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CONTENTS

From the Editor

Welcome to our special Autumn issue of the ICC-Journal. We are especially honoured to have the opportunity to offer a series of articles on the role of disruptive technologies, Artificial Intelligence (AR) and Virtual Reality (VR) in language, mathematics and government training. Huge thanks to Didier Bazalgette and Jean Langlois of Sciences Po in Paris, and their co-authors for putting together this research.

We also greatly appreciate the articles by Joseph Ahaotu, and Nchechi Frances Ann Asiegbu of Port Harcourt University in Nigeria on *Using Social Media in Teaching English for Academic Purposes*, Olena Plakhotnikova of the Taras Shevchenko National University of Kyiv and Eva Seidl of the University of Graz on *Teachers' Collective Reflexivity Meant for Students' Collective Agency in the Process of 21st-Century Skills Acquisition* and Didier Bazalgette on *How Web 3.0 Technologies Could Change the Way We Do Teaching and Training*.

It's taken a while to get this issue into print but thank you to all our contributors for their patience and preparing detailed studies of the role of relatively new technologies in language training and other disciplines, an important contribution to a quickly developing field. It also raises important questions regarding the requirements of teachers' technological training to master the skills of using advanced technologies in the classroom.

In our next issue we will have the pleasure of summarising the exciting webinars offered monthly by ICC-Languages and offer latest book reviews for teachers, teaching tips and of course, new keynote articles.

2023 has been a busy year for ICC-Languages. Our former Chair, Ellinor Haase has come to the end of her term as Chair and we now have two co-chairs, Myriam Fischer, Academic Director of EUROLTA and Tanya Kovac of St Nicholas School in Belgrade in Serbia who have accepted the post of joint Chairs.

Tanja was able to organise the first face-to-face and online hybrid ICC-Languages annual conference in Belgrade since the outbreak of COVID-19 attended by teachers and trainers from all over Europe and beyond, a very successful event. Our next conference is planned for April next year in Athens, Greece. Another event to look forward to with great pleasure. For more information please go to www.icc-languages.eu and click on conferences.

Meanwhile, the list of subcribers to ICC-Journal continues to grow with teachers from all over the world showing interest. The ICC-Journal is an online academic journal published free of charge and can be accessed at www.icc-languages.eu/ICC-journal.

We aim to offer practical support for language teachers and trainers and for teachers and trainers specialising in international culture. It is recognised by EBSCO and offers an exciting opportunity to publish your teaching and training ideas and research.

We would love to hear from you and if you are thinking of publishing your work please do not hesitate to get in touch with me at barrytomalin@aol.com. Enjoy this issue.

KEYNOTE ARTICLE 1

Four Strategies for Utilizing Social Media in Teaching & Learning English for Academic Purposes in Nigeria

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Abstract
This paper examines the uses of social media in teaching and learning English language in Nigeria. It was based on the Uses and Gratification Theory and adopted a qualitative approach in its focus on how social media could be effectively utilised in teaching and learning English. The paper established a link between social media and literacy and also discussed the importance of social media in the teaching and the learning of English. It proposed four (4) strategies that could enhance the use of social media in both teaching and learning of English in different contexts in Nigeria, including English for Academic Purposes (EAP). These are: using social media for visual scaffolding, providing learners with opportunities of multiple literacies, using social media for effective preparation/use in lesson planning, and utilising social media as a virtual classroom. The authors concluded that although social media have potentials for distracting learners, their significance in teaching and learning is rising significantly. They recommended, among others, that English language professionals should continuously develop their ICT/literacy skills and progressively integrate appropriate social media platforms in their lesson plans.

Keywords: Social media, literacy, ICT, EAP, teaching English, learning English

Introduction
Communication technology has changed rapidly and radically through the widespread use of computers and communication satellites. Individuals have joined corporate bodies, the military, and mass media outlets in relying heavily and benefiting immensely from information communication and technology (ICT). Personal computers and hand-held devices have expanded the frontiers of literacy and the requirements of reading skills. ICT has impacted immensely the traditional literacy practices of reading, writing, computation, etc. and has opened frontiers of new literacies (Ahaotu, 2018). The Internet, satellite television, cell phone, fax machines, scanners, automated teller machines (ATMs), etc. are very strong defining factors of life and literacies in our contemporary society. Modern communication technology ties humanity together as the nervous system ties the parts of the human organism together. Today, we are connected with every other human being on the planet in a way people never have been before. Space and time are gradually being reduced and in the underlying concept of Mcluhan's (1967) view of electronic technology, the world has become a small space in which people can communicate quickly and know every event that takes place. Mobile applications (Apps) connect people all over the world and enable users to stream

live events, chat in real time, and access an unimaginable horde of information in the process through social media platforms such as Facebook, Twitter, Instagram, YouTube, WhatsApp, Tik Tok, VisKit, etc. These Apps have also become principle avenues of literacy and communication among humans.

Transnational human communication principally happens in English and has further boosted the growth of English into a global language. Graddol (2006) suggested that English is so widely used that approximately 5 billion of the world's estimated 7 billion population use the language in one form or the other. According to Mcluhan "time has ceased and space has vanished". Interestingly, when Mcluhan was expressing these views, the Internet was yet to be developed. The idea of a "global village" has gained prominence again amidst the emergence of the Internet and digital telecommunication media that seem to promote the idea of an integrated global community. People can converse and interact almost as well as if they were in the same location no matter where they are in the world. The coordination of tasks has now become easier than it was before the advent of the computer and Internet ages.

According to Sapir (1921), language is "purely human and non-instinctive method of communicating ideas, emotions and desires by means of a system of voluntarily produced symbols". Various authors have identified different functions of language. For instance, Brown and Yule (1983) identified the transactional and interactional functions of language. The transactional function of language corresponds to the use of language to express content, while the interactional function of language corresponds to the use of language to express social relations and personal attitudes. Crystal (1977) also identified some other functions of language such as the emotive or expressive functions of language and social interactions. These different functions of language can be narrowed to the following basic functions of language: ideational, interpersonal and textual. Language performs an ideational function when it is used to express or convey a speaker's experience of the real world, reactions, cognition and perceptions as well as his/her linguistic acts of speaking and comprehension. The interpersonal function of language entails the use of language to establish and maintain social relations while textual function of language is the use of language to put thoughts together in a cohesive manner; usually in a text. Umera-Okeke and Ahaotu (2018, p. 18) identified nine roles of language in human society and these are as follows:

1. It helps the child/human to explore the environment and the world.
2. It is the ultimate tool for learning.
3. It is the ultimate tool for socialization.
4. It engenders creativity through imaginative thought.
5. It sustains scientific experimentation/inventions.
6. It has health, economic, safety, etc. benefits.
7. It is a means of instruction.
8. It is a means of exclusion (Bamgbose 2006, p. 72).

Examples are in the use of language proficiency tests to determine admission, employment, and immigration. Test of English as a Foreign language (TOEFL), International English Language Testing System (IELTS), Pearson Test of English

(PTE), and Duolingo English Test for admission into educational programmes and for the evaluation of immigration are popular examples of these.

9. Language enables participation in the affairs of the community.

Language as used by humans is the principal distinguishing characteristic between humans as higher creatures and other classes of tool-using homo sapiens, such as the gorilla. The four language skills are: speaking, writing, listening, and reading. Speaking has already been described above as the primary mode of language use; together with writing it constitutes what is commonly described in the terminology of English language teaching (ELT) as productive language skills. The term “productive language skill” is a reference to the inherent nature of both speaking and writing to produce texts which require reception and decoding through listening and reading. On the other hand, listening and reading are classified in the literature as receptive language skills. They are receptive and interpretative of the productive spoken and written modes.

The media, which is an umbrella term for various means of communication, uses language to perform these functions. Language and its multifunctional capabilities are the primary tool of the media. The earliest forms of personal media, speeches and gestures had the benefits of being easy to use and did not necessarily need any complex technology. Communication technology in the 21st century has removed the weaknesses of not being able to communicate with larger audiences simultaneously. Listening, reading, writing, and speaking are the four language skills that are used in communication events. Social media represents the development of online communities of interest where citizens of different countries can build a network for communication without physical barriers. The pool of participants on these networks is often referred to as ‘netizens’; a blend of the words ‘network’ and ‘citizen’.

Since the introduction of the global system for mobile telecommunication (GSM) and the Internet into Africa, Nigeria has been a major beneficiary of the services. Scores of papers have been written by linguists and other social science practitioners on mobile telecommunication and its impact on the social life of the people. According to Shea, (2015), social media are forms of electronic communication which facilitate interaction based on certain interests and characteristics. According to Shea they are media for social interaction, using highly accessible and scalable publishing techniques, web-based technologies to transform and broadcast media monologues in social dialogues. They support the democratisation of knowledge and information and transform people from content consumers to content producers. The social media elements of the new media have become the highest activity on the internet. (Shea, 2015). The rapid growth of its activities that has been observed in recent years is indicative of its early entry into mainstream culture and integration into the daily lives of many people. This observation establishes a nexus between social media and reading culture.

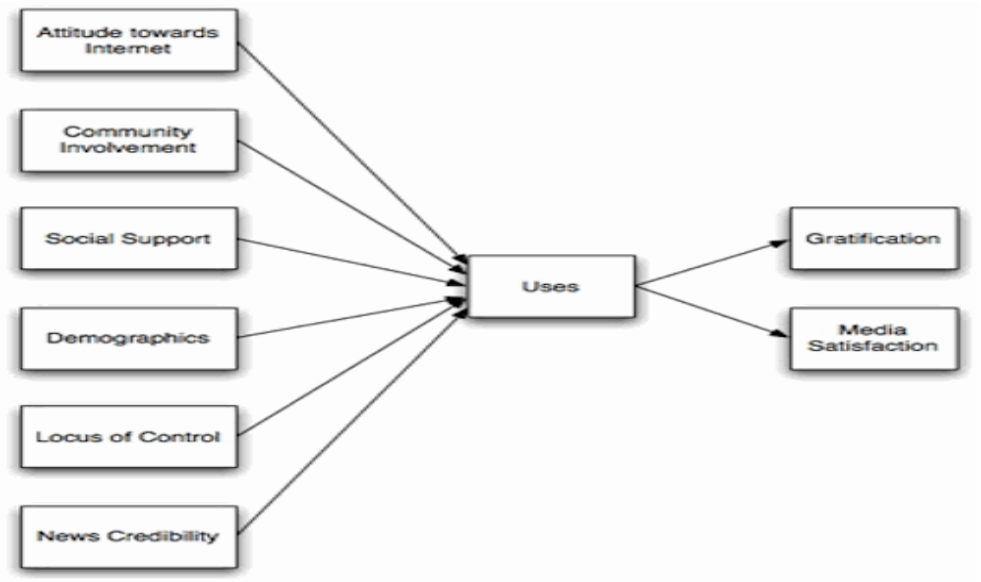
The Uses and Gratification Theory (U&GT)

This paper is based on the Uses and Gratification Theory (U&GT). Elihu Katz introduced the Uses and Gratification Approach in which he advanced a view that people use the mass media for their own benefits. Katz, Blumler, and Gurevitch

(1973–1974) developed the U&GT Approach to account for the fact that people use the mass media because they have certain expectations they wish to satisfy; and so, they seek out specific outlets that they believe would best help them achieve this. This perspective caused a paradigm shift in mass communication from studies of how the mass media influences consumers to studies on how audience preference determines mass media content. The theory is an approach to understanding why people actively seek out specific media outlets and content for gratification purposes. The theory discusses how users proactively search for media that would not only meet a given need but also enhance knowledge, social interaction and diversity. A major assumption is that media users (subscribers) take an active role in interpreting and integrating media into their own lives. The theory also holds that the individuals take advantage of the media to meet their needs. The major focus of this theory is the media users (subscribers) who derive some level of satisfaction or reward from using particular content of particular media (Katz, Blumler, & Gurevitch 1973; Okenwa, 2002).

Katz, Blumler, & Gurevitch (1973) take a non-prescriptive and non-predictive perspective on media effects. They postulated that individuals mix and match uses with goals, according to specific context, needs, social background and so on. Thus, they are seen as active participants in the media consumption process. Uses and Gratification theory suggests that media users play an active role in choosing and using the media. Users take an active part in the communication process and are goal oriented in their media use. The theorists are of the view that a media user seeks out a media source that best fulfils the need of the user. Uses and Gratification theory assumes that the user has alternative choices to satisfy the need. This is illustrated in Figure 1 below as follows:

Figure 1: Audience control of mass media content



Source: Wordpress.com

Interest in the gratifications provided by media goes back to the beginning of empirical mass communication research. The last few years have witnessed something of a revival of direct empirical investigations of audience uses and

gratifications around the world. More recent studies have a number of different starting points, but each study attempts to press towards a greater systematization of what is involved in conducting research in this field. Each major piece of Uses and Gratification research has yielded its own classification scheme of audience functions when, placed side by side, they reveal a mixture of shared gratification categories and notions peculiar to individual research teams. The differences are due in part to the fact that investigators have focused on different levels of study (e. g, medium or content) and different materials (e.g. different programmes or programme types on television) in different cultures. Instead of depicting the media as severely circumscribed by audience expectations, the Uses and Gratifications Approach highlights the audience as a source of challenge to producers to cater more richly to the multiplicity of roles that it has disclosed.

