically, improvement was higher in the control group but the difference was not statistically significant.

Table 8: Teachers' knowledge progression in ICTs for multimodal representation of information and the development of memory in the experimental group

Stats	Test Level		Mean difference
	Pre-test	Post-test	
N	8	8	
Mean	5.5	5.9	0.4
Std. Deviation	1.6	2.0	
SD_g	1.8		
Calculated Effect Size	0.2		
Theoretical Effect Size	0.7		

Interpretation (Cohen's *d*)*	The theoretical effect size is the bigger than the calculated one, we then accept the hypothesis that the means are not different. This therefore implies that there was no significant progression from pre-test to post-test.

Table 9: Teachers' knowledge progression in ICTs for multimodal representation of information and the development of memory in the control group

Stats	Test Level		Mean difference
	Pre-test	Post-test	
N	8	8	
Mean	5.1	6.2	1.1
Std. Deviation	1.7	1.7	
SD_g	1.8		
Calculated Effect Size	0.6		
Theoretical Effect Size	0.7		
Interpretation (Cohen's *d*)*	The theoretical effect size is bigger than the calculated one, we then accept the hypothesis that the means are not different. This therefore implies that there was no significant progression from pre-test to post-test.		

Table 10: Students' knowledge progression in ICTs for multimodal representation of information and the development of memory in the experimental group

Stats	Test Level		Mean difference
	Pre-test	Post-test	
N	7	7	
Mean	5.7	7.5	1.8
Std. Deviation			
SD_g	1.9		
Calculated Effect Size	0.9		
Theoretical Effect Size	0.7		
Interpretation (Cohen's *d*)*	The theoretical effect size is smaller than the calculated one, we then reject the hypothesis that the means are not different. This therefore implies that there was a significant progression from pre-test to post-test.		

Table 11: Students' knowledge progression in ICTs for multimodal representation of information and the development of memory in the control group

Stats	**Test Level**		**Mean difference**
	Pre-test	Post-test	
N	7	7	
Mean	6.3	6.5	0.2
Std. Deviation	1.2	2.1	

SD_g	1.3	
Calculated Effect Size	0.2	
Theoretical Effect Size	0.7	
Interpretation (Cohen's *d*)*	The theoretical effect size is bigger than the calculated one, we then accept the hypothesis that the means are not different. This therefore implies that there was no significant progression from pre-test to post-test.	

Discussion

With respect to teachers' knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group, paradoxically, progression was higher in the control group with a value of 11.2% as compared to of 3.8% for the experimental group. The drop-in performance between pre-test and post–test result could be because the duration of the training was slightly modified to reduce the rate of instrument mortality and increase the number of teachers and students completing the course. The change may also be due to any possible knowledge acquired by any of the control group participants during the holidays or any other exposure.

With respect to students' knowledge of ICTs for multimodal representation of information and the development of memory, comparing progression between experimental and control group, progression was higher in the experimental group with a value of 13.9% as compared to 4.3% for the control group. Looking that the progress made by the student experimental group at the posttest level, we could conclude that even though they did not reach the P value of 0.5, it is obvious that they recorded a positive benefit from exposure to the intervention. Finally, looking at the results, it can be seen that students are more engaged with technologies for learning purposes than teachers are for teaching. Learners are interested in learning through videos in particular. They want to explore learning content related to their trades and subjects. Teachers need to be trained using practical videos on how to source content for lesson planning and delivery as well as on how to create curriculum based online resources for the Cameroonian educational system. Nalova, (2018) on the use of ICTs in teaching critical thinking skills in secondary schools in the South West Region of Cameroon equally revealed that the use of videos in teaching enhanced critical thinking skills in learners. Oben et. al., (2023) also found benefits in the use of smart devices not only in helping students in information sourcing but also in enhancing their communication skills, critical thinking and problem-solving skills, creativity and team working skills.

The information processing theory used in this study provides elaborate guidelines on ways teachers can use ICTs to benefit memory. If ICTs are used to catch and sustain learner attention, build connections between classroom activities and real-life tasks, chunk or summarize information, deep learning activities, deeper level learning is bound to occur. Brunner's modes of representation also shows that representing learning content in different sensory formats (iconic, echoic and symbolic) enhance understanding and deepen learning experiences. The VAK theory also throws more light on the need for the teaching method of teachers to be diversified so that their teaching meets the needs of learners with different learning styles. Differentiated instruction ought to be respected in the course delivery as well. Trainings that lack practical hands–on activities are therefore disadvantageous to kinesthetic learners.

Among the important milestones is how to integrate ICTs or digital tools in teaching and learning in secondary schools. The use of online courses should be followed by practical hands on trainings. The focus should be on the use of specific tools that are basic for teachers and students such as ICT tools for multimodal representation of information. If this is done, teachers will be able to compete with teachers around the world in terms of knowledge creation to solve education problems at home and abroad. Teachers trained in Cameroon migrate to different parts of the world due to the global shortage of teachers. Therefore, quality teacher training cannot be jeopardized. Cameroonian

students as well are not bound to end up in the nation. Teaching at world class standard cannot be compromised in this digital age. A good teacher is known by the quality of learners he or she produces.

This study has shown that online courses such as the UNESCO Digital Teacher course alone is an insufficient prerequisite for the digitalisation of teaching and learning. This course should be followed by practical hands-on capacity building workshops to enhance learner acquisition of knowledge, memory and creative-problem solving skills. The development of these skills empowers teachers to acquire knowledge in online spaces, present teaching content in different modes for inclusive education and create diverse kinds of teaching materials to facilitate understanding, storage and retrieval of knowledge to solve problems at different levels.

