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Digital Future in Education.Paradoxes, Hopes and Realities

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From the Editor

This book emerged from a shared vision among dedicated authors, researchers, and contributors, all of whom recognized the profound impact of the digital age on education. In today's rapidly evolving landscape, the paradoxes, hopes, and realities of digital education have become more complex than ever before. It is our collective belief that understanding and navigating this dynamic background is outstanding to shaping the future of learning.

Our editorial journey has been guided by a commitment to rigor, relevance, and inclusivity. Each chapter has been carefully selected and curated to provide a comprehensive and balanced exploration of the digital future in education. We have strived to ensure that this book serves as both a source of inspiration and a practical guide for educators, policymakers, researchers, and anyone passionate about the transformative potential of technology in education.

As the editor of this compelling book, I have had the privilege of collaborating with creative authors, researchers, and experts who have dedicated their passion and expertise to the field of digital education. Their contributions have enriched the discourse on this critical subject matter, and their diverse perspectives have given life to the multifaceted details within these pages.

The chapters of this book drive us on an interesting journey through the dynamic landscape where education and technology converge, offering profound insights into the complexities, promises, and realities that shape our digital educational ecosystem.

Our exploration begins with Chapter 1. *Education and Technology in a Data Driven Society. Turning Data into Education Intelligence* which debates how educational institutions can leverage data to make informed decisions, tailor instruction to individual student needs, pinpoint areas requiring improvement, and optimize the allocation of resources. In a world where data has become a powerful currency, this chapter emphasizes how the abundance of data and technological advancements are reshaping the educational experience and also how personalized learning experiences, improved information access, and enhanced educational outcomes are all attainable through the intelligent use of data and technologies. This optimistic outlook is balanced with a realistic assessment of the challenges and complexities that educators and institutions face when adopting data-driven strategies.

Chapter 2. *Information Epistemology in Digital Learning*, takes a comprehensive look at the multifaceted aspects of digital learning, touching on both its promises and the inherent threats and risks in the digital landscape. The inclusion of case studies, particularly the examination of MOOC, adds a practical dimension to the chapter. These case studies provide tangible evidence of the educational outreach efficacy achieved through digital facilitation, reinforcing the chapter's arguments regarding the value of digitization in education.

Chapter 3. *Online Learning and Digital Education of the Future. The Role of Digital Learning in Education* successfully communicates the benefits of digital learning while acknowledging the challenges and complexities that come with it. Chatterjee & Mousumi provide a comprehensive overview of the ways in which digitalization has made learning more accessible, convenient, and flexible. The chapter also underscores the important role of remote learning and online classes, especially in the context of the global educational landscape, offering students seamless access to a variety of course materials and educational resources via the Internet. The concept of remote learning, once a novelty, try to become step by step a norm in educational institutions worldwide.

Chapter 4. *Connectedness, Collaboration, and Co-creation* is a valuable addition due the fact that offers a holistic view of the transformative potential of connected learning, collaboration, and learner-centric customization. The chapter challenges educators and institutions to adapt to the evolving educational landscape, recognizing that the future of education lies in flexibility, adaptability, and empowering learners.

Chapter 5. *Using Game-Based Learning to Improve Learning Outcomes in K-12 Mathematics Education* provides an insightful exploration of the potential of game-based learning (GBL) in enhancing mathematics education at the K-12 level. The chapter not only discusses the essential elements of GBL but also outlines the practical application of these principles in the creation of an educational game. The author effectively communicates the value of integrating elements of play and interactivity into the learning process, particularly in the context of mathematics education, which often poses challenges for young learners.

Chapter 6. *Exploring the Implementation of Online Learning at the Higher Institutions of Ethiopia: The Case of American College of Technology (ACT) & Harambee University (HU)* presents a comprehensive examination of the experiences and challenges faced by these institutions in implementing online learning programs for their students. The examination of the Learning Management System (LMS) used by the institutions, specifically MOODLE, offers practical insights into the technological infrastructure supporting online education. The variations in the interactions students have with instructors, the institution, and their peers underscore the importance of fostering a supportive and engaging online learning environment.

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The chapter's findings regarding the need for periodic feedback to motivate students and enhance their learning experience are significant.

Chapter 7. *Challenges and Opportunities in Language and Literature Education in the Era of Global Connectivity* offers a comprehensive exploration of the complexities faced by language and literature educators in a rapidly globalizing world. Through qualitative research involving interviews, focus group discussions, and classroom observations with both students and teachers, the study provides valuable insights into the evolving landscape of language and literature education. The identification of significant themes related to cultural diversity, multilingualism, and the integration of technology in language learning is an important contribution. These themes reflect the multifaceted nature of language and literature education in the context of global connectivity.

Chapter 8. *Student Performance in E-learning Systems* provides a comprehensive examination of the assessment of student performance, particularly in the context of the COVID-19 pandemic and the widespread adoption of e-learning platforms. The research paper introduces a sophisticated approach, utilizing a convolutional neural network and a two-step system that combines Bayesian model averaging with methods for estimating parameters in a multinomial logistic regression model. The introduction of a convolutional neural network (CNN) to assess student performance represents a forward-looking approach to educational evaluation. CNNs, which have shown success in various domains, are leveraged here to provide a robust framework for analyzing student outcomes. The two-step system, which combines Bayesian model averaging with frequentist methods, adds sophistication to the statistical analysis and enhances the credibility of the findings. This approach contributes to the reliability of the research's empirical example, illustrating its application in analyzing student performance.

The last Chapter 9. *The Impact of Government Expenditure on Education in the Environmental, Social and Governance Models at World Level* presents a comprehensive analysis of the relationship between Government Expenditure on Education (GEE) and various environmental, social, and governance (ESG) factors using data from 193 countries spanning the years 2011-2020. The study employs a variety of statistical methods and machine learning algorithms to examine this complex relationship. The chapter's rigorous analysis, diverse methodologies, and valuable findings make it a valuable resource for policymakers seeking to understand the multidimensional relationship between government spending on education and broader socio-economic and environmental factors.

Each of these chapters contributes to a holistic understanding of the digital future in education, addressing paradoxes, nurturing hopes, and confronting realities. As you embark on this intellectual journey through the pages of this book, I invite you to embrace the complexities, cherish the possibilities, and confront the challenges that lie ahead.

I extend my gratitude to the esteemed authors who have contributed their knowledge and expertise to this book. Their dedication to advancing the discourse on digital education is evident in the quality and depth of their contributions.

With warm regards,

The Editor,

PhD Professor Laura Nicola-Gavrilă

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Chapter 1.

Education and Technology in a Data Driven Society. Turning Data into Education Intelligence

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Abstract

In a data-driven society, education and technology have become closely intertwined, transforming the way we learn, teach, and acquire knowledge. The availability of vast amounts of data and the advancements in technology have brought about significant changes in the education sector, enabling personalized learning experiences, improved access to information, and more effective educational outcomes. By embracing a data-driven approach, education systems can make informed decisions, tailor instruction to student needs, identify areas for improvement, and optimize resources, ultimately leading to improved student outcomes and enhanced educational experiences.

In this chapter, we'll explore how data-driven technologies are unlocking the power of data for transforming education in an intelligent resource. Connecting data and leveraging technological tools we aim to foster collaboration, and contribute to the continuous improvement in teaching and learning outcomes.