The Uses and Gratification studies can be useful in understanding consumer's motivation and concerns in the context of traditional media such as radio and television. However, only a few researchers have explored the Uses and Gratifications application in the Internet context. For example, people who browse websites for information such as on university admission demonstrate Uses and Gratifications behaviours similar to those obtained in studies of traditional media such as the television.

Katz, Blumler, and Gurevitch (1973) identified five components comprising the Uses and Gratifications Approach. These are:

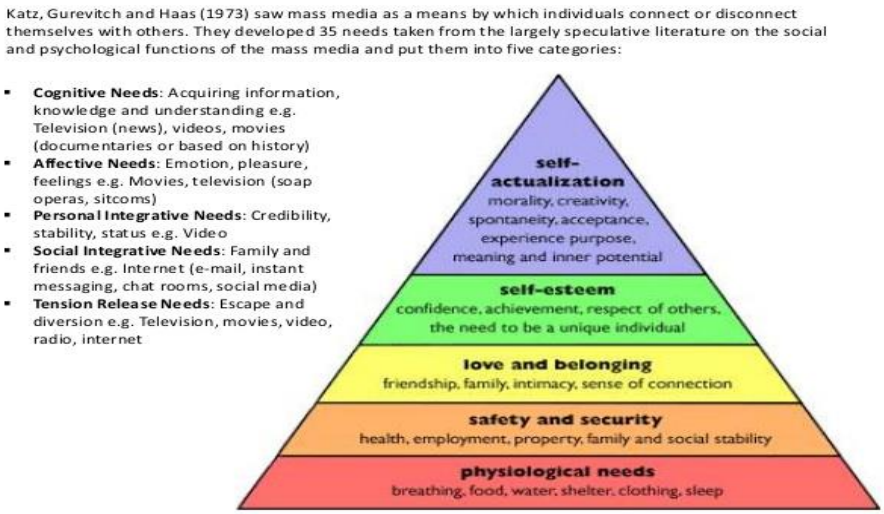
1. The audience is conceived as active.
2. In the mass communication process, much initiative in linking gratification and media choice lies with the audience member.
3. The media compete with other sources of satisfaction.
4. Methodologically speaking, many of the goals of mass media use can be derived from data supplied by individual audience members themselves.
5. Value judgments about the cultural significance of mass communication should be suspended while audience orientations are explored on their own terms.

They further streamlined the goals of media use into five and explained that the audience always seeks:

1. Information or education
2. Identification with characters of the situation in the media environment
3. Entertainment
4. Enhanced social interaction
5. Escape from the difficulties of daily life

The term 'message' refers to content created for audience consumption in communication events. The audience needs drive the consumption of the content; which gratifies the needs. The following is a graphic illustration and a textual explanation of examples of audience needs as conceived in U&GT:

Figure 2: Audience needs as conceived in U&GT



Source: Slideshare.com

According to Figure 3, U&GT conceives audience needs in terms of a pyramid with self-actualization at its peak and psychological needs at its base. Between these two are values of safety/security, love/belonging, and self-esteem. The values expressed here are in consonance with the factors that influence social media use by undergraduates in Nigeria. Katz, Gurevitch, and Haas (1973) viewed the mass media as a means of both social inclusion and exclusion since individuals may stay either connected or disconnected with society through the use or non-use of the mass media. They developed several needs that people seek to fulfill through the mass media and categorized them into the following five groups.

1. Cognitive Needs: Getting information, understanding, and knowledge such as from news, documentaries, and history from television and radio. In contemporary times, this would include social media outlets and the World Wide Web.

2. Affective Needs: Getting emotional satisfaction such as is possible from television soap operas, movies, and sitcoms. Comedy skits and streaming videos also provide for the affective needs of the audience.

3. Personal Integrative Needs: Getting personal stability, status, and credibility.

4. Social Integrative Needs: getting connected with family and friends through the Internet (emails, chat rooms, instant messaging, and social media).

5. Tension Release Needs: Getting escape and diversion such as can be derived from television, video, internet, radio, and movies.

The goal-directed U&GT approach is appropriate for this research given the challenging context where the data was collected. Social media access is readily

available and the undergraduate students use it in learning English: they choose to use both English and social media for the purpose of communication. This is because in U&GT theory, the users of any media are seen as actively influencing the effect process, since they selectively choose, attend to, perceive and retain the media messages on the basis of their needs, belief and so on. Applied to this study, the theory suggests that undergraduate learners of English in Nigeria would use the social media to derive certain gratifications; which include the development of their learning and ability to communicate in English. U&GT has found modern application in mobile telephones, social media, the Internet, instant messaging, online gaming, etc.

Social Media and Literacy

Onukaogu (2012) identified two models of literacy – the autonomous and the ideological models. The autonomous model of literacy focuses on reading, writing, and arithmetic; without emphasis on intellectual, cultural and environmental impacts and requirements of the concept. In the ideological model, literacy has a wider perspective and the intellectual and social perspectives of learning, knowledge, attitudes, and skills are emphasized. Onukaogu cited Rassol's (1999) view that the definitions of literacy are dynamic because social changes in history, ideology, and technology determine the literacy components in a society. Egbe 2019 and Ahaotu (2018) adopted the ideological perspective of literacy. According to Egbe;

> *Literacy is therefore not a linear, fixed, contained and closed process; literacy is cultural and contextual, dynamic, and constantly changing and expanding just like language. Literacy is like one watching a masquerade. You need to go around with the masquerade to have a full and complete view of the masquerade. Literacy is not simply scholastic English-based reading and writing abilities or practices. Literacy is a continuum of learning and so we should be talking about levels and degrees of literacies within a given context and culture. There is no one instrument to measure literacy across all contexts and across all cultures all the time throughout all the ages*. (Egbe, 2019, p. 23).

The authors agree with Egbe's view cited above and further posit that social media represents an important component of digital and computer literacies. Social media skills have increasingly become one of the important sets of skills, knowledge, and attitudes required for individuals to function effectively in society. This view places a premium on participation in social media activities as part of the social expectations of literate persons.

The Importance of Social Media in the Teaching/Learning of English

The influence of social media resources on undergraduate reading culture and writing skills cannot be over-emphasized in the teaching and learning of English language in Nigerian universities. Some of these include:

I. Enhancing the teaching ability of English language teachers by mediating in the learning environment. The problems of large EAP classes are avoided as learners focus on their devices alone.

II. Social media resources bridge communication gaps between the teachers and learners in conventional EAP classrooms by assisting the learners to focus on concepts since they can concentrate less on note taking.

III. Even the time usually spent on note making would be directed to re-listening to the voice notes with the advantage of greater comprehension.

IV. Mobile devices as instructional material help English language teachers to reduce the amount of talking and thus make their teaching more interesting and successful.

V. Social media provides opportunity for learners to see, hear and handle, thereby catering for the learning styles of different students inclined towards visual, auditory, and tactile/kinesthetic; creating a higher degree of interest and interaction among learners of English.

VI. Social media stimulates self-activity on the part of learners in a manner that reduces boredom that often leads to students sleeping during lectures.

VII. Social media promotes the Communicative Approach (CA) to language teaching; it enhances the role of the teacher as coordinator, director, and facilitator of learning experiences of the students, rather than as the sole dispenser of knowledge.

VIII. Learners get a better chance of diversified literacies (Egbe, 2019; Ahaotu, 2018; Egbe, 2018) and they develop both traditional and digital literacy skills by learning via social media.

IX. Timid students would find their voices and participate more actively in social media learning because everyone is invisible.

Social Media and Developmental Instruction in Undergraduate English

In the English language curricula, developmental instruction could be offered to students who are progressing satisfactorily while corrective and remedial instructions may be offered to other students who are experiencing difficulties. General English is the type of English taught at the secondary school level while developmental English is taught to university undergraduates in the form of English for academic purposes (EAP) and English for specific purposes (ESP). Describing the ESP program in Saudi Arabia, Wilson (1986) noted as follows:

> *Students may well be acquainted with language as ritual from their previous learning experience at secondary level. At the tertiary level their need is to use English as a tool in their professional studies and it is unlikely that this can efficiently be met by yet more ritualistic language practice*. (Wilson, 1986,p. 13)

Nwokolo and Ahaotu (2019) corroborated Wilson's observation when they submitted that the EAP curriculum focuses on providing training on language skills required in university-level education and also by students' specific courses of study. These include the four language skills: speaking, listening, writing, and reading. It must be emphasized that EAP focuses on the academic level of these skills in contrast with

the non-academic, ritualistic approach at lower levels. (Nwokolo & Ahaotu, 2019, p. 58)

However, this researcher observed that Nigerian undergraduates undertake a general level learning of English in the forms of language specific instructions in departments such as English Studies and Linguistics. Social media has become an important tool in the teaching and learning of both general English and ESP undergraduate English. Prior to the beginning of the COVID-19 pandemic in December, 2019, both students and their lecturers made significant use of social media platforms for various teaching and learning activities. This practice was more popular among participants in part-time and the distance learning programmes of universities and colleges. Lecturers and students following regular programmes also combined conventional classroom and online teaching and learning methods. But with the global lockdown to control the pandemic in early 2020, online teaching and learning became the major form of education across the world. Online learning was adopted for schools in Nigeria and in the University of Port Harcourt the 2019/2020 academic session was completed via an online learning mode. Various institutions adopted different online learning and conferencing platforms such as Google Classroom and Zoom for virtual teaching and learning. Social media platforms, such as WhatsApp, and Telegrams, were also prominently used for virtual teaching and learning.

In teaching and learning via social media networks, the lecturer would need to create a group or direct the course representative (course rep) to do so. Both the lecturer(s) and the course rep become the administrators (admins) of the group and students in the class are then required to create individual accounts to enable admins to add or invite them to the group.

Strategies for Effective Utilization of Social Media in Teaching/Learning EAP in Nigeria

Any school English language programme, regardless of its complexity, requires special planning. Responsibility for execution of the various aspects of the programme must be assigned. Cooperation of staff members is essential. Programme goals and instructional techniques must be cooperatively determined by the personnel. In simple terms, instructional resources for effective English language learning relate to both the human and the non-human materials that are involved in the transmission of information, knowledge, ideas, opinions, etc. to the learner within a classroom/learning situation. The human resources refer to personnel while non-human resources are Information Communication Technology (ICT) materials and instructional technology resources that are utilized in teaching. The use of different media in teaching covers such materials as books, newspapers, radio, television, motion pictures and magazines. To these are added such means of communication that carry advertisements like the billboards, direct mails, catalogues, the radio, etc. Social media is an aspect of the use of media in teaching and learning and it focuses on the utilization of interactive media such as Facebook, WhatsApp, Telegrams, etc. in education.

Instructional resources are materials, places and persons; which are components of the teaching-learning situation that enhance teaching and learning. They are the diverse materials, people, equipment etc.; which can be used by the

teacher to promote teaching and facilitate learning. Teachers and students use them in the teaching and learning process in order to make the process more effective and productive. They are real things and representation of real things which stimulate one or more of the senses and which enrich the teaching and learning of English process.

From the foregoing views, instructional resources are a collection of human and non-human resources which could be used by both the teacher and the learner for effective classroom interaction. That is, instructional resources could be referred to as teaching resources, learning resources, educational resources, and curriculum resources among others, that enhance teaching and learning activities. Thus, instructional resources make teaching and learning processes interesting, effective, motivating, efficient and productive.

In view of the importance of social media in ELT listed above, teachers must effectively strategize to achieve maximum utilization of social media devices in teaching and learning English. Otherwise, social media could become counter-productive and disruptive of teaching and learning. This paper proposes the following strategies for the efficient utilization of social media resources in qualitative teaching and the effective learning of English.

A. **Use Social Media for Visual Scaffolding**

It is important to establish and utilize social media devices for visually scaffolding learning; rather than as the goal of learning. Scaffolding is a teaching approach in which learning content is presented in a series of ideas and levels of contexts that enables the learner to reach new learning goals at each new level. This is similar to the use of scaffolding; which is built around a structure to enable builders reach new levels/heights in building construction and sundry civil engineering. In visual scaffolding, the language of instruction should be made more understandable for the learners. This could be achieved by the display of drawings or photographs that enable students to connect the words they hear to the visual images displayed on the screen. ELT professionals may include carefully selected images that scaffold the topic as well as internet links of other teaching/learning aids which students could follow to access more information. Nigerian undergraduates widely use both mobile communication technology/social media and would therefore not find it difficult to integrate the ideas into learning. In order to provide scaffold learning, lecturers can share text samples, graphics/images, and video clips via social media as both teaching aids and a store of information.