Furthermore, the review of related literature and discussions led to a comparative analysis of the nature of research on ICT in education in Cameroon and developed countries. Research from the west focus on experimental studies that seek to train teachers and students on how to use specific ICT tools for specific subjects to maximize impact. Such studies seek to find out how to improve learning via ICT rather than surveying or gathering pieces of information on what obtains in the field. If we begin to ask the right questions in our own research endeavours, we may make enormous progress in the digitalization process.

It is important to note that the concern of ICT implementation in the teaching and learning process is the collective effort of all stakeholders in the education enterprise; both the individual teachers, students, parents, community, NGOs and the government for the much-needed change to take place. Efforts towards improving teaching and learning outcomes should not be seen as the sole responsibility of the government. If a whole system approve is adopted wherein every stakeholder in education puts in their own quota, student learning with the use of ICTs could be facilitated by teachers taking responsibility over their own professional development, taking advantage of training opportunities offered by non-governmental organizations, PTAs making available teaching and learning technologies or parents providing extra trainings for children on weekend days or during the holidays.

The objectives for this study capture a continuum of key areas of teacher and student competency in digital skills thereby providing a framework for the assessment of teacher ICT competency skills. If future research focus on these important concerns of ICT competency skills, much of teaching and learning in Cameroon secondary schools could be digitalized. Teachers and students alike could be better equipped with the skills needed to solve local and global problems.

Conclusions

In a nutshell, this study set out to investigate the use of ICTs in teaching and learning processes and the implications on learning. The main objective of this study was to find out to what extent the use of ICTs for multimodal representation in teaching processes enhance the learning in terms of the acquisition of knowledge, memory and creative problem-solving skills. The study was done using an embedded design with a quasi-experiment followed by interviews at the end of the post-test. The data sets were analyzed separately using simple descriptive statistics such as frequencies, percentages and standard deviation and paired T-test. Qualitative data was analyzed thematically. The findings showed that the teacher experimental group experienced a paradoxical progression of 11.2% for the teacher control group and 3.8% while the student experimental group experienced a progression of 13.5% as against 4.3% for the control group.

Thematic analysis of the interview showed that 4 teachers reported providing guidance to their students on search strategies, websites to visit, use e-dictionaries with them in class. Three (3) teachers reported the ability to use multimodal resources while 4 said they were still to learn % of them create WhatsApp groups for the students 3 could do video recordings of classroom activities. Three also said they could create some educational contents like lesson summaries, infographics, worksheets and e-books. On the part of the student experimental group, 5 could source for information online through Google or trade related YouTube videos for practicals, extract information online or create videos.

One of the major challenges faced during the training was teacher attitude towards the use of ICTs. Some complained about the policy and could not handle documents online. Others were not available because of other preoccupations. They complained of being too

busy. At the start of the training, gender balance was ensured but along the way most of the males had to be replaced by other female colleagues who were ready to sacrifice time. Most of the male teachers had contracts to pursue or were busy at their other side hustles. It was also noticed that most of the teachers had no value for continuous professional development. They perceived the value of the course in terms of what immediate financial benefit it could bring. Most of them wanted to know the economic benefit of the course before enrolling. Again, a good number needed follow up because they were occupied with construction contracts and could not create time to complete the course. The use of teacher leaders in ICT related development projects in schools could encourage teacher up-take of digital skills.

Technological tools are often disruptive. Some of the participants could not complete the training ether because their phones developed a fault, got bad or just had network problems. The lack of good and regular internet connection in the school computer lab made it difficult to carry out the training onsite. For that reason, most of the work was done using mobile phones at home and we only met in school to facilitate those facing difficulties mastering the Framerspace platform or the digital teacher course itself. The government also need to facilitate the availability of a good internet connection in schools by signing an agreement with telecom companies obliging them to provide free internet in school. The internet bandwidth for schools could also be increased such that many teachers and students can work without depleting the network. Telecommunication companies with better network could be commissioned to connect educational institutions and also function nationwide fully as is the case in other African countries. Most principals go for low bundles that provide very low bandwidth that cannot carry the population of a school for economic reasons. Besides, the supply of MTN and Orange network is very inconsistent and unreliable.

One of the complaints was on the lack of facilities to ace the transition from traditional to digital instruction. ICT related projects by NGOs and other international organizations should be guided by research findings in the field. By so doing, investment funds will be channeled more to human capital development than to the purchase of tools and gadgets that soon get bad and cannot be maintained for lack of expert use. Specifications and guidelines for the different digital tools suitable for academics and research need to be made available to teachers and students alike so that their resources are well invested on digital gadgets that will best meet their needs. Google pixel phones for instance and rechargeable mini projectors. Rechargeable mini projectors can be used in classrooms without electricity.

Government investment in digitalization policy should target hands-on trainings of teachers on the use of specific digital tools and applications for teaching and learning rather than on theoretical online courses only. Such trainings should enable them build subject based online resource banks, sources videos, infographic summaries, audios and texts that can be used to teach. Teachers also need to be taught how to create and share curriculum based educational resources like worksheets, digital lesson plans, videos to upload on social media and other platforms to facilitate student access to learning contents design their syllabuses in mind. Computers and other gadgets which end up getting bad without being used because those who were supposed to use them lack the skills needed. An example is the school projector which was being used only during computer science, accounting and other commercial trade subjects that depended on computer. The deplorable conditions of infrastructure talk less of technology in some urban, semi-urban and rural schools present other harsh realities to the use of ICTs in enhancing student learning in both urban and rural schools in Cameroon.

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