Keywords: data-driven; technology; education intelligence.

JEL Classification: I20; O33.

Education and technology in a data-driven society hold immense potential to transform learning, improve outcomes, and empower individuals. However, it is crucial to strike a balance between data utilization and ethical considerations, ensuring that technology serves as an enabler rather than a barrier, and that education remains student-centred, inclusive, and equitable. Data-driven technologies are changing education by

personalizing learning experiences, providing valuable insights for educators and institutions, and facilitating evidence-based decision-making for continuous improvement in the educational process. As these technologies continue to advance, they have the potential to revolutionize the way we approach education and enhance learning outcomes for students worldwide.

The short-term surge in online learning has highlighted the need for long-term strategies. As more data becomes available in the context of online learning, educational organizations can derive valuable key insights to inform their long-term strategies revolving around student performance, learning analytics, dropout and retention rates, curriculum design, teacher effectiveness, resource allocation, continuous improvement, and predictive analytics. By analysing historical data, institutions can predict enrolment rates, graduation rates, and even student retention, enabling them to proactively address challenges and plan for future needs. Predictive analytics helps identify patterns and trends in educational data to make informed decisions. Educational institutions can implement early intervention systems that use data to identify struggling students and intervene before academic problems escalate. By addressing challenges early on, institutions can improve student success rates.

Unlocking intelligent education involves leveraging innovative approaches that harness the power of technology, data, and personalized learning empowering students to succeed in a rapidly evolving world. Different intelligent approaches as personalized learning: virtual and augmented reality: intelligent tutoring systems: social learning and collaboration: open educational resources can transform education into a more intelligent and adaptive system, catering to the diverse needs of students and preparing them for the challenges of the future.

Following paragraphs deal with works which analyses the latest research in the field, the next sub-chapters explore how education and technology intersect in a data-driven society, the last section summarizes the contributions of chapter and puts forward in future that education intelligence to become within everyone's reach.

1.1. Impact of Data-driven Approaches in Education

This literature review section provides an overview of the research and scholarly articles focused on the implementation and impact of data-driven approaches in education. The review highlights the key findings, methodologies, and implications for practice in

utilizing data to inform decision-making, enhance instruction, and improve educational processes.

The integration of technology in education has led to numerous positive outcomes, ranging from enhanced student engagement and personalized learning experiences to improved teaching methodologies and increased access to educational resources. Haleem, et al. (2022) made deep research for us to understand the role the role of digital technologies in education examining the impact, benefits, challenges, and potential future directions of integrating digital technologies into educational settings. Furthermore, they explore emerging trends such as artificial intelligence, virtual reality, and adaptive learning systems, and their potential to further revolutionize the educational landscape. Bernacki, Greene, and Lobczowski (2021) employ a systematic approach to investigate who is responsible for personalization (such as teachers, technology, or students themselves), what aspects of learning are personalized (content, pacing, assessment), how personalization is achieved (adaptive technology, differentiated instruction), and the intended outcomes of personalized learning (academic achievement, engagement, skill development).

Through systematic analysis, Yılmaz (2021) delves into the effects of technology integration on critical and creative thinking skills, highlighting how technology-enhanced learning experiences can stimulate higher-order cognitive processes. They shed light on the potential benefits and challenges associated with technology integration and offer insights into how technology can be effectively harnessed to enhance critical thinking, creative thinking, multidimensional skills, and academic performance among aspiring educators. Schildkamp's (2019) research explores into the utilization of data for making informed decisions to enhance the quality of education and highlights the significance of data-driven approaches in shaping educational policies and practices. A comprehensive analysis identified key research insights related to the importance of a data culture in schools, the role of leadership in fostering data use, the challenges related to data interpretation and implementation, and the impact of data use on student outcomes and their improvement efforts.

However, there are some gaps in the literature, and we can point to areas that require further investigation. These gaps encompass issues such as the integration of different types of data, the effectiveness of various interventions based on data analysis, and the connection between data-based decision-making and broader educational system changes. Through an in-depth examination of six intervention studies, Visscher (2021)

Figure 1.1. Key activities to build a culture of data use in education

Data integration and data ingestion are two distinct processes that play a crucial role in managing and utilizing data effectively. While they are related, they serve different purposes in the data lifecycle. Data integration focuses on merging and unifying data from various sources to create a consolidated and consistent view. It involves data transformation, synchronization, and schema mapping. On the other hand, data ingestion primarily deals with acquiring and loading data from external sources into a target system or storage environment, with a focus on data extraction and loading processes. Both processes are essential for managing and leveraging data effectively within an organization's data infrastructure.

Data integration refers to the process of combining and merging data from various sources into a unified and cohesive view. It involves bringing together data from different systems, databases, applications, or formats and transforming it into a consistent and coherent structure (Lenzerini and Daraio 2019). Main characteristics of data integration include these aspects:

At the same time, technology provides unprecedented access to vast amounts of educational resources and information. Online libraries, digital textbooks, open educational resources (OER), and Massive Open Online Courses (MOOCs) make learning materials available to a wider audience. Online courses, webinars, and educational apps enable individuals to acquire new skills, pursue professional development, and explore their interests at their own pace, offering opportunities for individuals to engage in lifelong learning and personal development. Advanced search algorithms and recommendation systems assist learners in discovering relevant content, empowering them to explore and acquire knowledge beyond traditional classroom boundaries.

However, it is important to consider potential challenges and ethical concerns in a data-driven education system. Privacy and security of student data, algorithmic bias, and the digital divide are among the critical issues that need to be addressed to ensure equitable and responsible use of technology in education. Proper policies, regulations, and ethical guidelines must be established to safeguard the rights and well-being of learners and educators in a data-driven society.

1.4. Data-Driven Technologies to Improve Education. Outstanding Solutions and Experiences

The incorporation of technology and data analysis in education has been transformative, as it enables educators to improve teaching methods, identify the needs of individual students, and track the progress of students and classes. Technology helps educators keep better track of student performance by allowing for real-time monitoring of students' understanding, progress and engagement.

Data-driven technologies have the potential to significantly improve education by providing personalized learning experiences, data analysis for better decision-making, and increased efficiency in educational processes. It's important to note that while data-driven technologies offer significant benefits, they also raise concerns about data privacy, security, and ethical considerations. Educational institutions and policymakers must prioritize safeguarding student data and ensuring responsible data usage when implementing these technologies. When used responsibly, innovative data-driven technologies would-be revolutionize education and lead to education intelligence with more efficient, effective, and personalized learning experiences for students of all ages.

Today, we are witnessing a new crop of data-driven organisations that are utilizing emerging technologies like Artificial Intelligence (AI) and Machine Learning (ML) to move beyond the conventional tools of educational processes. A systematic revision of artificial intelligence and machine learning approaches in digital education is provided by Munir, Vogel and Jacobsson (2022) in order to discover important insights for policy makers, educators, researchers and higher education institutions that can help develop the potential of AI- and ML-supported technologies for digital education.

Implementing AI in education requires careful planning, effective integration with pedagogical approaches, and ongoing assessment of its impact on learning outcomes. Education Intelligence integrates professional growth analytics with student and staff outcomes data to create insights that empower educators to know exactly which programs are driving improved results and which are not. With this correlated and connected data, resource-strained educators no longer have to spend valuable time and money on unproven programs, technology platforms, student data analysis, or training.