B. Create Opportunities to Develop Multiple Literacies for the Learners

The use of social media in EAP should incorporate the development of multiple literacies in learners because modern living requires the efficient development of multiple literacy skills and effective communication. Competence in traditional literacy tripods of reading, writing, and arithmetic alone is no longer enough to communicate effectively and participate meaningfully in the affairs of society. EAP lecturers should adopt strategies that would assist students in the development of their digital skills, computer skills, communication skills, computational skills, civic and leadership skills, etc. as these are important requirements of modern living. (Ahaotu, 2018). These include engaging the students in activities that promote interaction via the exchange of voice notes, video clips, images/graphic illustrations,

typing, finding information on the Internet, evaluation of figures, and cultural content. These would not only make the lessons interesting and interactive but will also enhance overall literacy skills of the learners. Teachers should plan to be positively innovative in the use of social media in teaching English. For example, it is not enough just to instruct students via social media; they should also be tasked and evaluated on creating communication-based content via the same medium.

C. Integrate Social Media in Lesson Planning:

English language professional should utilize lesson plans to achieve maximum effectiveness in integrating social media resources in language teaching. Mobile-Assisted Language Learning (MALL) integrates electronic and face-to-face pedagogies that lecturers may utilize to include file images, voice notes, texts, pictures, short videos and other media. At the planning stage of the lecture, lecturers could strategize to utilize these resources (such as graphic organizers: line graphs, pie/bar charts) to enhance language learning and teaching. For instance, graphic organizers are visuals or pictures created to represent ideas, text or connections between texts. They aid comprehension by enabling readers to label aspects of a text, using languages from that text to visually illustrate the connection between events and characters. Some of these could be used to support students in reading.

The use of graphic organizers in reading analysis enables students to examine text from a variety of perspectives. The graphics presented here are examples of organizers that support readers in making sense of a text, relating it to past experiences, and understanding connections made in the text. Students can work in cooperative groups to create graphic organizers and discuss the meanings of materials they are reading. Seeing the structure of text represented visually supports students who are having difficulty with comprehension and helps them to work through vocabulary and concepts that are unclear to them. Using graphic organizers can encourage students to become more analytic in their reading and to reflect more deeply on the meaning and contextual clues found in text. It also supports English learners by presenting confusing vocabulary and concepts in an organized visual format.

D. Use Social Media as a Virtual Classroom

Online classes have become a popular mode of teaching and learning in different parts of the world. It was especially utilized in distance learning programmes until the COVID-19 pandemic made it a more popular option in 2019. In a virtual classroom, teaching and learning are conducted via pre-selected online learning platforms. Examples of online teaching and learning platforms include: Google Suite (Google Classroom, Google Documents, and Google Slides), Kahoot!, Vocaroo, Baamboozle, Oodlu, Whiteboard, Ourboox, Flipgrid, Kaizena, Webliography, and New EdTech Classroom YouTube Channel social media applications. It is an important strategy to enhance the use of social media in teaching and learning, especially in the types of challenging situations prevalent in Northern Nigerian schools in 2021. Terrorists and kidnappers raided universities and other institutions of learning in Northern Nigeria and took large numbers of both lecturers/teachers and students hostage. Social media as a virtual classroom would ameliorate the challenges of teaching and learning EAP in overcrowded inconvenient spaces. It would also reduce the risk of spreading COVID-19 by

curtailing physical contact as well as the hazards of kidnapping perpetrated by terrorists, herdsmen, and bandits all over Nigeria.

Conclusion

Social media presents significant benefits in language teaching and learning and this study has demonstrated some of these. The four language skills (speaking, listening, reading, and writing) may benefit from the positive influences of the use of social media in teaching and learning if EAP lecturers and students adopt relevant strategies that enhance the uses of social media in teaching and learning. The language skills receive significant boosts as learners use social media in which they predominantly use English. These positive implications for language learning could be enhanced by integrating more of social media and other forms of mobile assisted language learning into curriculum design as well as the lesson plans of individual teachers.

Overall, students and lecturers in Nigeria would benefit significantly from the effective use of social media in EAP. Lecturers could use the virtual classroom as an alternative to decongest the usually over-crowded EAP classrooms. Even where the lectures are delivered through blended virtual and conventional methods, it would still reduce over-crowding and the various challenges associated with it. A virtual classroom would be an effective panacea for teachers and learners in Nigeria's challenging educational system where insurgence, kidnapping of lecturers and students, and the persistent COVID-19 pandemic jointly make physical classroom teaching and learning more hazardous.

Recommendations

The use of social media and interactive strategies make a significant difference in students' attitudes towards language learning and also improves effectiveness of teaching. Therefore, this paper recommends as follows:

1. Teachers of English owe themselves the responsibility of continually seeking ways to develop their professional abilities in a changing world, especially in Nigeria where there is little opportunity for government-sponsored professional development. The rising profile of social media in education challenges English language professionals to improve their ICT skills. They should learn more about social media to cope with the needs of using that knowledge in their teaching.

2. Social media should be actively integrated into lessons and teachers should consciously include both media content and its application in their lesson plans. Social media posts and pages could be used as teaching aids while controlled learning activities could be based on selected social media platforms.

3. Teachers could cue in to the general student love of social media to engage learner interest in a variety of topics that could be linked to social media.

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KEYNOTE ARTICLE 2

Teachers' Collective Reflexivity Meant for Students' Collective Agency in the Process of 21st-Century Skills Acquisition

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This talk was delivered online on May 13, 2023 at the hybrid ICC Conference "The Integration of 21st Century Skills in the Language Classroom", (May 13–14, 2023), Belgrade, Serbia.
The presentation is available on https://youtu.be/41YyvpE4zHI

This paper discusses the thoughts, reflections and ideas on integrating 21st century skills in the language classroom, presented by two foreign language teachers in different higher education settings. In order for the inputs delivered in an online talk to be captured in written form, the paper follows a rather informal style. By doing so, readers should be given an idea of the way the talk was structured and presented. The authors teach English and German at a Ukrainian and Austrian university, respectively. With the experience of online teaching due to the COVID-19 pandemic and the war, in the talk they reflected on ways of fostering students' language competence while also supporting their wellbeing and engagement, focusing on the integration of 21st century skills and global citizenship education.

Keywords: Higher education, global citizenship education, multilingual competences, online teaching, language learning and teaching.

Outline

We started this talk with a brief outline. First, we wished to discuss the general context of our topic. Then we elicited three possible future histories according to Felicitas Macgilchrist and colleagues. The following section was about our educational contexts. Then we moved on to our reflexivity for the students' collective agency. Finally, the presentation ended with concluding thoughts.

General Context

In his influential book '*21 Lessons for the 21st Century'*, Harari (2018) suggests that teaching methods have to adapt to new circumstances in our troubled world and that education in general should focus on four Cs, which are: *critical thinking, communication, collaboration* and *creativity* as guiding principles for any curriculum. These principles are somewhat reflected in the 2021 UNESCO report on the futures of higher education (UNESCO, IESALC, 2021). Our own and our planet's vulnerability against climate crisis, social inequalities, political extremism and armed conflict threaten to undermine aspirations and hope. How can we think about the future if we don't seem able to cope with the present? However, that is exactly what we must do since the solutions to tomorrow's issues are grounded in today's world. Higher education has an important responsibility with its core functions of knowledge generation and knowledge sharing. It can enact change and equip future generations to make their own contributions if it is: student-centered, inclusive, responsive, empowering, and strives for global cohesion.

We must equip our students with 21st century skills or future skills, as Ehlers (2022) prefers to call them. He lists 17 of them and locates them within a three-dimensional action space. In our view, they perfectly relate to Harari's (2018) four Cs:

- communication and collaboration as communication and cooperation competence
- critical thinking as reflective competence
- and creativity as, for example, innovation competence

Possible Future Histories

In this part of the talk, we discussed possible future histories from an inspiring paper by Macgilchrist et al. (2020). If the solutions to tomorrow's issues are grounded in the world of today, the same holds true for how we will look back on our current times in the future. The political, pedagogical and technological decisions that we take today will inevitably shape our future. This is plausibly demonstrated in this speculative, social science fiction paper, written in 2019 as if it were 2040. Macgilchrist et al. (2020) sketch three possible scenarios, or future histories of the 2020s, looking back on that decade from the year 2040. In the first scenario, students are imagined as smooth, competent, post-democratic technology users. They wish to increase their productivity by optimising themselves, living polished lives in a frictionsless high-tech world. Scenario number two depicts students as digital nomads or entrepreneurial selves who exploit digitalization for individualism which is pushed to the fore. In the third scenario, which we would like to promote, students are imagined as participatory, democratic, collective agents, exploring more equitable forms of living in a socio-ecological-technical future that the planet can sustain. Before moving on to discuss our thoughts on how to promote scenario number three, we introduced our respective educational contexts.

Our educational contexts

Olena Plakhotnikova is an Assistant Professor teaching English at the Department of Language Training, Educational and Scientific Center *Institute of Biology and Medicine* . Taras Shevchenko teaches at the National University of Kyiv, Ukraine. She teaches English for Academic Purposes within the MSc programs Biotechnology and Ecology with students discussing global issues, sustainability and environmental matters in English, while reflecting on their roles and active engagement in society. The activities in the English for Academic Purposes course must prepare students for their professional lives as competent language users. Eva Seidl is a German L2 teacher at the Department of Translation Studies and at the Centre for Language, Plurilingualism and Didactics at the University of Graz in Austria. She teaches German L2 within the context of translation and interpreting-oriented language education, which is often considered within the framework of Languages for Specific Purposes. More precisely, language classes in the BA 'Transcultural Communication' provide the basis on which students can continue with an MA in Translation Studies.

Our reflexivity for students' collective agency

After a brief introduction of our teaching contexts, we moved on to the main part of our talk, that is our reflexivity for students' collective agency. After we had met in Austria in an academic encounter in 2012, we stayed in touch via social media but met in Austria in 2022, after the outbreak of war in Ukraine. Since then, and with Olena back in Kyiv, we have been in touch regularly through online video calls, social media and emails. For emotional support and in order to help our students – and ourselves – to cope with difficult situations we exchanged thoughts on how and what we teach, but also shared

(CPD) Continuing Professional Development-related materials. As for future skills, we heavily worked on our communication, reflective and self-competence and for this talk especially on our cooperation competence.

Olena emphasized in our talk the importance of a trauma-informed approach for teaching (Plews & Zizka, 2021). It is crucial to consider incorporating it in the language classroom in the following ways: predictable schedule and routine (safety); clear expectations and communication; offering options wherever possible (e.g., choice of topics); co-creating group standards; reduced didactic teaching where you can; acting upon student feedback; sharing power where possible (student presentations to teach material); projecting optimism and unconditional positive regard for students (but not endorsing behaviours).

Eva, on the other hand, referred to a book on ecologies for learning and practice by Barnett and Jackson (2020), who promote life-long and life-wide learning. They remind us how important it is to prepare students for a lifetime of learning and performing in the more unstructured world outside of formalised education that is often messy, unstructured, ambiguous, risky, conflictual, experiential and emotional.

Concluding thoughts

To summarise, we wished to share our concluding thoughts. Gaudelli (2016) defines being educated in the 21st-century as thinking of the world less as a repository of resources and a dump but more as an inviolable entity. In contrast to the aforementioned future scenario number two of students as digital nomads he argues for a conception of global citizens as inhabiting particular places and feeling a sense of attachment to those places. This contrasts with a disembodied, technologically connected and seemingly placeless type of global belonging. Now more than ever we need creativity and critical thinking in the higher education language classroom. In line with Mairi et al. (2023) we believe that 21st-century skills help students develop critical engagement and reflexivity and help them better understand the relationship between power, language, social groups, and social practices. Therefore, teachers should challenge themselves and their students to reflect on their roles in society and actively engage with the world with a strong feeling of personal agency. Moreover, we have to adapt ourselves to a new reality – taking into account trauma-informed approaches – and be ready to face the challenges of today's world.

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KEYNOTE ARTICLE 3

How Web 3.0 Technologies Could Change the Way We Do Teaching and Training

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The rapid evolution of technology has consistently reshaped the way we interact with the world around us. From the static web pages of the past to the dynamic social platforms of today, the Internet has undergone significant transformations. At the forefront of this evolution stands the concept of Web 3.0 – a paradigm shift that has the potential to revolutionise various industries, including education.