We will address some outstanding solutions and experiences that help educators guide students' online learning, promote collaboration and maximize learning time and also contribute to an education Intelligence giving leaders actionable insights into the effectiveness of programs and initiatives for driving long-term change and improvements.

1.4.1. Non-Presential Supervision of Assessment Tests

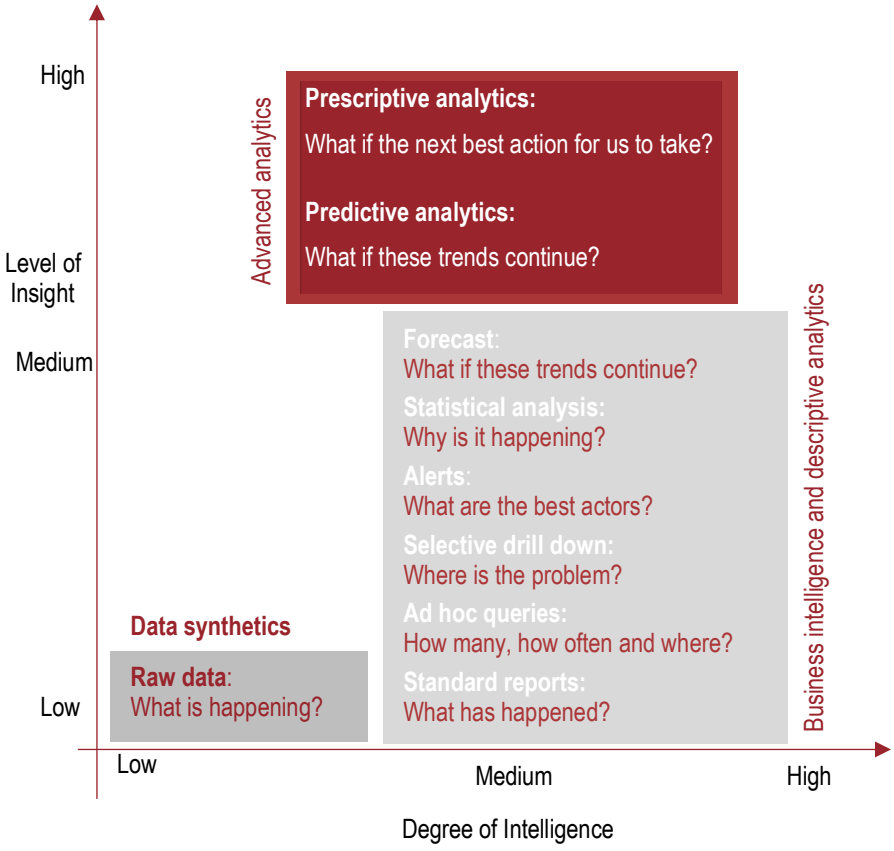
Non-presential supervision of assessment tests, also known as remote proctoring or online proctoring, refers to the practice of conducting assessment tests where students are located remotely and using telematic resources to monitor and invigilate the exams. This approach has gained popularity with the rise of online education and the need for secure and scalable testing solutions.

Some educational technology companies have tried to propose a solution by offering online, real-time surveillance of students taking the exam remotely through the webcams of professional proctors employed by the company. Among the most prominent companies offering these services with different approaches we can mention Proctorio, Respondus, ProctorU, HonorLock, Kryterion Global Testing Solutions, y Examity.

Other companies, such as Proctorio or Respondus, have adapted the human proctoring outsourcing model to develop algorithmic proctoring, sometimes referred to as "automated proctoring." Instead of an outside employee observing students take tests individually, tests are recorded, including student audio and video, and reviewed through

financial, mental health, and other variables, enabling institutions to identify at-risk students who may not exhibit obvious signs using traditional approaches.

Figure 1.2. Techniques of data analytics and machine learning

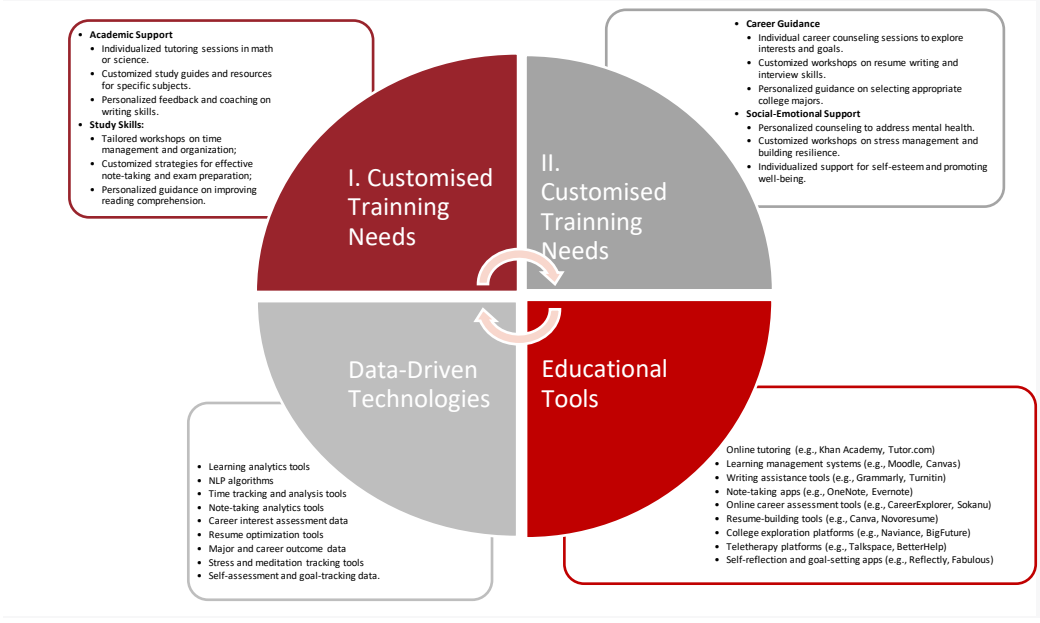


Furthermore, advanced analytics can provide a predictive capability, allowing institutions to anticipate potential risks and intervene proactively. By utilizing the power of algorithms, institutions can develop predictive models that forecast student outcomes, such as the likelihood of dropping out or academic success. These models can identify early warning signs and enable timely interventions to support students before they reach a critical point.

Modern classroom management solutions employ various techniques to identify and address behavioural or attention problems. These solutions leverage technology, data analysis, and proactive strategies to provide real-time insights and support for a positive learning environment. It's important to explore the commonly used techniques in modern

With the help of data-driven technology, educators and support staff can gather and analyse relevant data to gain insights into students' learning progress, engagement levels, and well-being. These educational tools leverage data analytics, machine learning, and artificial intelligence to provide personalized recommendations, track performance, and inform instructional and support interventions. The use of data-driven technology enhances the effectiveness and personalization of the training process, enabling educators to make informed decisions and provide targeted support to meet the individual needs of students

Figure 1.3. Data-driven technology used to support the personalised training needs of students



Here are four benefits of engaging personalized training programs:

- enhanced relevance and effectiveness for personalized training programs tailored to the specific needs of learners. Focusing on individual goals and challenges, these programs can deliver content and activities that are directly applicable and meaningful to learners' roles and responsibilities. This relevance increases learner engagement and enhances the effectiveness of the training;
- individualized learning paths which permit to get personalized training programs allowing learners to progress through the content at their own pace and in a way that suits their learning style. Learners can receive targeted instruction and practice on the

areas where they need improvement, accelerating their learning and reducing time spent on topics they have already mastered. This individualized approach helps optimize learning outcomes;

- increased motivation and engagement offered by personalized training programs designed to engage learners by addressing their specific interests and goals. Offering relevant and tailored content, activities, and assessments, learners feel a sense of ownership over their learning journey. This increased motivation and engagement contribute to a more effective and enjoyable learning experience;
- targeted skill development: to identify and address specific skill gaps and learning needs. By conducting a thorough assessment of learners' existing knowledge and competencies, the training program can target areas that require improvement. This focused approach allows learners to develop the exact skills and knowledge they need to excel in their roles.

These examples provided an overview of some outstanding educational solutions and experiences and also demonstrate how data-driven technologies can provide leaders in education with actionable insights to drive long-term change, and continually improve the education system for the benefit of students and stakeholders.

1.5. Education and Technologies: Conclusions and Further Research

Data-driven technology has the potential to revolutionize the way we think about education. From personalized learning algorithms to virtual and augmented reality, AI-powered tools and technologies are helping to enhance the learning experience in ways we never thought possible.

This chapter findings highlight the growing interest among education leaders in leveraging data to inform decision-making and improve educational outcomes. Aggregating and analysing data from multiple systems, institutions can gain insights into learner needs, identify trends, and develop evidence-based strategies to support student success. It reflects a shift towards data-driven practices and the recognition of the value that data analytics can bring to education institutions.

However, there are challenges to implementing data-driven decision making in education, such as lack of resources and training in data analysis and privacy concerns. Nevertheless, technology is becoming increasingly integrated into the education system and offers an endless range of opportunities for teachers and students in a data-driven society.

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I am thankful to my family for their unwavering support and understanding during the challenges and achievements of this endeavor. Their belief in me has been my driving force. Lastly, I am grateful to the academic community for providing a platform where ideas can be shared and nurtured. Their collective contributions have been a constant source of inspiration.

Credit Authorship Contribution Statement

This chapter represents the sole work and contribution of the author. The author conceptualized the research, conducted the literature review, designed the methodology, collected and analyzed the data, interpreted the results, and wrote the manuscript. Any significant contributions from others have been duly acknowledged and appropriately referenced. I take responsibility for the content and integrity of the work as a whole.

Conflict of Interest Statement

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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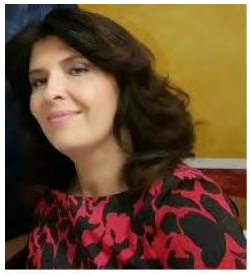
PhD Laura Nicola-Gavrilă is a distinguished professor and researcher in the field of Information Technology and Business Informatics. With a passion for fostering knowledge and innovation, she holds the esteemed position of PhD Professor at Spiru Haret University, Romania. PhD Nicola-Gavrilă's wide expertise encompasses a diverse range of subjects, including Elements of Information Technology, Databases, Business Informatics, Decision System Support, and E-Business. Her commitment to education is paralleled by her commitment to research, as demonstrated by her 2005 PhD diploma in Economic Cybernetics from the University of Craiova. Her rigorous research and dedication have led to significant contributions in understanding the dynamic interplay between technology and business processes.



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Chapter 2.
Information Epistemology in Digital Learning

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Abstract

The research explores the transformative epistemological potentials of digital education fostered with information systems. It takes the current developments of Massive Open Online Courses (MOOCs) as case baseline, for a cross-disciplinary discussion in the phenomenological trends. With existing threats and risks in the digital realm, the chapter focuses on the education-centered vantage point in the discussions. The methodology proposed focuses on the cognitive advantages for learning efficacy with digital facilitation. Elements of institutional management have been considered in intellectual properties and scientific assets.

Digitization as intermediate artefacts in education serves both for in-person and digital classroom settings. Case studies are reported based on an astronomy MOOC, and the case effects have demonstrated the educational outreach efficacy of digital facilitation. The chapter concludes that infrastructural upgrades in the education sector's information system is healthy investment. Education equality through digitization is limited for underdeveloped low-income population, and governmental and humanitarian supports are needed. Scientific paradigm shift in the information and telecommunication age calls for the overdue paradigm shift in education, and tautological paradigm shifts are needed with the changing media. Education innovation involves deep social and governmental topics, and digital education's potentials in fostering critical thinking skills of the learners largely determine the future directions.

Keywords: education equality; information infrastructure; media psychology; security; visual ontology.

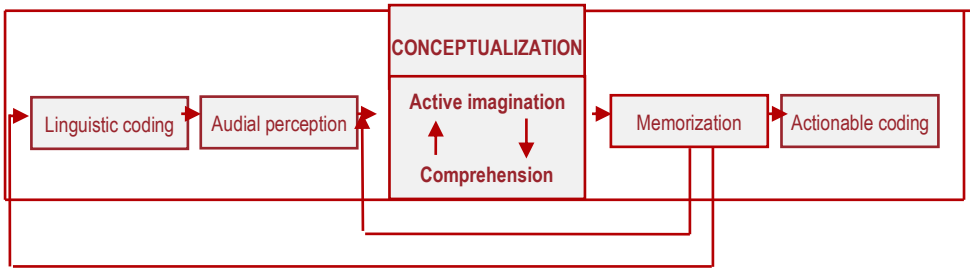
JEL Classification: E02; F01; H44; H83; I25; I28.

The researcher experimented with university-industrial collaborations in scientific visual narratology between 2015 and 2017 in Ouyang Changlin Studio in Communication University of China, and the industrial costs with Virtual Reality (VR), Augmented Reality (AR), and etc. for scientifically accurate representations have been beyond the expectations of the education sector, especially for dimensionally expandable simulations.

Furthermore, the development of Artificial Intelligence (AI) with information backends and automation risks of widening the information asymmetry gaps for public-funded universities in linguistically reliant models (Pachankis, 2022b and Zhang *et al.*, 2022). One of the tactics applied was in an architecture course, shooting onsite and bringing the Aristotelian pedestrian style into course videos.

Figure 2.1. summarizes the traditional learning process in in-person education cognitive styles. It has not been fully realized that even only with an added layer of video in information stimuli, the conceptualization process in learners' cognitive process can be greatly enhanced. The limitation in digital course delivery is mostly contributed by the educators' self-perceived supervisory roles in course management throughout the whole process in traditional in-person education. The involvement of authoritarian processes on the utilities of learning, such as job-seeking, paygrade raise, social mobilization etc. have been the contributing factor in the lack of institutional incentives in the power position for learner-centered innovation. From a competition perspective without utility incentivization, the lack of social incentives in participating in the autonomously self-optionable learning designs and the choice-overload currently available in MOOCs and social media, have been the distinct reality faced with idealism in life-long learning and continued upgrades.