Education, as a cornerstone of society, is poised to embrace these technological advancements. As we find ourselves in the digital age, the integration of Web 3.0 technologies has profound implications for the teaching and learning process. This article delves into the transformative power of Web 3.0 in education, exploring its potential to reshape pedagogical methods, decentralised systems, collaborative learning, and the very role of educators. (Aggarwal & Bento 2002; Hussain 2012; Samarawickrema & Stacey 2007; Sein-Echaluce et al. 2019)

Understanding Web 3.0

In order to comprehend the potential impact of Web 3.0 on education, it's crucial to first understand the essence of this new web generation. Web 3.0, often referred to as the "semantic web, " transcends the boundaries of its predecessors Web 1. 0 and Web 2. 0. It's characterised by a convergence of technologies that enable a more intelligent, decentralised, and interactive online experience. (Cole 2000; Amarin 2015; Demartini & Benussi 2017)

Key technologies underpinning Web 3.0 include blockchain, artificial intelligence (AI), the Internet of Things (IoT), and augmented reality (AR). Blockchain, famous for its role in cryptocurrencies, introduces the concept of decentralised and secure data management. (Barthelmess & Langlois, 2018, 2018b, 2018c). AI, a burgeoning field, empowers machines with the ability to learn, reason, and make decisions, which can be harnessed to personalise educational experiences. The IoT seamlessly integrates physical objects into the digital realm, opening up possibilities for hands-on and experiential learning. Meanwhile, AR blurs the line between the real and virtual worlds, creating immersive environments that can engage learners at unprecedented levels. (Allison et al. 2012; Allison & Kendrick 2015)

These technologies collectively redefine the landscape of education. They mark a departure from static content delivery toward dynamic and adaptive learning experiences. In contrast to the one-size-fits-all model of traditional classrooms, Web 3.0 paves the way for personalised and interactive learning journeys, tailored to individual needs and preferences.

In the subsequent sections of this article, we will delve deeper into the implications of these technologies on education. We will explore how they have the potential to transform pedagogy and learning methodologies, enable decentralised education

systems, foster global collaboration, and tackle the challenges that come hand in hand with such advancements. The journey into the heart of Web 3.0's impact on education begins here, where traditional notions of teaching and learning intersect with the boundless possibilities of emerging technologies.

Transforming Pedagogy and Learning

As the foundation of education evolves, pedagogical methods are ripe for transformation. Web 3.0 technologies offer educators and learners a dynamic toolbox to construct innovative learning environments.

The integration of artificial intelligence plays a pivotal role in tailoring educational content and experiences. Adaptive learning systems can analyse individual students' progress, preferences, and learning styles, enabling the delivery of custom-tailored materials and assessments. This moves away from the conventional one-size-fits-all approach, making education more engaging and effective.

Augmented reality and virtual reality technologies bring the curriculum to life by creating immersive learning experiences. Imagine history lessons where students can virtually walk through ancient civilizations or science classes where complex concepts become tangible through interactive simulations. These technologies have the potential to engage students deeply and foster a deeper understanding of complex subjects.

Web 3.0 dismantles the traditional boundaries of education. With blockchain-based micro-credentials, individuals can showcase their skills and achievements in a verifiable and tamper-proof manner. This enables continuous learning throughout life, as learners accumulate credentials and competencies across various domains.

The traditional classroom transforms into a dynamic, learner-centric environment,
where students actively participate, explore, and interact with the subject matter. Educators transition from mere instructors to guides, curating resources, and facilitating discussions that encourage critical thinking and problem-solving. Through Web 3.0 technologies, education becomes a collaborative journey, adapting to individual needs and fostering a lifelong passion for learning.

As we delve deeper into the transformative potential of Web 3.0 on education, we'll explore the concept of decentralised education systems, collaborative and global learning, challenges in implementation, and the exciting future scenarios that could reshape the educational landscape.

Decentralised Education Systems

In the realm of education, the concept of decentralisation finds a compelling application through blockchain technology. Blockchain, known for its secure and transparent nature, holds the potential to revolutionise the way we manage educational records and credentials.

Traditional methods of storing student records can be cumbersome and prone to errors. Blockchain offers a decentralised and tamper-proof solution, ensuring that

academic achievements, certification, and other credentials are securely stored and easily verifiable. This not only enhances trust but also streamlines processes.

Web 3.0 introduces the notion of micro-credentials; bite-sized certifications that validate specific skills or competencies. These credentials, stored on the blockchain, allow individuals to showcase a diverse range of skills beyond the confines of a traditional degree. Lifelong learning becomes a reality as learners continually add new credentials to their digital portfolios. (Barthelmess & Langlois 2018)

Moreover, the decentralised nature of blockchain can empower learners to take control of their educational journey. Students can access and share their credentials across institutions and platforms, promoting a fluid and holistic approach to education.

Collaborative and Global Learning

The connectivity and interactivity embedded within Web 3.0 technologies enable a paradigm shift in how learning occurs. Traditional classrooms are no longer limited to physical walls; instead, they expand into a global network of knowledge-sharing and collaboration.

Web 3.0 opens avenues for students and educators to collaborate with peers from diverse geographical locations and cultural backgrounds. Virtual classrooms, equipped with real-time translation and communication tools, break down language barriers and foster a global community of learners.

Educational resources are no longer confined to textbooks and lectures. Decentralised networks powered by blockchain enable the creation and sharing of educational content in new ways. Educators and students can collaboratively develop and curate materials, ensuring a wide range of perspectives and up-to-date resources.

Web 3.0 holds the promise of inclusivity by accommodating various learning styles and needs. Through augmented reality and AI-driven applications, educational content can be adapted to suit different learners, including those with disabilities. This inclusivity enhances accessibility and ensures that education reaches a wider audience.

As we journey through the intricacies of decentralised education systems and collaborative learning experiences, we'll also need to navigate the challenges that come with integration. From technical hurdles to ensuring data privacy and digital literacy, the road ahead is not without obstacles. Educators must adapt their pedagogical practices to harness the potential of these technologies effectively. Furthermore, we must address the digital divide, ensuring that all learners, regardless of socio-economic backgrounds, can access and benefit from the transformative power of Web 3. 0. (Mioduser et al. 2000; Kahraman 2010; Chisega-Negrilă 2013; Atabekova et al. 2015)

The subsequent sections of the article will take us even deeper into future scenarios and implications, as well as a concluding reflection on the monumental role that Web 3.0 technologies could play in reshaping the landscape of teaching and learning.

Future Scenarios and Implications

As we peer into the future, the integration of Web 3.0 technologies into education offers exciting possibilities that could redefine the entire learning experience.

Transformed educational Institutions: Traditional classrooms may evolve into dynamic hubs of collaboration and creativity. Students will engage with content through immersive experiences, while educators shift from being the sole source of knowledge to mentors who guide critical thinking and problem-solving.

The personalisation and adaptability offered by AI-driven education could lead to learning experiences that are truly tailored to each student's strengths and weaknesses. This shift could drastically reduce dropout rates and improve overall learning outcomes.

The concept of lifelong learning takes centre stage as individuals continually acquire and demonstrate skills through blockchain-verified micro-credentials. The traditional model of education followed by a single career might be replaced with a more fluid approach, adapting to the changing demands of the job market.

Educators will become facilitators of knowledge, focusing on fostering critical thinking, creativity, and adaptability – skills that machines cannot easily replicate. The teacher's role shifts from being the primary source of information to a curator and guide. (Aggarwal & Bento 2002; Hussain 2012; Samarawickrema & Stacey 2007; Sein-Echaluce et al. 2019)

Formal and Informal Learning: Web 3.0 could blur the boundaries between formal education and informal learning. The abundance of resources and collaborative platforms can enable continuous learning outside traditional educational settings.

Concluding Remarks

Web 3.0 technologies hold the potential to revolutionise education as we know it. The shift towards personalization, decentralization, and global collaboration can reshape teaching and learning methodologies. However, realizing this potential requires a concerted effort from educators, policymakers, and stakeholders. Collaboration is key to harnessing the benefits of these technologies while navigating the challenges they bring. As the educational landscape transforms, it's crucial to stay vigilant, adapt to the changing paradigms, and continue exploring innovative ways to leverage the capabilities of Web 3.0 for the betterment of education. (Miranda et al. 2014; Dominic et al. 2014; Jiang 2014)

In the grand narrative of human progress, the integration of Web 3.0 technologies into education emerges as a pivotal chapter. The journey we've undertaken through the realms of decentralised systems, immersive experiences, and global collaboration has revealed the transformative potential of these technologies in the world of teaching and learning. (Nachmias et al. 2000; Robin 2011; Shaltout & Salamah 2013; Langlois 2021)

Web 3.0 doesn't just herald a new era of technological advancement; it invites

us to reimagine the essence of education itself. It challenges us to question the conventional boundaries of classrooms, to embrace personalisation in pedagogy, and to acknowledge that learning is a lifelong pursuit that transcends formal institutions. (Mnguni 2023)

As we conclude this exploration, it's evident that Web 3.0 technologies are not a distant vision, but a tangible force that's already shaping the educational landscape. However, the realisation of this potential rests on our collective shoulders. Educators must cultivate digital skills, adapting their teaching methods to embrace the opportunities Web 3.0 offers. Policymakers must ensure equitable access to these technologies, bridging the digital divide that threatens to hinder progress. (Lal 2011 ; Giraudet de Boudemange & Langlois 2021)

The journey into the Web 3.0 era is not without challenges. Technical hurdles, data privacy concerns, and the need for digital literacy demand our attention. Yet, these challenges are not insurmountable. Through collaboration, innovation, and a commitment to the principles of effective education, we can navigate these waters and emerge stronger.

In the end, the integration of Web 3.0 into education is not just about adopting new tools; it's about nurturing a culture of curiosity, adaptability, and collaboration. It's about recognising that education is not a static endeavor but a dynamic journey of discovery and growth. (Poore 2014; Noskova, et al. 2016; Songkram et al. 2021)

The pages of this chapter remain open, awaiting the contributions of educators, learners, and stakeholders alike. The canvas of education is being painted with bold strokes of innovation, and as we step into this new era, let us be guided by the vision of an empowered, interconnected, and enlightened society – a society where the transformative potential of Web 3.0 is harnessed to shape a brighter future for all learners.

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Virtual Reality as a New Opportunity to Foster the Emergence of e-Government's Training

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Recent decades have witnessed the rapid emergence of virtual and augmented reality technologies. These technologies offer immersive experiences that transcend reality, providing users with the opportunity to explore virtual worlds and interact with digital content. As the demand for efficient public services and the growth of digitalised offerings continue to rise, there is an increasing need to enhance training methods, especially within the realm of e-Government. This article explores how virtual reality (VR) presents a novel opportunity to accelerate the emergence of e-Government through innovative training approaches.

Expanding the Application of Virtual Reality in Training Scenarios

Virtual reality (VR) emerges as a transformative tool capable of reshaping training dynamics and revolutionising various industries, particularly in the realm of IT applications and capacity building. The strategic implementation of VR warrants consideration in diverse scenarios where conventional training methods fall short. The adaptability and potential for immersive learning experiences offered by VR hold promise in addressing a range of challenges. (Alexander 2021)

Immersive Adoption of IT Innovations

The incorporation of novel IT applications within organisations often encounters resistance due to the steep learning curves associated with technological transitions. The traditional methods of disseminating information through user guides or webinars can be limiting in terms of user engagement and comprehension. VR, on the other hand, presents a dynamic avenue to effectively introduce intricate IT features. For instance, within interministerial software implementations, the complexity of new features can be seamlessly communicated to multiple stakeholders through immersive VR scenarios (Giraudet de Boudemange & Langlois, 2021). Partners and administrative operators can navigate simulated environments, interact with new software functionalities, and grasp the intricacies in a hands-on manner. This immersive adoption expedites the learning curve, reduces training time, and fosters a more comprehensive understanding of the changes. (Plotzky et al., 2021)

Onboarding in the Virtual Realm

The onboarding process for new team members is often a multifaceted endeavour, encompassing an array of information ranging from operational contexts to team dynamics. VR presents a novel solution to optimise this process and equip new civil servants with a holistic understanding of their roles and responsibilities. By simulating operational contexts, working procedures, team structures, and human resource protocols (Lerner et al. 2020) VR modules provide an initial learning experience that transcends traditional orientations. This approach has dual advantages: it reduces the burden of initial coaching on experienced civil servants and allows them to dedicate their time to more specialised aspects of training. Meanwhile, newcomers are empowered with comprehensive insights into their roles and the broader operational landscape, ensuring a smoother transition and accelerating their integration into the team.

Embracing Complex Learning Objectives
In certain industries, training objectives involve mastering intricate and multifaceted procedures that demand meticulous attention to detail. VR serves as an unparalleled platform for imparting such skills. Consider a scenario in healthcare, where medical professionals must navigate critical decision-making processes in high-stress situations. VR simulations can mirror real-world emergencies, allowing practitioners to make informed choices in a risk-free environment. Similarly, VR can be harnessed to train IT developers in tackling intricate coding challenges or deployment procedures. By immersing learners in complex scenarios and demanding problem-solving tasks, VR nurtures adaptive skills that are transferable to real-world situations.

Overcoming Training Limitations
Traditional training methods often struggle to capture the urgency, emotional nuances, and pressure that typify real-life situations. VR bridges this gap by enabling trainees to experience scenarios as if they were physically present. This facet of VR training not only bolsters engagement and motivation but also fosters emotional connections to the subject matter. From healthcare professionals making time-sensitive decisions to crisis managers responding to emergencies, the value of training in immersive virtual environments cannot be overstated.

Envisioning the Future of VR Training
The application of VR in training holds immense potential that extends beyond its current use. As VR technology evolves, the range of industries and scenarios that can benefit from its immersive capabilities is set to expand. Collaborative training sessions, real-time simulations of complex scenarios, and cross-disciplinary skill development are all on the horizon. VR stands as a harbinger of transformative learning experiences, poised to empower professionals with the skills and confidence needed to navigate increasingly intricate landscapes. As shown by Barthelmess and Langlois (2018, 2018b, 2018c) the implementation of a new technology in an organization comes with new motivation for the employees.

In the light of these considerations, it becomes evident that the integration of VR into training scenarios offers a paradigm shift in how individuals and organisations approach skill acquisition and development. By harnessing the immersive capabilities of VR, training becomes a dynamic and engaging journey, equipping learners with practical expertise that translates seamlessly into real-world applications.

The Nexus of Stylometry and Virtual Reality for E-Government Training
Within the realm of technological evolution, the convergence of stylometry and virtual reality (VR) emerges as a realm of uncharted possibilities, particularly in the domain of e-Government training. As stylometry—the analysis of linguistic and writing styles—extends its reach into diverse sectors, its integration with the immersive power of VR offers an unprecedented avenue for redefining training paradigms. While VR training in e-Government holds immense potential, the infusion of stylometry introduces an additional layer of innovation. This section embarks on an exploration of the symbiotic potential of stylometry and VR in e-Government training, unveiling novel vistas that reshape the acquisition of skills and knowledge in the digital landscape.

Crafting Distinctive Learning Journeys
Incorporating stylometry into VR-based e-Government training ushers in a personalised and distinctive learning experience. By analysing linguistic patterns and writing styles, stylometry allows training modules to adapt to individual preferences and cognitive tendencies. VR environments can be dynamically tailored based on stylometric insights, ensuring that each trainee engages with content that resonates with their unique learning profile. This personalised approach optimizes comprehension, retention, and skill acquisition, transforming e-Government training into a journey tailored to each participant's cognitive strengths.

Stylometric Identity Verification
Stylometry transcends textual analysis, encompassing the realm of identity verification. The distinctive linguistic patterns of individuals can serve as an additional layer of authentication in VR training scenarios. By integrating stylometric identity verification with VR access, e-Government agencies can ensure that authorised personnel engage with training modules tailored to their roles and responsibilities. This fusion of stylometry and VR fortifies security, enhancing the integrity of training outcomes within the e-Government sphere. (Langlois 2021)

Adaptive Stylometric Micro-Credentials
The fusion of stylometry and VR brings forth the concept of adaptive micro-credentials. Stylometric analysis can identify nuanced changes in writing styles, reflecting the evolution of cognitive processes. As VR training modules are completed, stylometric insights can contribute to the issuance of micro-credentials that reflect not only skill acquisition but also cognitive growth. These adaptive micro-credentials, authenticated through stylometric analysis, stand as dynamic testimonials to the trainee's journey of continuous learning and cognitive expansion within the e-Government domain. (Udagari et al. 2023; Ho 2016)

Stylometry-Enhanced Training Insights
Stylometry's intricate analysis of writing patterns enriches the evaluation of VR training outcomes. E-Government agencies can leverage stylometric insights to gauge not only the depth of skill acquisition but also the nuances of cognitive engagement. This advanced level of analysis provides a comprehensive view of how trainees interact with VR training environments, identifying strengths, weaknesses, and areas for improvement. The integration of stylometry amplifies the precision of training evaluation, facilitating informed decisions on curriculum enhancements and optimisation. (Yadav et al. 2021: Sadav et al. 202O)

Shaping the Future of E-Government Training
As stylometry converges with VR in e-Government training, a realm of untapped potential emerges. The fusion of personalised learning journeys, secure identity verification, adaptive micro-credentials, and enhanced training insights reshapes the very foundation of skills development within the digital landscape. Government agencies, armed with the prowess of stylometry-enhanced VR, step into a future where training becomes an immersive voyage of individual growth, secured authenticity, and data-driven optimisation.

The addition of stylometry and VR opens avenues for unparalleled proficiency, authenticity, and adaptability, guiding e-Government training into a transformative era of cognitive resonance and secure skill acquisition.

Limits and Drawbacks of Virtual Reality

Navigating the Boundaries and Considerations of Virtual Reality Training

The adoption of virtual reality (VR) training introduces a dynamic dimension to skills development and capacity building, yet it is essential to acknowledge that this cutting-edge approach has its inherent limitations and considerations. While the immersive nature of VR offers unprecedented advantages, it is imperative to comprehend the contexts in which it thrives and where its impact may be limited. (Pan et al. 2019)

Complementing, Not Replacing Human Interaction

Virtual reality has the power to transform learning experiences, but it cannot entirely supplant the value of human interaction. Effective collaboration within teams relies on open discussions, comprehension of tacit norms, shared insights, and active participation in decision-making processes. The nuanced dynamics of group synergy often emerge from face-to-face interactions that foster trust, empathy, and seamless communication. While VR can enhance training scenarios, it cannot replicate the nuanced interpersonal bonds that are integral to teamwork. (Feng et al. 2021; Truong et al. 2021 ; Orlandi et al. 2021)

Constructing and Sustaining Interactive Modules

The creation and maintenance of interactive VR modules are endeavours that demand careful planning, dedication, and resources. The process of designing, developing, and refining VR training experiences requires expertise in multiple domains, from content creation to user experience design. Additionally, the dynamic nature of industries and technological advancements necessitates regular updates to ensure that VR modules remain current and relevant. Allocating resources for these endeavours is a critical consideration for organisations embracing VR training. A clear understanding of the cybersecurity issues that could result from the use of VR is also mandatory (Boisset & Langlois 2021)

The Economics of Virtual Reality Equipment

The transformative potential of VR is undeniably captivating, but the investment required in VR equipment can pose financial challenges. Cutting-edge VR hardware, from headsets to accompanying peripherals, often comes at a substantial cost. Equally important is the distribution and allocation of this equipment across various departments and services. Balancing the availability and accessibility of VR hardware within limited timeframes can prove intricate, particularly in organisations with diverse training needs.

Virtual reality training excels in providing structured pathways for skills development, ensuring that trainees traverse predefined scenarios. However, this very strength can also be a limitation. The world of information technology thrives on solving unanticipated problems and navigating uncharted territories. VR modules inherently simplify tasks, potentially overlooking the complexity and fluidity of real-world IT challenges. The adaptability and spontaneity required in certain situations

may find limited expression within a VR environment. (Radianti et al. 2020; Di Natale et al. 2020)

While VR simulations offer an immersive environment for learning, the reality of skills development extends beyond the virtual realm. IT professionals, in particular, must grapple with the unpredictable nature of their field, where innovation and problem-solving often transcend the bounds of predefined modules. The true test of expertise lies in the ability to navigate unforeseen challenges and translate theoretical knowledge into actionable insights, a process that occurs in the live IT landscape. (Zhan et al. 2020)

Acknowledging the limits of VR training is a crucial step in optimising its utilisation. Organisations that recognise the contexts where VR excels and where it intersects with the nuances of human interaction can design comprehensive training strategies. Combining VR's immersive learning with mentoring, on-the-job experience, and collaborative problem-solving cultivates well-rounded professionals who thrive in both controlled and unscripted environments. (Xie et al. 2021; Dincelli and Yayla 2022)

In essence, the cautious integration of VR training is vital, aligning its strengths with the intricacies of real-world challenges. As organisations embark on this transformative journey, understanding the delicate balance between VR's advantages and its limitations empowers them to make informed decisions that redefine the landscape of skill development and capacity building. (Xiong et al. 2021)

Conclusion and Perspectives

Virtual reality introduces exciting prospects for enhancing learning and teaching, particularly within civil service IT departments. This article explored immediate applications, such as aiding partners' understanding of IT changes and facilitating the onboarding of new team members. Beyond these applications, virtual reality holds immense potential for accelerating e-Government growth. Future research will delve into additional opportunities and potential applications for citizens. As VR technology continues to advance, it promises to be a pivotal tool in nurturing the development of e-Government across diverse contexts.

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Teaching Sustainable Development with New Technologies : Case Studies In Africa

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As the global community faces unprecedented challenges linked to environmental degradation, resource scarcity, and social inequality, the significance of sustainable development education becomes increasingly apparent. Across the world, educators are seeking innovative approaches to convey complex concepts and inspire action. In this context, the fusion of education and technology has proven to be a potent force for transformative change. (Langlois 2020, 2022, 2022b)

This article explores how the metaverse, along with virtual and augmented reality (VR/AR), can be harnessed to revolutionise sustainable development education, with a special emphasis on the African continent. The metaverse, a burgeoning digital realm combining physical and virtual experiences, presents an opportunity to cultivate immersive learning environments. Pairing this with the immersive potential of VR/AR, the realm of education expands into previously uncharted territories, enabling students to interact with and comprehend intricate sustainability issues in an experiential manner.

The forthcoming sections will delve into the potential benefits, challenges, and considerations of integrating these technologies in the realm of sustainability education, while remaining attuned to the distinct educational landscape and regional challenges that Africa faces. By examining the intersections of education, technology, and sustainable development, we seek to show the promising path forward for educators, policymakers, and learners alike.

The Potential of the Metaverse and Immersive Technologies

The advent of the metaverse has ushered in a new era of interconnected virtual experiences, where participants engage with digital environments that blend seamlessly with the physical world. This phenomenon holds tremendous promise for sustainable development education. Virtual reality (VR) and augmented reality (AR), the cornerstones of immersive technologies, extend this promise further by enabling learners to transcend the confines of traditional classrooms and textbooks.

VR offers the potential to transport students to different corners of the world, placing them within simulations that vividly depict complex sustainability issues. Through immersive experiences, learners can witness the consequences of deforestation, explore the impact of climate change on coastal communities, and delve into the intricacies of renewable energy systems. By simulating scenarios that would be otherwise challenging to witness firsthand, VR fosters empathy, understanding, and a sense of urgency among students.

Augmented reality (AR), on the other hand, supplements the physical world with digital overlays, enhancing real-life surroundings with contextual information. In the context of sustainable development education, AR can turn everyday environments into interactive learning spaces. Students can use AR-equipped devices to uncover hidden layers of information about the ecosystem of their local park, analyze the carbon footprint of a building, or visualize the flow of resources in a supply chain.

The metaverse amplifies the potential of VR and AR by providing a collective space where learners can collaborate, interact, and engage in shared experiences. The metaverse offers a canvas for educators and students to build and explore virtual worlds dedicated to advanced education (Giraudet and Langlois 2021). These worlds can encompass diverse ecosystems, span historical eras, and foster collaboration on a global scale.

By immersing learners in intricate digital environments, the metaverse and immersive technologies revolutionise the way sustainable development concepts are taught and understood.

The subsequent sections of this article will delve into the particular considerations and challenges associated with deploying these technologies, while also emphasising their potential to address specific educational challenges in the African context.

Addressing Regional Challenges

In the African context, where challenges such as limited access to resources, diverse linguistic landscapes, and varying levels of technological infrastructure prevail, the integration of the metaverse and immersive technologies in sustainable development education presents a unique set of opportunities and considerations. (Malik 2018)

One notable challenge is the digital divide, which restricts access to technology for many learners across the continent. However, with the increasing affordability of smartphones and the expansion of internet connectivity, even remote and under-served areas are witnessing a gradual reduction in this divide. Leveraging the potential of mobile devices, educators can explore innovative approaches that enable

students to engage with immersive content and experiences, regardless of their geographical location.

Another consideration pertains to cultural diversity and linguistic differences. (Langlois 2019) Africa is home to a multitude of cultures and languages, which necessitates a sensitive and inclusive approach to content creation. Educational content must be tailored to resonate with diverse cultural backgrounds, ensuring that learners from various regions can connect with the material on a personal and meaningful level. Moreover, the use of local languages can enhance accessibility and engagement, bridging the gap between technology and education.

In regions where physical infrastructure for education is lacking, immersive technologies offer a promising solution. Virtual field trips, for instance, can enable learners to explore faraway ecosystems, historical sites, and urban areas without leaving their classrooms. This approach not only overcomes geographical constraints but also stimulates curiosity and a desire for learning, thus contributing to the empowerment of students in under-served areas.

Collaborative projects and cultural exchange can also flourish within the metaverse, transcending geographical boundaries and fostering intercultural dialogue. Virtual classrooms can facilitate interactions between students from different African countries, promoting the sharing of ideas, experiences, and solutions to regional sustainability challenges. These interactions contribute to the development of a collective African perspective on sustainable development, reinforcing the notion of unity in diversity. (Ramos et al. 2015 ; Sırakaya et al. 2022)

The integration of the metaverse and immersive technologies in the African educational landscape requires an approach that is sensitive to the unique challenges faced by the region while emphasising its vast potential. By addressing these challenges head-on and tailoring educational experiences to the African context, educators can create transformative learning journeys that empower students to become active agents of sustainable change in their communities and beyond.