Figure 2.1. Traditional in-person learning process



Semiotic visual coding puts "what is there" or "what will be there" into direct perceptible conceptualization to the learners. Traditional intermediate artefact modelling served the same purpose in tautological designs, and data science adds on an interactive element to it. Narratology on semiotic elements directly link linguistic coding with conceptual objects, instead of using signs as signifiers in traditional classrooms. The mass reproducible scale of narratological changes in information-based learning increases the course delivery efficacy in course durations for individual learner concentration, and decreases the faculties' repetitive efforts in basic science content delivery. Such practices have become common in scientific documentation and journaling, especially in online based publications; the user scenarios are applicable in in-person settings.

Due to the differences in scientific disciplines and relative advantages in content digitization with informatics, current MOOCs' design methodologies vary greatly. With the certification facilitation in MOOC platforms as a social and administrative form of power in education, robustness has been centered on professional and vocational education, or introductory courses (McAuley *et al.*, 2010). The marketing position can be determinant to the learner background distribution. The Chinese education departments followed the deductive logic in the MOOCs trend for on-the-job training or pre-university introductory courses. Albeit the MOOCs' potentials for education resource equalities have been acknowledged by the Chinese education officials, the expanded spheres in the sociology of knowledge in the development have been neglected, or in some circumstances willfully undermined due to ideological controls. The MOOCs' potential is currently limited by socioeconomic positions, and the acknowledgment of the formal degrees on MOOC platforms varies greatly by sectors and regions. However, the significant roles of societal formation by informatics from computational linguistics and computational sociology developed from the 1950s are nonnegligible, with important modern and contemporary roles in scientific practices; informatic literacy and informatic practices in education have lagged behind instead of being premature.

2.3. Education Digitization with Information Infrastructure

Case studies have been conducted with the University of Arizona astronomy MOOCs with professor Chris D. Impey. Albeit the MOOC classes have still followed the traditional linguistic instruction models, aesthetic properties have been subtly implemented with the visual presentations (Impey, 2020). The visual presentations are not only based on scientific datasets, but are also physical properties that cannot be observed with naked

infrastructural requirements still bar the less developed regions and lower income populations from the vision of education equality in digital form.

Current evidences are still unclear if digital education is more demanding of critical thinking skills of the learners, or fosters the learners' critical thinking skills in the information age. Further empirical research into the detail will largely determine the educational strategy formation in digitization. If the former is true, current MOOC strategies are flawed in fostering mass education in terms of education equality, and the potentials of MOOCs are restricted to serving the middle class and élite-targeting nicth market, if this were not the cognitive bias of the researcher. If the latter is true, digital education will lead to a sociological change in human society, including with the epistemological paradigm shifts and cultural changes that have already taken place in digital media. The potentials may lead to more discrete governmental attitudes towards digital education with conservative basis in the power dynamics, with an open future discussion.

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Credit Authorship Contribution Statement

The author takes sole credit for writing the paper, drafting and modelling the theory, as to conceiving the idea of the paper, thus having played the full part in conducting the entire research.

Conflict of Interest Statement

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Yang I. Pachankis, Ph.D. worked in the cinematic & arts and television in mainland China for more than 10 years, and conducted independent research in nonproliferation, arms control, disarmament with human rights focus. He was acknowledged with Masters & Ph.D. in global governance, cosmology, post facto to the empirical research proving black hole and white hole thermonuclear binding.

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Chapter 3.
Online Learning and Digital Education of the Future. The Role of Digital Learning in Education

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Abstract

This chapter discusses the importance of digital learning, digitalization of the education system, and its implications on the society. Digital tools and technologies have now started to shape how learning should take place, and what role it plays in education. Digitalization of the education system is concerned with learning facilitated by technology and the Internet, and how it would affect the future of education.

Digitalization of education has taken the front seat in most countries around the world where teaching and learning process has been greatly transformed. It has made learning easier with seamless access to course materials, books and educational resources now being made freely available for all through the internet. It has enabled remote learning and online classes have become the norm in most educational institutions. This chapter discusses all these issues and contributes to further understanding of how digital technologies promote learning and education in society.

Keywords: digitalization of learning; digital education; e-learning; m-learning; online learning.

JEL Classification: O11.

3.1. Educational Systems Literature Review

All forms of educational systems - including the higher education system are undergoing extraordinary changes due to rapid digitalization of education, teaching and learning process (Alenezi, 2023). Online availability of course materials, study tools, and the learning process have witnessed digital transformation that has created tremendous progress in the educational system.

The use and adoption of artificial intelligence (AI) based systems (Open AI) is one of the best examples where one could gauge and perceive the tremendous impact which it has on the education system that advocates ethical and fair use of advanced technologies for learning (Mhlanga, 2023). In fact, AI-based tools alike ChatGPT and others could be harnessed for lifelong learning, and they could be used as digital aids to learning to boost student performance, productivity, knowledge acquisition, etc. Besides, some researchers have discussed on the aspect of the possibility of creative use of AI-based tools to boost learning that have generated significant interest among students and teachers (French et al., 2023).

The use of electronic technologies for learning is redefining the entire concept of education (Uden, Wangsha, Damiani, 2007; Anderson, 2023) that has seen rapid digitalization of the means and methods by which instructions are being delivered. The concept of e-learning and digital education is also connected to the idea of green-learning and its sustainability. This has become possible all due to availability of the means and materials that could be accessed and downloaded electronically as digital media files; i.e., pdf documents and various other formats. New mode of scholarly communication has evolved as well which has given rise to electronic journals (e-journal). The use of e-journals and electronic editions of printed journals and magazines make it possible for students and teachers to freely access and use them for the purpose of reading, study, and research. This form of content creation using electronic formats greatly contributes to the growth of e-learning (Singh, 2017)) and facilitates digitalization of education. Digital tools have been designed and introduced for remote (online) teaching and instruction delivery which make use of technology for online learning and for the promotion of Open Online Courses (see, for instance, MIT Courseware) that leads to digitalization of the entire educational system (Bujang et al., 2020; Knox, 2013).

traditional mode of learning. Access to and cross reference to accessory materials for further reading help students to broaden their learning horizon. It also enhances student accountability.

3.3. The Digital Driver of Economic Growth and Social Development

It is to be universally acknowledged that education is the default engine of humanity's progress, economic growth, and social development. Through education we learn how to turn potentialities into productive capital. Education empowers us to turn our productive capabilities into capital resources. On this frontier, the synergy between digital technology and education, or digitalization of education unlocks a future with endless possibilities (Means, 2018).

Digitalization is a means of transforming learning into a collaborative process that can be shared equality among all. The learning machines of the future, powered by artificial intelligent engines, are smarter, faster, and more effective means of propagation of knowledge across the society. It is the driver of growth and producer of new human capabilities that have inventiveness, creativity, and are sustainable. One of the advantages which is observable to all is the speed and efficiency that digital technologies have brought in teaching and research.

Although some scholars question this transformation where they see the value of education being constrained, confined, and subordinated under the structure of technology-driven capitalism (Means, 2018), it needs to be understood that the advantages of digitalization of education seem to far outweigh its apparent disadvantages, if there be any such. Since human capabilities today are valued in terms of economic growth and industrial productivity, it needs be seen that the real benefits beyond catering to the interests of businesses and corporates be equitably accrued by the common people in the society.

3.4. The Future of Education Digitalized

It would be highly impertinent to discuss the future of education without considering the theories of Piaget (1973) put forth as such, and that still applies today and will have implications for the future of education. Piaget always stressed on the need for greater educational equality for girls and boys. He also stressed for a much-needed social upgrading of the teaching profession to handle the rise in the number of school and university students. This is relevant today in most emerging and developing nations where

public education plays a very significant role in the development of their national economies. Technology in this respect not only could address the real shortage of quality teachers but bring in reform in public education system in these countries. Now, it remains to be seen how far such an ambience created by the digitalization of the learning and education systems is able to inspire the students towards learning; i.e., if such an environment is intellectually stimulating, or is able to arouse student curiosity.

Model classrooms equipped with digital tools, computers and the internet, and large LED TV screens accompanying wall mounted whiteboards could arouse the interest and curiosity of the students and provide the teachers with special aids for teaching more efficiently. Perhaps, Piaget had thought of such a mechanized "teaching machine" that he envisioned in his book titled, "To Understand is to Invent". Quoting Piaget (1973):

> "The role assigned to conditioning, particularly under the influence of Skinner, has led to the ideal of programmed instruction through progressive associations mechanically arranged ("teaching machines"), and the enthusiasm for this approach in some circles is well known, although it is moderated by the cost of the apparatus required."

This excerpt from his work readily indicated a predisposition to the introduction and use of technological aids for conducting classes. And, why not? Keeping up with the rapid progress in every domain of industrial and professional activities, whether in science, communication technologies, broadcasting, transportation and logistics, or in engineering, medicine, fine arts, graphical art, and even publishing industries, education too, must be brought under such a paradigm of reformation that is to be aided by technology and digitalization. It points to a better tomorrow where technology would support learning and to prepare the students of the future, it is essential to upgrade and update educational sectors as well so that they could readily absorb the innovations applicable to this sector.

3.4.1. Tomorrow Belongs to Those Who Prepare for it Today

Education prepares students for the future which can be highly uncertain and unpredictable. It is education which prepares students of today for a bright future of tomorrow. And, to be more effective in delivering education, schools must adopt smart means of imparting instructions to their students. By adopting digital technology and its various accessory tools of communication, it will revolutionize how students will learn tomorrow to become more efficient and competitive citizens of the future.

Technology is changing fast: all due to rapid innovations in technology itself. Technology is also changing how students are learning and teachers are teaching (Sadiku,

have been undertaken or are still being developed on a grand scale. Examples include DIKSHA, VidyaDaan, E-Textbooks, Shodhganga, PRAGYATA, Shiksha Vani, among other initiatives being undertaken by the Government of India in its mission to reform the education sector to educate India.

3.5. Benefits of Digital Education and Digitalization of Education

This chapter concludes with a note: digital education and digitalization of education has several benefits that could be accrued by the students. First, it allows equitable access to learning materials. It is mostly free to access and download, given that, various governmental e-portals have been developed to facilitate equitable and free sharing of educational content. It also facilitates seamless access to and use of online educational materials. Students can download and store books and notes in digital formats, share them instantaneously with other students. Similarly, teachers now have the advantage of sharing instructional materials directly with the students' using emails and dedicated web portals allied to their course curriculum.

The benefits of digital education and digitalization of the education system could be enumerated as follows:

- Unrestricted availability and access to learning materials in digital formats to everyone;
- Access to library holdings in digital formats like books, periodicals, magazines, archival materials, etc.;
- Learning in a digital environment coupled with online mode of instruction delivery will enhance the educational achievements of the masses;
- Digitization allows conversion of printed documents that are rarely accessible to be made available to the students and teachers alike;
- Libraries are constrained with limited resources. Hence digitization will reduce such constraint since more and more documents could be converted and uploaded on the servers for continued and seamless access. This is a great advantage for the libraries;
- Digitization enables every school and institute of higher education to be equipped with online infrastructure for e-learning and e-access to learning materials;
- A well-equipped and state-of-the-art digital library system is the primary instrument of learning and education that supports efficient conduction of both formal and informal education;

- Digitization promotes creativity and innovation among the learners as they create a socially-enabled digital environment that stimulate further curiosity which boosts learning;
- Digitization of education creates new values for the society where technology meets talent and ability and forms an efficient and productive synergy for the benefit of the students;
- The classrooms of tomorrow will be well connected, far advanced and equipped with digital gadgets, and the internet-of-things for effective learning as delivery of education through multimedia portals has the capability to reach every remote corner of the world;
- Digitization of the learning and education systems will meet the growing information needs of the current and future students and learners;
- Digitalization will also support and improve traditional learning and bring about innovations in it for the betterment of the society;
- Digitalization of education will improve learning and stimulate students' aptitude.

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The work has been jointly collaborated and completed. The corresponding author, Sidharta Chatterjee has conceived the idea and contributed to writing whereas Mousumi Samanta has drafted the book chapter and contributed to the content of the book chapter, and therefore, take joint credit and ownership of the entire work.

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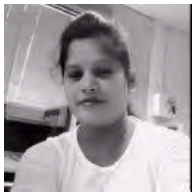
Sidharta Chatterjee is a researcher and an aspiring writer who has years of experience in the fields of Knowledge Management (KM), Behavioral Sciences, and Cognitive Economics, and he serves as a reviewer of several journals of international repute. He is a visiting researcher at the School of Economics, Andhra University. Being the author of several published articles on Knowledge Management (KM) across several international and national journals, he is widely cited for his works related to KM. He is also a motivational speaker and a writer who writes extensively on the core issues of human productivity, knowledge management, and self-improvement.



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Chapter 4.
Connectedness, Collaboration, and Co-creation

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Abstract

As the world we live in changes to embrace tech futures, how and what we teach in our education system will also be reshaped to keep up to date with the growing demands of the 21st century, hence the need for straightforward approaches to future Learning in the context of business and management. Our contributions to the call for book chapters in 'Digital Future in Education: Paradoxes, Hopes and Realities' will be based on the following three-sub-chapters, *i.e.*, 1) Networking and team working, 2) Anywhere, anytime, learning, and 3) Customization for a learner-first approach.

Our findings show that educators need to facilitate these experiences in context, and our classrooms need to reflect this model of learning. We also find out that the current and future environment for learning and teaching using the said methodology is too volatile to sustain this educational structure. Students will need to learn what they need and when they need it. Conversely, teachers will become facilitators of Learning and teaching, and students will have more control of their learning journey.

Keywords: connectedness; collaboration; co-creation; information recall; transmissive; digital future; learning and teaching.

JEL Classification: A19; A29; A39; B19; B29.

There are numerous approaches to the context of future learning in business and management. Some approaches, such as producing information modules that test information recall, are no longer recommended. In some cases, aware of the limited outcomes using this approach, attempts have been made to encourage reflection or analysis, but then the limitation of the approach leaves the learner with little or no formative feedback and reductive forms of assessment. The other approach includes online sourcing, clicks and scrolling modules, as they teach all the wrong things, even if the subject matter content is spot on. They are purely transmissive, leaving the learner to consume information passively. They substitute multimedia bells and whistles for substance. Their only actual usefulness, in the past, was to introduce people in the sector to "e-learning" as a digital version of transmissive pieces of training in which the slide deck is the pedagogy.