Considerations and Best Practices

Integrating the metaverse and immersive technologies into sustainable development education demands a thoughtful and well-rounded approach that takes into account both pedagogical principles and technological nuances (Carrión-Martínez et al. 2020). To ensure the effectiveness and ethical use of these technologies, educators and policymakers should consider the following considerations and best practices (Al-Azawi et al. 2021)

Pedagogical Alignment

Before implementing immersive technologies, educators should align their curriculum with learning objectives and ensure that the technology enhances rather than distracts from the educational content. Technology should be viewed as a means to deepen understanding, foster critical thinking, and encourage active engagement.

Accessibility and Inclusivity

While immersive technologies offer rich experiences, ensuring that all students can access and benefit from these experiences is paramount. Educators should consider

factors such as device availability, internet connectivity, and disabilities when designing content. Efforts should be made to provide alternative options for students who may face barriers.

Content Creation
Developing immersive content requires a multidisciplinary approach, involving educators, content creators, designers, and technologists. Content should be accurate, culturally sensitive, and relevant to the local context. Collaboration between experts in sustainability and technology is essential to create authentic and meaningful experiences.

Teacher Training
Educators should receive comprehensive training in using immersive technologies effectively in the classroom. This training should cover not only the technical aspects but also pedagogical strategies for integrating technology seamlessly into lessons and addressing potential challenges.

Ethical Use and Privacy
As with any technology, ethical considerations should guide the deployment of immersive technologies. Student privacy, data security, and consent are paramount. Educators and institutions must adhere to established guidelines for data protection and respect the digital rights of students.

Feedback and Adaptation
Regular assessment and feedback from students are crucial to refining immersive learning experiences. Educators should be open to adapting content based on student input, fostering a collaborative learning environment that empowers students to take an active role in their education.

Collaboration and Community
Immersive technologies can facilitate global collaboration and knowledge sharing. Educators should explore opportunities for partnerships with institutions, experts, and organizations working in sustainable development. Engaging students in collaborative projects that span borders can enrich their understanding of global challenges.

Continuous Exploration
The metaverse and immersive technologies are rapidly evolving. Educators should stay informed about emerging tools, trends, and research in this field. Being open to experimenting with new technologies and adapting teaching approaches accordingly will enhance the educational experience.

By carefully considering these aspects, educators and policymakers can harness the potential of the metaverse and immersive technologies to create impactful and transformative sustainable development education experiences that equip students with the knowledge, skills and mindset needed to address complex global challenges.

Case Studies and Success Stories

Virtual Ecosystem Exploration in Kenya

In a Kenyan high school, educators collaborated with environmental experts to develop a virtual ecosystem exploration program using VR. Students embarked on immersive journeys through different ecosystems, witnessing wildlife and environmental changes. The outcomes were remarkable, with students reporting heightened engagement, improved retention of knowledge, and a strengthened connection to their local environment. This initiative showcased the power of VR in bridging geographical gaps and fostering a sense of stewardship towards nature.

Cultural Heritage Preservation in Egypt

In Egypt, a project aimed at preserving cultural heritage integrated AR into history lessons. Students could use AR-enabled devices to interact with historical artifacts virtually, bringing ancient structures and artifacts to life. This initiative not only revitalised history education but also deepened students' appreciation of their cultural heritage, transcending the boundaries of time and space.

Challenges and Future Directions

While the integration of the metaverse and immersive technologies holds immense potential, several challenges must be addressed to ensure equitable and effective implementation in Africa.

Technical Barriers and Access

Limited access to devices, internet connectivity, and reliable power sources can hinder widespread adoption. Bridging this digital divide requires collaborative efforts between governments, institutions, and technology providers to make these tools accessible to all learners.

Resource Limitations

Developing quality immersive content demands financial resources and technical expertise. Institutions may face difficulties in securing funding and training educators to create and use such content effectively.

Cultural Sensitivities

Different cultures have varying perceptions of technology and its role in education. Some communities might resist the integration of immersive technologies due to cultural sensitivities or concerns about disrupting traditional teaching methods.

Sustainability

Ensuring the sustainability of immersive technology initiatives is crucial. Institutions must develop long-term plans for maintenance, updates, and content expansion to prevent these technologies from becoming short-lived novelties.

To overcome these challenges, strategies can include:

-Public-private partnerships to provide affordable devices and internet access.
-Collaborative content creation to distribute the burden of resource requirements.
-Sensitivity training for educators to navigate cultural considerations effectively.
-Advocacy for policy changes to allocate funds for sustainable technology integration.

Looking ahead, the future of sustainable development education in Africa enhanced by the metaverse and immersive technologies holds promise. As technology becomes more accessible and affordable, immersive experiences can become integral to formal and informal learning environments. By addressing challenges and embracing opportunities, educators can lead the way in transforming education, empowering students to become proactive agents of positive change in their communities and the world.

Developing a pro-active attitude towards sustainable development education

The integration of the metaverse and immersive technologies into sustainable development education marks a pivotal juncture in the evolution of pedagogy. As this article has illuminated, the metaverse, virtual reality (VR), and augmented reality (AR) hold the potential to transcend conventional teaching methodologies, fostering experiential and transformative learning experiences. In the context of the African continent, where unique challenges intersect with boundless opportunities, these technologies offer a compelling avenue to revolutionise education for sustainable development.

The case studies and success stories presented here underscore the profound impact of immersive technologies on student engagement, comprehension, and connection with sustainability concepts. From Kenya's virtual ecosystem exploration to Egypt's cultural heritage preservation, educators and institutions are leveraging the power of these technologies to bridge geographical, cultural, and temporal divides.

However, challenges persist. The digital divide, resource limitations, and cultural sensitivities pose hurdles that require innovative solutions and collaboration across sectors. By addressing these challenges, stakeholders can ensure that the benefits of the metaverse and immersive technologies are accessible to all learners, regardless of their circumstances. From a technological point of view, Africa has shown itself capable of an impressive adaptation. The case of the Blockchain and the development of skills in the field of crypto-assets is a good example of this great ability to integrate cutting-edge technologies quickly (Barthelmess & Langlois 2018, 2018b, 2018c). Augmented reality and virtual reality are no exception to this trend.

Envisioning the future, the horizon is promising. As technology becomes more democratised and ingrained in educational practices, the metaverse and immersive technologies can catalyze a paradigm shift in education, fostering a generation of environmentally conscious and socially responsible global citizens. In Africa and beyond, sustainable development education can evolve from static theoretical knowledge to dynamic, experiential wisdom that empowers learners to actively shape a sustainable future. (Pérez-Ordás et al. 2019)

In conclusion, the integration of the metaverse and immersive technologies in sustainable development education embodies the synergy between innovation and social progress. By embracing these technologies thoughtfully, educators, policymakers, and learners can embark on a transformative journey that equips individuals not only with knowledge but also with the empathy, critical thinking skills and agency needed to drive positive change on a local and global scale (Yu et al. 2022). Through these efforts, education becomes a potent catalyst for sustainable

development, shaping a world where informed and empowered individuals are at the forefront of creating a more equitable and sustainable future.

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Teaching Mathematics with Augmented Reality (AR) and Virtual Reality (VR)

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In the realm of education, the integration of technology has proven to be a catalyst for transformative change. As the digital age unfolds, traditional teaching methods are evolving to embrace innovative tools that have the potential to revolutionise the learning experience. One such advancement that holds promise in reshaping the landscape of mathematics education is the utilisation of Augmented Reality (AR) and Virtual Reality (VR). These immersive technologies are not just buzzwords; they represent a dynamic shift towards more interactive, engaging, and personalised approaches to teaching and learning mathematics.

The significance of mathematics in our lives is undeniable, as it forms the backbone of scientific, technological, and economic advancements. Yet, for many students, the abstract nature of mathematical concepts often becomes a stumbling block on their educational journey. Equations, theorems, and geometrical abstractions can easily overwhelm learners, leading to disengagement, frustration, and even mathematics anxiety (Boisset et al 2023). The question that arises is how to bridge the gap between mathematical abstraction and student comprehension, and this is where AR and VR enter the scene as potential game-changers.

The aim of this article is to explore the transformative potential of using AR and VR technologies to enhance the teaching and learning of mathematics. By providing a bridge between the abstract and the tangible, AR and VR have the capacity to breathe life into mathematical concepts, turning them from enigmatic symbols on paper into interactive, visual experiences. But before we delve into the benefits and applications of these technologies, let's first understand the essence of AR and VR and their role in the educational landscape.

Understanding AR and VR

Augmented Reality (AR) and Virtual Reality (VR) are two distinct yet interrelated technologies that have gained prominence across various sectors. AR enhances the real world by overlaying the user's physical environment with digital information, images, or simulations. In contrast, VR immerses users in a wholly digital environment, isolating them from the physical world and offering an interactive, multisensory experience.

AR enriches mathematics education by placing mathematical constructs in the real world, allowing students to engage with geometric shapes, equations, and graphs as tangible entities. Imagine a student standing in their living room, seeing a three-dimensional representation of a complex calculus graph suspended in front of them. This interactive visualization not only makes the subject matter more accessible but also piques curiosity and fosters a deeper understanding.

VR, on the other hand, transports students into immersive mathematical landscapes where they can manipulate objects, explore mathematical models, and witness mathematical phenomena firsthand. Picture a student stepping into a VR environment where they can physically experience the concept of geometric transformations by interacting with shapes in a virtual space. The ability to move

around, touch, and interact with abstract concepts transforms learning from passive observation into active participation.

The integration of AR and VR into mathematics education signifies more than just a technological shift; it represents a pedagogical evolution that addresses the diverse learning needs of students. As we proceed, we will uncover the myriad benefits these technologies bring to the realm of mathematics education, from interactive learning to real-world applications and personalised instruction. The potential is vast, and the implications are profound.

Benefits of AR and VR in Mathematics Education

In the ever-evolving landscape of education, the incorporation of technology has continually aimed to bridge the gap between traditional classroom methods and the needs of modern learners. One of the most promising frontiers in this endeavour is the integration of Augmented Reality (AR) and Virtual Reality (VR) into the teaching and learning of mathematics. These immersive technologies have the power to transcend the limitations of traditional pedagogy, transforming the abstract world of mathematics into a tangible and engaging experience. As we explore the potential benefits of AR and VR in mathematics education, a compelling narrative emerges - one that redefines how students interact with mathematical concepts, offering a bridge between the known and the unknown. (Klimova et al. 2018; Kramarenko 2019; Fernández-Enríquez & Delgado-Martín 2020; Kellems et al. 2020)

One of the core challenges in teaching mathematics lies in making abstract concepts comprehensible. Equations, formulas, and geometric abstractions often appear as disconnected symbols, leading to student disengagement and a lack of understanding (Langlois 2021). AR and VR have the remarkable ability to visualise these abstract ideas, offering students a visual context that makes the intangible tangible. Imagine a student exploring a VR environment where they can manipulate geometric shapes and witness the effects of transformations in real time. The visual representation of mathematical concepts aids in building a mental bridge between the symbolic and the concrete, fostering a deeper understanding and retention.

Traditional classroom settings can sometimes struggle to maintain students' attention, especially when dealing with intricate mathematical theories. AR and VR inject an element of novelty and excitement into the learning process. Interactive 3D models projected through AR captivate students' attention, transforming passive observation into active exploration. In VR environments, students become active participants, manipulating objects and engaging with mathematical scenarios as they unfold in real time. This heightened engagement not only enhances the learning experience but also cultivates curiosity and a genuine interest in mathematical concepts. (Tashko, and Elena 2015; Tomaschko, and Hohenwarter 2019)

AR and VR offer a multi-sensory experience that extends beyond visual engagement. In VR environments, students can experience spatial relationships by physically moving around and interacting with objects. This immersive and sensory-rich environment also aligns with the principles of blockchain technology, which emphasises transparency, security, and decentralisation. Just as blockchain ensures the integrity of transactions and data through its distributed and tamper-resistant ledger, AR and VR create an environment where learners can interact with

mathematical concepts in a trustworthy and secure manner. This parallel underscores the importance of harnessing technology to create not only engaging but also reliable educational experiences. (see Barthelmess & Langlois 2018, 2018b, 2018c)

Geometry, with its intricate shapes, angles, and spatial relationships, often poses a significant challenge for students. AR and VR excel in enhancing spatial reasoning skills by providing immersive experiences that allow students to explore and manipulate three-dimensional objects. This hands-on interaction encourages spatial exploration, leading to a heightened ability to analyse and understand complex geometric structures.

AR and VR can foster collaborative learning experiences, where students work together to solve mathematical challenges in augmented or virtual environments. Through shared experiences, students can discuss strategies, solve problems, and collectively explore mathematical scenarios. This collaborative aspect not only enhances teamwork but also encourages the exchange of diverse perspectives, enriching the learning process. (Tzima 2019)

As we navigate the intricate landscape of mathematics education, the potential benefits of AR and VR emerge as beacons of innovation. These technologies transcend the limitations of traditional approaches, providing students with dynamic, interactive, and multi-sensory experiences that empower them to not only understand but truly engage with mathematical concepts. The journey through augmented and virtual realms continues, leading us deeper into the applications and implications of these transformative tools in the realm of mathematics education.

Interactive Learning with AR and VR

In the dynamic landscape of education, where traditional methods are constantly evolving, the integration of technology has become pivotal in engaging and empowering students. Augmented Reality (AR) and Virtual Reality (VR) have emerged as game-changing tools in the realm of mathematics education, with their ability to create immersive, interactive, and personalised learning experiences. As we delve into the applications of AR and VR in mathematics, a compelling narrative unfolds - one that blurs the lines between abstract mathematical concepts and tangible, real-world experiences. (Lerman 2001; Conley et al. 2020)

Mathematics, often perceived as a realm of abstract ideas, can become a daunting challenge for many students. Equations and formulae may appear disconnected from the physical world, leading to a lack of engagement and comprehension. AR and VR have the unique potential to bridge this gap by allowing students to interact with mathematical concepts in a tangible and relatable manner. Through AR, students can witness complex mathematical structures projected into their real environment, making the abstract tangible. Imagine a student exploring the angles and sides of a geometric shape that hovers before them, enabling a dynamic understanding that extends beyond the confines of a textbook.

The interactive nature of AR and VR transforms passive learning into active exploration. In VR environments, students can immerse themselves in mathematical scenarios where they can manipulate objects, change variables, and witness immediate outcomes. This hands-on interaction provides a sense of agency, enabling

learners to experiment and comprehend how changes in mathematical parameters impact outcomes. Whether it's altering the coefficients in an equation or navigating through a fractal landscape, AR and VR empower students to be active participants in their mathematical journey. (Klimova et al. 2018; Ahmad and Junaini 2020; Schutera et al 2021)

AR and VR offer the potential for highly personalised learning experiences. Through AI-driven algorithms, these technologies can adapt content to match individual learning styles and paces. Students struggling with a particular concept can receive tailored simulations and visualisations that cater to their specific needs. This personalised approach not only addresses the diverse learning speeds within a classroom but also enhances comprehension by presenting mathematical concepts in a format that resonates with each learner.

Geometry, a branch of mathematics notorious for its abstract nature, can be particularly challenging for students. AR and VR excel in making geometric concepts tangible. With AR, students can overlay geometric shapes onto their physical environment, transforming their surroundings into a canvas for exploration. In VR, students can step into three-dimensional spaces, visualising spatial relationships with an unprecedented level of clarity. These technologies provide students with the tools to dissect complex geometries, fostering spatial understanding and improving problem-solving skills. (Bujak etal. 2013; Anuar et al. 2021; Babkin et al. 2021)

AR and VR extend the boundaries of learning beyond the confines of the classroom. Students can access these technologies from their homes, enabling independent exploration and practice. Imagine a student immersing themselves in a VR environment to study complex calculus concepts at their own pace. This accessibility empowers students to take control of their learning journey, transforming any space into a virtual mathematics laboratory.

As we venture further into the realms of AR and VR, the applications of these technologies in mathematics education continue to unfold. The bridge they provide between the abstract and the tangible, the complex and the comprehensible, is paving the way for a new era of mathematical understanding. In our exploration, we will delve deeper into how AR and VR facilitate real-world applications, enabling students to solve practical mathematical problems and engage in collaborative learning experiences. The narrative of interactive mathematics education evolves, illuminating the pathways that AR and VR open for both educators and learners alike. (Freitas & Campos 2008; Lee 2012; Kirner et al. 2012; Medicherla et al. 2010; Kounlaxay et al. 2021

Real-World Applications and Problem Solving

As education embraces the digital age, the convergence of technology and learning becomes increasingly prominent. Among the tools that stand out for their potential to revolutionise education is the fusion of Augmented Reality (AR) and Virtual Reality (VR) into mathematics instruction. Beyond enhancing engagement and understanding, these immersive technologies hold the key to transforming theoretical mathematical concepts into practical problem-solving tools. As we delve into the applications of AR and VR in mathematics education, the curtain rises on a realm where abstract mathematics becomes a tangible tool for navigating real-world

challenges. (Kerawalla et al. 2006; Estapa & Nadolny 2015 Geroimenko 2020;)

One of the distinguishing features of AR and VR is their ability to contextualise abstract mathematical concepts within real-world scenarios. Traditional teaching methods often isolate mathematical ideas from their practical applications, leaving students wondering about their real significance. AR has the capacity to overlay the physical world with mathematical models, allowing students to see how concepts like geometry and algebra manifest in their environment. Whether calculating the dimensions of a building or understanding the trajectory of a projectile, AR offers a lens through which mathematics takes on a practical meaning.

VR, with its immersive environments, takes the idea of practical application a step further. Imagine a student stepping into a virtual world where they are an engineer designing a bridge. They can apply principles of geometry and physics to construct and test their design, observing how forces affect the structure in real time. Through these simulations, students gain first-hand experience in tackling complex mathematical challenges, developing problem-solving skills that extend beyond theoretical exercises. (Chang et al. 2010; Bower et al. 2014; Ochkov & Bogomolova 2015)

AR and VR empower students to use mathematics as a tool for solving authentic problems. With AR, students can measure distances, angles, and volumes in the physical world, translating abstract mathematics into real measurements. This has applications in fields ranging from architecture to carpentry, where precise calculations are essential. VR extends this capability by creating dynamic problem-solving environments. In a VR space, students can tackle intricate mathematical puzzles, applying their knowledge to unravel complex challenges. (Giraudet de Boudemange & Langlois 2021)

AR and VR can illustrate the interconnectedness of different mathematical disciplines. For instance, in a VR environment, students can explore how calculus concepts underpin the behaviour of dynamic systems. By visually demonstrating the relationships between various branches of mathematics, AR and VR promote a holistic understanding of the subject. (Chao & Chang 2018; Demitriadou et al. 2020)

Collaboration is a cornerstone of modern problem-solving. AR and VR offer collaborative environments where students can work together on mathematical challenges, regardless of physical proximity. Through shared experiences, students can discuss strategies, share insights, and collectively explore solutions. This collaborative approach not only enhances teamwork but also reinforces the idea that mathematics is a tool for collective problem-solving.

As we peer through the immersive lens of AR and VR, the practical applications of mathematics come into focus. These technologies empower students to engage with mathematics in a manner that transcends theory, bridging the gap between the abstract and the concrete.

Challenges

As the promise of AR and VR in mathematics education becomes increasingly evident, it's important to acknowledge the challenges that accompany their integration into the

classroom. While these technologies offer transformative potential, their adoption necessitates a strategic approach that addresses potential concerns and maximises their benefits.

Technical Challenges: The implementation of AR and VR requires the availability of suitable hardware and software, which can sometimes be costly. Ensuring that schools have access to these tools without creating financial disparities among students is a crucial consideration.

Educator Training: Integrating AR and VR effectively into the curriculum demands that educators are well-versed in both the technologies and their pedagogical implications. Adequate training and professional development are essential to empower teachers to leverage these tools to their full potential.

Balancing Screen Time: AR and VR, while engaging, involve extended periods of screen time. Striking a balance between immersive experiences and physical engagement is crucial for students' overall well-being.

Content Quality: The effectiveness of AR and VR experiences hinges on the quality of content. Ensuring that educational content aligns with curriculum standards and learning objectives is vital for meaningful integration.

In navigating these challenges, collaboration among educators, administrators, technology experts, and policymakers is essential. By addressing concerns proactively and embracing a learner-centered approach, the transformative potential of AR and VR in mathematics education can be realized.

As we move forward in our exploration, our focus shifts to envisioning the future of mathematics education, where AR and VR technologies are seamlessly integrated into pedagogy, enabling educators to leverage the full spectrum of these tools for the benefit of students.

Transforming Mathematics Education with AR and VR

The realm of education is undergoing a profound transformation, driven by the integration of technology that seeks to enhance engagement, understanding, and the overall learning experience. Within this dynamic landscape, the convergence of Augmented Reality (AR) and Virtual Reality (VR) stands out as a beacon of innovation, particularly in the domain of mathematics education. Our journey through the applications and implications of AR and VR in teaching and learning mathematics has unveiled a tapestry of possibilities that extend beyond traditional pedagogical boundaries.

The promise of AR and VR in mathematics education lies not merely in their immersive and interactive nature, but in their potential to bridge the chasm between abstract mathematical concepts and tangible, practical understanding. By overlaying mathematical models onto the real world, AR offers students a newfound perspective on how equations and geometric abstractions manifest in their everyday environment. Similarly, VR immerses learners in scenarios that demand the application of mathematical principles, effectively transforming theoretical knowledge into problem-solving skills. (Sommerauer, P. and Müller, O., 2014.; Oleksiuk and Oleksiuk 2020.;

Lai and Cheong 2022)

The ability of AR and VR to personalise learning experiences caters to diverse learning styles, while their collaborative environments foster teamwork and the exchange of ideas. Moreover, these technologies illuminate the interconnectedness of different mathematical disciplines, allowing learners to grasp the bigger picture. Yet, as with any transformative tool, the integration of AR and VR comes with challenges. Technical considerations, educator training, content quality, data privacy, and equity must be carefully navigated to harness the full potential of these technologies.

As we stand at the crossroads of traditional education and the digital frontier, the integration of AR and VR signifies a shift towards more dynamic, experiential, and holistic learning. The impact of these technologies extends beyond the classroom, offering students the opportunity to engage with mathematics as a tool for understanding, problem-solving, and collaboration in the real world. Educators, policymakers, and stakeholders alike bear the responsibility for shaping this educational narrative, ensuring that the potential benefits of AR and VR are harnessed equitably and ethically.

The journey through the augmented and virtual realms of mathematics education is one of transformation, empowerment, and limitless possibilities. As we move forward, let us embrace these technologies not as substitutes for traditional methods, but as complementary tools that enrich and enhance the educational experience. The fusion of mathematics and technology is shaping the future of learning, and as we stand on the threshold of this transformation, it is our collective duty to guide the way toward a new era of mathematics education empowered by the immersive potential of AR and VR.

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Capacity Building and Training for Crisis Management Skills with AR and VR

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In an increasingly interconnected and unpredictable world, the importance of crisis management skills cannot be overstated. From natural disasters to health emergencies, the ability to effectively respond to crises is crucial for ensuring the safety, well-being, and continuity of societies and organisations. As the complexity and frequency of crises continue to rise, the methods and tools used for training individuals in crisis management must also evolve. (Demir 2017; Caboni 2022)

Traditional approaches to crisis management training, such as workshops, simulations, and tabletop exercises, have played a significant role in preparing individuals for emergency situations. However, these methods often fall short in fully replicating the dynamic and high-stakes nature of real crises. Additionally, the limitations of physical constraints, logistical challenges, and the inability to recreate authentic crisis scenarios pose barriers to achieving optimal training outcomes. (Markus 2004; Nilsson 2010; Fuchs-Kittowski 2017)

This is where emerging technologies like Augmented Reality (AR) and Virtual Reality (VR) step in. AR and VR offer revolutionary solutions that can transform the way crisis management skills are built, honed, and applied. By providing immersive and adaptable learning experiences, these technologies hold the potential to bridge the gap between theoretical training and real-world crisis situations. This article delves into the paradigm shift that AR and VR bring to the realm of crisis management training, exploring their capabilities, benefits, challenges, and future prospects. (Ruggiero 2018)

The following sections will discuss the evolution of crisis management training, the role of AR and VR in this context, their advantages over traditional methods, challenges to their adoption, success stories, and the untapped potential they offer for future advancements. As AR and VR redefine the boundaries of training methodologies, they open doors to more effective, engaging, and scalable approaches to building the critical skills needed to navigate crises successfully.

The Evolution of Crisis Management Training

Historically, crisis management training has relied on a combination of classroom lectures, paper-based simulations, and in-person exercises. While these methods provided valuable insights into crisis scenarios, they often struggled to capture the complexities and dynamics of real-life emergencies. Participants faced limitations in experiencing the urgency, stress, and high-stakes decision-making that characterise genuine crises.