The remaining approaches, fortunately, are grounded in more constructive pedagogies. They have been shown to scaffold, support and promote realistic outcomes that matter for developing competencies around analysis, teamwork, and leadership. Once we realize how we teach is at least as important as what we teach, these two distinct approaches open new possibilities for Learning, especially after the Covid-19 lockdown disruptions. They are the topic of many of our proposed chapters, which review the evidence, case studies, and practical aspects of each built on the following three sub-chapters. The remaining sections will be as follows; the literature review is discussed in sub-chapter one, the methods and theory in next sub-chapter, and next sub-chapter provides a detailed discussion of the results; last sub- chapter concludes.

4.1. Today's Learning and Education

The classrooms for today's learning and education have been designed and built to enable digital and remote learning for education and training. Teachers can conduct interactive, face-to-face classes that actively engage remote students. Teachers are not simply connecting face-to-face to lecture passive students. The platform provides tools that allow teachers to introduce innovation in education. This article will delve into innovation in education, provide some examples, and explain its importance. We shall cover innovative teaching strategies in addition to innovation in education. This emphasis on innovation in education is due to skill gaps. Our objective as educators is to provide knowledge to students. By receiving an education, students can pursue higher levels of

Lave and Wenger (1991), on the situated learning and communities of practice, suggested that situated learning occurs within a specific social and cultural environment. Situated learning was initially based on the Learning of the apprentice weavers' model within workshops (Lave and Wenger, 1991). Situated learning is most associated with learning within a community of practice within an authentic context. Novice learners begin as "legitimate peripheral participation" and progress to full membership of and participation in the community.

The learning pedagogies*, i.e.*, "a situated, multifaceted, and complex process, involving multiple relationships and, crucially, driven by specific and often conflicting purposes, power relations and interests. (Wenger, 1998) suggests that it allows us to ask, 'What should they/we become?' and 'What should they know?' and 'How can we make sure they know it?'

According to Brookfield and Holst (2011), as learning is always imbued with a political purpose, it strives to enact forms of knowledge production and distribution which are cooperative, collective, and fully democratic. What makes teaching radical is the deliberate attempt to help people critique capitalist ideology, envision a genuinely democratic future, and learn democratic socialist practices.

The fascinating thing about theories of Learning is that many of them exist. This enables us to select from those that seem plausible to the needs of our students. Learning is an inherently complex process experienced by a wide range of individuals; we should not expect one idea or theory to account for all we understand by the term learning (Brookfield and Holst, 2011).

Therefore, while not an entirely new approach, student learning spaces will supersede the typical classroom that we know today. The student learning spaces will see students become partners or co-creators of their Learning. Collaborative, communicative, and team-oriented experiences for all students often transpire beyond the bounds of the classroom. We must facilitate these experiences in context, and our classrooms must reflect this. Students bring their own experiences, identities, and values to Learning, so it is necessary to consider the whole person.

4.2.2. Anywhere, Anytime, Learning

When considering educational technology, people often consider learning management systems (LMSs) as the primary focus. LMSs are typically a significant part of a school's technology, but unless you are responsible for implementing a new LMS, you likely will not be introducing one in your classroom. Instead, let us explore creative educational technology options you could bring into the classroom:

- Effective feedback is crucial for both students and teachers. It enables teachers to assess students' understanding in real-time and obtain a quick class overview. Feedback assessment tools such as polling, surveys, forms, and knowledge checks are easy to incorporate into the classroom. Even the traditional method of raising hands and counting responses is a form of feedback assessment. These tools make learning more engaging for students by allowing them to leverage technology. Additionally, they save teachers time by gathering data and storing responses for later review.
- Virtual classrooms and video conferencing have become increasingly popular in recent years. While many teachers and students have had to adapt to this new way of learning, virtual academies and schools have been utilizing virtual classroom platforms for years. These platforms are designed specifically for learning, with tools allowing virtual collaboration and class instruction. Students and teachers must become comfortable with video communication to fully utilize these platforms.
- Our students are skilled in creating videos as they are digital natives and frequently use platforms such as TikTok, YouTube, Instagram, or Snap. To make the most of their talent, you can assign projects that involve creating a video around a specific topic. This will allow them to exercise their creativity and improve their communication skills as they collaborate with other students.
- The virtual classroom is an example of educational innovation; with the platform's tools, teachers can conduct interactive and engaging face-to-face classes, even with remote students. This goes beyond traditional lecturing and allows for innovation in education.
- Teachers can use a live polling tool to get real-time feedback from students. They can ask students to raise their hands or use a hand raise button on the video, but using a polling tool is even better. This tool has pre-set options; teachers can

providing knowledge, these technologies act as co-creators of information, mentors, and assessors. Students find it easier to use software and tools to personalize their Learning through presentations and projects. Moreover, an iPad is lighter than a stack of notebooks, and surfing an E-book is more comfortable than reading a heavy book. These technological improvements have increased students' interest in research. The classroom and how teaching is delivered must change. Customized Learning allows students to develop self-advocacy skills by expressing their interests and becoming equal partners in their learning experience. However, there are some risks associated with this approach. Teachers will become facilitators of learning, and students will have more control of their learning journey[1].

4.3.1. Research Methodology

We have based our analytical method on recent studies in educational sciences and practice theory, such as those by (Bagga-Gupta, 2019; Bonderup et al., 2020, Cerratto-Pargman and Jahnke, 2019a; Hager and Beckett, 2019). Our approach focuses on the contemporary conceptualizations of 'practice(s)' in different school subjects, practice theory, and emerging practices that utilize digital tools and resources. In this framework, 'practices' are viewed as a means of:

- situating and transferring knowledge and skills in (digital) contexts (Bonderup et al., 2020).
- engaging in formal and informal Learning across analogue-digital sites (Bagga-Gupta, 2019).
- comprehending how humans continuously become through their actions in socio-material contexts (Cerratto-Pargman and Jahnke, 2019, Kemmis, 2019).

According to Hager and Becekett's (2019) explanation, one's understanding of specific practices in a particular context is not solely based on individual performance. Other people, objects, and neighbouring practices also shape it. This concept is inspired by Kemmis (2019) theoretical framework of practice architecture, which holds together various practices and sub-practices in the construction of sayings, doings, and relating. This framework considers the intertwined dynamics of cultural-discursive, material-economic, and social-political dimensions. We use this framework to analyse the relationships between emerging practices within an institutional structure, specifically the

[1] https://www.understood.org/en/articles/personalized-learning-what-you-need-to-know

school we studied at. Our study collected detailed narratives from teachers about the weeks before and after their school's shutdown due to the pandemic. These narratives shed light on the practical aspects of digital contexts in Education and reveal how an upper-secondary school dealt with the immediate crisis. Using a narrative methodology, we understood the experiential dimension of practice and how social practices are crucial for learning and growth (Lindberg et. al., 2020).

Using digital technology has brought about new practices in a specific school context. The narrative method helps us understand the experiences and cultures of those involved. Through the narratives teachers provide, we learn about their focus and actions during the transitional phase. Their language use reflects their perceptions of what was happening, while their actions show what they considered important in changing their practices. The teachers' relationships also affected how they viewed the connections between different groups and practices in their institution and beyond. Our analysis primarily focused on the teachers' actions, specifically their narratives about how they adapted to remote teaching during a limited time and the factors that helped or hindered the transition.