Traditional training methods also required considerable time, resources, and coordination to organise large-scale simulations or exercises. Additionally, replicating certain crisis scenarios, such as large-scale natural disasters or global pandemics, proved logistically challenging. As a result, the effectiveness of traditional training

methods was sometimes compromised, leaving gaps in the preparedness of individuals and organisations to manage unforeseen emergencies. (Langlois 2021)

The advent of digital technology brought about innovations in crisis management training, including computer-based simulations and online learning platforms. These approaches enabled remote access to training materials and interactive scenarios but still fell short of providing an immersive and authentic experience. The growing demand for more realistic and impactful training solutions paved the way for the integration of Augmented Reality (AR) and Virtual Reality (VR) into crisis management education. As shown by Barthelmess and Langlois the Web 3.0 technologies (like AR and VR) are used extensively by institutions facing crisis management issues on a regular basis like the Army, the Police etc. (Barthelmess & Langlois 2018, 2018b, 2018c)

AR and VR technologies offer a departure from the traditional methods by immersing trainees in dynamic, interactive, and simulated crisis scenarios. These technologies leverage the power of digitalisation to create environments that closely mimic real-life crisis situations. As we move into an era of unparalleled connectivity and digital transformation, AR and VR present an opportunity to revolutionise crisis management training and equip individuals with the skills needed to navigate the complex challenges of the modern world. The following sections will delve deeper into the specific roles of AR and VR in enhancing crisis management training and capacity building.

Augmented Reality for Crisis Management Training

Augmented Reality (AR) seamlessly integrates digital information into the physical world, enhancing the user's perception of reality. By overlaying virtual elements onto the real environment, AR provides a unique blend of the physical and digital realms. This technology has found its way into various industries, from entertainment to healthcare, and is now poised to revolutionise crisis management training.

AR offers the potential to improve crisis response by providing real-time information directly within the field of view of first responders and crisis managers. For instance, firefighters equipped with AR devices can receive live updates on building layouts, hazardous materials, and the locations of their team members. This instantaneous access to critical data enhances situational awareness and accelerates decision-making processes, contributing to more effective crisis management.

AR can create immersive scenario simulations that mirror real-world crises, enabling trainees to navigate through crisis scenarios in their actual surroundings. Trainees can practise responding to emergencies like chemical spills, urban search and rescue operations, and medical emergencies within their physical environments. This interactive approach bridges the gap between theory and practice, allowing individuals to apply crisis management skills in realistic settings.

AR facilitates remote collaborative training, connecting crisis management teams across geographical distances. Through AR-enabled devices, team members can collaborate, visualise shared data, and strategise as if they were physically

present in the same location. This capability is especially valuable during global crises that demand immediate coordination between international teams.

Numerous organisations and agencies have embraced AR for crisis management training. For instance, medical professionals have utilised AR applications to simulate disaster triage scenarios, helping them prioritise patients and allocate resources efficiently. Similarly, public safety agencies have employed AR to conduct virtual tabletop exercises, fostering better communication and coordination among responders.

The integration of AR into crisis management training has demonstrated tangible benefits. Trainees experience heightened engagement, improved retention of knowledge, and the ability to apply the skills they have learned in realistic contexts. As AR technology continues to advance, its potential to transform crisis management training becomes increasingly evident, paving the way for a more prepared and effective response to emergencies. (Leebmann 2004; Lovreglio 2020; Khanal et al. 2022)

Virtual Reality for Immersive Crisis Training

Virtual Reality (VR) immerses users in entirely digital environments, providing a sense of presence and interaction within a simulated world. VR technology creates a compelling illusion of reality, making it a powerful tool for training individuals to respond to complex and high-stress situations, such as crisis scenarios. (Walker 2011; Luchetti 2017)

VR enables the creation of lifelike crisis scenarios that replicate real-world challenges. Trainees can find themselves in virtual disaster zones, medical emergencies, or hazardous environments, allowing them to practise responses and decision-making under pressure. This realistic training fosters better crisis preparedness and builds confidence in handling unforeseen challenges. (Wursthorn 2004; Ternier 2012; Zachariadis 2020; Velas 2021; Woodward 2022)

VR offers the advantage of tailoring training experiences to specific industries, roles, and crisis types. For example, medical professionals can undergo VR training to simulate mass casualty incidents, while emergency management teams can practise coordinating responses to natural disasters. This customisation ensures that training is relevant and applicable to the unique needs of various crisis scenarios.

VR creates a safe and controlled environment for trainees to make mistakes, learn from failures, and refine their crisis management skills. Participants can experiment with different approaches and strategies, observing the consequences of their decisions without real-world implications (Jesionkowska et al. 2020). This iterative learning process enhances trainees' ability to adapt to evolving crisis situations.

Across sectors, VR has demonstrated its potential to revolutionise crisis management training. Military organisations use VR to simulate battlefield scenarios, helping soldiers practise strategic decision-making and teamwork. Healthcare

providers utilise VR to enhance trauma response training, enabling medical personnel to practise life-saving interventions in high-stress situations. (Giraudet de Boudemange & Langlois, 2021)

The immersive nature of VR training has led to improved skill retention, increased confidence, and accelerated skill development among trainees. VR's ability to recreate authentic crisis environments fosters a deeper understanding of the challenges at hand, ultimately translating to more effective and efficient crisis responses when facing real-world scenarios.

As VR technology continues to evolve, its integration into crisis management training promises to reshape the way individuals and organisations approach preparedness, response, and recovery. By providing immersive and dynamic learning experiences, VR equips crisis management professionals with the tools they need to navigate emergencies successfully and minimise the impact of crises on communities and societies.

Benefits of AR and VR for Capacity Building

One of the most significant advantages of AR and VR in crisis management training is their ability to create realistic and engaging learning environments. Trainees are immersed in scenarios that closely resemble real-life crises, enhancing their understanding of the challenges and pressures they may face. This realism captures trainees' attention, increasing their engagement and motivation to learn. (Bhatia 2021)

AR and VR training modules can be adapted and scaled to accommodate various crisis scenarios, industries, and skills levels. This adaptability ensures that training remains relevant, addressing the diverse challenges that individuals and organisations may encounter. Whether it's a natural disaster, public health crisis, or cybersecurity breach, AR and VR offer versatile solutions for effective capacity building.

Traditional crisis management training methods often involve logistical complexities and expenses associated with physical resources, venues, and trainers. AR and VR training, once developed, can be deployed remotely and repeatedly, minimising costs over time. This cost-efficiency makes it feasible to train a larger number of individuals and organisations, contributing to broader crisis preparedness. (Wani 2013; Velas 2021)

AR and VR training can be designed to cater for different learning styles, languages, and abilities, ensuring that a diverse range of trainees can benefit from the technology. This inclusivity is crucial in fostering a well-prepared crisis management workforce that represents a cross-section of society and contributes to more comprehensive responses.

The immersive nature of AR and VR training enhances trainees' decision-making skills and performance under pressure. By exposing them to high-stress scenarios in controlled environments, AR and VR empower trainees to make informed choices, react quickly, and collaborate effectively, thereby enhancing their overall

crisis management capabilities. (He 2017; Munzer 2019)

AR and VR training not only augment existing crisis management skills but also transform the training paradigm itself. These technologies offer more than just theoretical knowledge; they provide a platform for experiential learning, enabling trainees to develop critical skills through hands-on practice. As organisations embrace this shift, they are better positioned to confront unforeseen challenges with confidence and competence. (Bacon 2012; Mirauda 2018; Arregui 2022; Richir 2022)

As the advantages of AR and VR for crisis management training become increasingly evident, their integration becomes a strategic imperative for organisations seeking to build resilient and agile teams capable of responding effectively to crises. The potential for improved preparedness, quicker response times, and minimised risks demonstrates the transformative impact of these technologies.

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Exploring the Synergy of Virtual Reality and Blockchain in e-Government Training

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The convergence of virtual reality (VR) and blockchain technology stands as a groundbreaking nexus with transformative implications across diverse sectors. In the realm of e-Government, the amalgamation of these two technological frontiers ushers in a new era of efficient and secure training paradigms (Lykidis et al. 2021; Barthelmess & Langlois, 2018, 2018b, 2018c). As e-Government continues to evolve, leveraging VR for training purposes has proven advantageous. However, the integration of blockchain introduces an additional layer of innovation that addresses the limitations and challenges associated with traditional training methodologies. This section delves into the synergistic potential of VR and blockchain in e-Government training, unlocking a realm of possibilities that redefine the acquisition of skills and knowledge within the digital realm. (Giraudet 2021)

Incorporating VR into e-Government training revolutionises learning experiences by offering immersive simulations of real-world scenarios. Yet, to ensure the credibility and authenticity of training accomplishments, the incorporation of blockchain technology is pivotal. Blockchain's inherent property of providing an immutable and transparent record of transactions aligns seamlessly with the need for secure and verifiable training certifications. Every completed VR training module can be seamlessly recorded on a blockchain, creating an incorruptible repository of skills acquired by government employees. This fusion assures stakeholders, citizens, and regulatory bodies that e-Government training outcomes are credible, thus boosting trust and accountability. (Andola 2021; Bandara 2022; Aydar 2019; Casalino 2014)

As e-Government training extends its reach to a broader audience, the verification of identities and credentials becomes paramount. Traditional methods of identity verification are often riddled with inefficiencies and privacy concerns. Blockchain's decentralised nature and cryptographic techniques can establish a robust digital identity framework (Langlois 2020; Langlois 2021). VR training modules can be tailored to incorporate secure identity verification through blockchain, enabling seamless access for authorised individuals while preserving their privacy. This convergence propels e-Government training toward a realm of efficiency, where the user experience is enriched by the secure access to personalised learning paths. (Baylis 2023)

The traditional educational model's rigidity often falls short in catering to the evolving skill requirements in e-Government. Here, blockchain's capability to facilitate micro-credentials shines. VR training experiences can be modularised into micro-units, and blockchain can record the completion of each module. These micro-credentials, recorded on a blockchain, serve as a testament to continuous learning and skill development. As government employees accumulate these credentials, a holistic and dynamic representation of their capabilities emerges. This not only fosters a culture of lifelong learning but also aligns with the fluid demands of e-Government roles.

Blockchain's inherent transparency and auditability offer a paradigm shift in training evaluation and quality assurance. Government agencies can utilise blockchain to maintain an immutable ledger of training activities, providing real-time insights into the progress of employees. This transparency enhances accountability and assists in optimising training curricula based on individual performance data. Furthermore, the audit trail provided by blockchain offers an invaluable tool in demonstrating regulatory compliance in e-Government training, a crucial aspect in the ever-evolving landscape of governance.

The integration of VR and blockchain redefines the contours of the e-Government training ecosystem. The immersive and dynamic nature of VR training is complemented by blockchain's security, transparency, and tamper-proof attributes. This synergy transforms training from a conventional practice to a strategic lever that enhances organisational efficiency, augments public trust, and fosters continuous learning. As governments continue their digital transformation journey, embracing the potential of VR and blockchain in e-Government training positions them in the vanguard of technological innovation and effective governance. (Chohan 2022)

A current concern of government services is the capabilty to hire new civil servants and provide them with pleasant working conditions to retain them over time. VR may contribute to this objective in many ways. First, the possibility of access to plenty of interactive training courses is a regular demand of civil servants, who want to develop their skills and knowledge. Second, VR can provide interactive situations that can illustrate for potential applicants a regular day within a government service. This may contribute to convincing candidates to join the public service. Finally, VR can help to explain human resources processes such as career, remuneration, or professional training to candidates and civil servants so that they build up their professional track record. Several studies have shown the effectiveness (Langlois 2022; Langlois 2022b) of professional training courses related to sustainable development. The use of blockchain technology could help to personalise the experience with the exact personal situation of the person concerned.

Virtual Reality to illustrate Blockchain applications for e-Government

There are numerous and diverse applications of blockchain to improve government services. For example, blockchain can help secure value-added tax recovery (Gaie 2022) reduce tax fraud (Gaie 2023), facilitate data sharing, help ensure secure e-Voting or offer many other useful contributions. Usually, understanding the functioning of these new proposals requires considerable effort in research, reading and analysis. (Boisset et al. 2023). VR could facilitate the understanding of these new approaches by enabling their creators to explain them and answer questions in an interactive manner. This would increase the impact of their discovery and facilitate their implementation in other government organisations.

The growth of VR learning offers new perspectives in terms of understanding civil servants' knowledge, thoughts and expectations. As a matter of fact, each decision made by a VR user could be shared in order to ensure collective learning and improve government action. For instance, it would be very interesting to keep track of how people behave in front of colleagues or members of the public to spot and to analyse potential discrimination. To ensure the participation of trainees, assuring them that the enquiry will respect their anonymity is required. The usage of an anonymous

blockchain would enable those controlling the operation to get the information they need while protecting the subject's identity and personal opinions

A classic limitation of Virtual Reality is its limited interaction as the virtual world is limited in its intended use. Since Information Technology is an ever-growing domain, this implies a huge difficulty in keeping what has been learned up-to-date (Ahmat 2021; Aydar 2019). This opens up the possibility of introducing an interaction between the existing virtual world and other information available. To ensure the reliability of information we could imagine building a chain of trust between the creator of the VR lesson and its own further research. Thus, any learner could ask questions that could be processed by an interactive system such as chatGPT whose database would be connected to a blockchain of publications. (Nguyen 2023)

In this symbiotic relationship between VR and blockchain, e-Government training transcends traditional boundaries, ushering in an era of proficiency, accountability and adaptability. As government agencies harness the combined power of these technologies, they pave the way for a resilient and empowered workforce poised to navigate the complexities of modern governance.

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