The teachers' experiences revealed how practices were organized, self-regulated, or left unmanaged, creating a context in which certainty and uncertainty intertwined. According to (Wenger-Trayner and Wenger-Treyner, 2020), "uncertainty" is a vital element of Learning, even though it is sometimes associated with incompetence. They argue that engaging with uncertainty means that everyone is on the edge of knowledge, and no one can claim to understand or own the destination fully. Uncertainty is distributed, but not necessarily equally or fairly. (Wenger-Trayner and Wenger-Treyner, 2020, 22). During the pandemic, new practices emerged that allowed teachers to adapt to uncertain situations. However, they could not reflect on how these changes aligned with their teaching values due to limited time. To address this, a retrospective view allowed teachers to process their steps in transitioning to new practices. This helped them construct a new working order for different situations.

During a pivotal transition, the teachers could engage in reflective Learning by sharing their experiences of how they handled things and what actions they took. This allowed us to recognize the teachers as competent individuals capable of reflecting on their life experiences and interpreting them individually and collectively (Polkinghorne, 1995). Additionally, they could consider the meaning-making process for themselves and their colleagues.

To understand the Paradoxes, Hopes and Realities of the "Digital Future in Education," our approach focuses on South Sudan and Uganda with three study sites each, capturing many issues, contexts, and dimensions in line with the call. We use mixed methods applying qualitative and quantitative techniques. The study's success is partly premised on understanding the sociocultural, policy-economic, and environmental dimensions in the target areas that underpin health, livelihood, resilience, and adoption of a digital future in education. Societies in these countries have complex and interdependent components that have evolved over many years in response to educational challenges and economic and sociocultural factors, conflicts, and civil wars. Our qualitative engagements of various community segments based on gender and expertise in the study sites combined with surveys widely focused on regional and national school officials, local community leaders, and local/regional health educators envisaged providing a base to redesign systems for digital future in education.

4.3.2. Study Design

Three priority sites were selected in each country to address a spectrum of digital futures in education. The sites in Uganda are:

- Kiryandongo District represents three attractive tenets for digital learning and the future of education study (a) it has a refugee settlement camp with a vulnerable population. The district has about 57,000 refugees (10,500 households) and approximately 300,000 host community members. Most refugees in the district are from South Sudan, although the camp hosts other refugees from the Democratic Republic of Congo (DRC), Rwanda, Sudan, Burundi, and Kenya, and some internally displaced Ugandans moved from landslide-affected areas.
- Kasese District is in Southwestern Uganda, bordering DRC, densely populated, and one of the most prone districts to disasters and an influx of refugees from the ongoing war in the DRC. It has a population of about 45,000. It perpetually

- Two designs, including Focused Group Discussions (FGDs) and individual in-depth interviews, were conducted as part of the qualitative approach, with two FGDs conducted at each site. We employ qualitative methods that involve engaging stakeholders, beneficiaries, women and youth groups in Learning and Education and conducting key informal interviews with traditional and opinion leaders. The objective is to study the existing Education Systems, their delivery, and Implementation Plan. The participants in these two qualitative approaches include men and women recognized as community opinion leaders. Both the quantitative and qualitative approaches try to assess the current education systems to identify the existing barriers undercutting the sustainability of the existing and future learning platforms by identifying issues affecting men, women, girls, boys, and people living with disabilities.
- The third approach includes desktop reviews, which include understanding the role of the digital future in education. The regional policies, strategies and reports were also explored to understand the country-based approaches to digital futures in education and learning in general concerning the country's regional and local educational practices to identify best practices. The two above approaches reviews helped us better conceptualize the intersectionality of national and international responses to address changing patterns in the digital future of education.

4.4. Digital Future of Education. Some Discussions and Conclusions

Thanks to digital technologies, students can virtually explore the world and visit distant places from the comfort of their computers. Adding a guest speaker to a lesson plan can also be a great way to make it more interesting. Video conferencing systems make it easy to bring experts into our classroom, no matter their location. We can even organize a video conference with students from another school. Digital tools like online polls engage all students, including those who may be too shy to speak up in class. Plus, online engagement tools allow us to check in with students regularly and get their feedback on course materials and assignments.

One way to identify areas where students might need more help is by paying attention to their insights. Using student response systems, students can participate in class and receive rewards for their contributions, fostering digital citizenship. Schools play a significant role in our communities, and their closure can hurt the mental health of families and children. However, digital technologies can help fill this gap. Online learning allows students to learn independently, revisit content as needed, and explore course material independently.

Active learning can be enhanced with the help of educational technology through strategies such as quizzes. Using technology like social media and interactive whiteboards, students can collaborate and share ideas seamlessly in class or remotely. Technology also allows for spontaneous discussions and quick access to answers to any questions or challenges related to a subject. Traditional collaboration's physical and social limitations are removed, enabling students to work together anytime and anywhere.

Due to self-paced learning and individual differences, students will inevitably finish their work at different times. Educational films, course-based games, or interactive learning tools can be provided to keep students engaged. This allows faster-paced students to progress without waiting for their peers, while slower-paced students can work at their own pace without feeling pressured. This Education 4.0 initiative will be implemented in upcoming schools to enhance education and equip the next generation.

How and what we teach in our education system needs reshaping to keep up to date with the growing demands of the 21st century, hence the need for precise approaches to future Learning, especially in business and management. The role of the teacher must adapt and grow. Educators' responsibility is to empower students to take risks, be innovative, and seize any opportunity thrown their way. Future teachers will be data collectors, analysts, planners, collaborators, curriculum experts, synthesizers, problem-solvers, and researchers.

The proposed chapter examined the relevance of digital transformation in the future-oriented methods for remote education, answering many questions such as production of information, transmissivity – online scrolling/clicks, constructive pedagogies, scenario simulation: educators of the future approach, knowledge community: Customization for a learner – first approach, Connectedness, collaboration, and co-creation.

Connectedness, collaboration, and co-creation: while not an entirely new approach, student learning spaces will supersede the typical classroom that we know today. The student learning spaces will see students become partners or co-creators of their learning. Collaborative, communicative, and team-oriented experiences for students frequently arise beyond the confines of the classroom. We must facilitate these experiences in context, and our classrooms must reflect this.

Anywhere, anytime, learning: As we ride the wave of the digital era, connecting with a global reach is becoming more accessible. A world of information is at your fingertips with the click of a button or a simple voice command, and as technology continues to advance, students need to grow their Learning with it. Technology is no longer a motivating factor for learning – it is a must. It needs to be incorporated into the future of education to ensure students are equipped with the skills to cope in a world dependent on technology. Traditionally, we have followed a linear formulation of society.

Customization for a learner-first approach: The classroom and delivery of teaching must change. For example, the old 'one model of teaching and learning fits all' is outdated and has no place on the agenda for future education. Teachers will become facilitators of learning, and students will have more control of their learning journey.

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The corresponding author, Dr Ayine Nigo, conceived the idea and contributed to writing the original draft. Mr Vincent Gibogwe has contributed to the chapter's content, in addition to supervision, review and editing, taking joint credit and ownership of the entire work.

Conflict of Interest Statement

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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Chapter 5.

Using Game-Based Learning to Improve Learning Outcomes in K-12 Mathematics Education

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Abstract

In this chapter are describe elements of Game-Based Learning (GBL) that can be used to support mathematics teaching using games. After creating a game that incorporates the elements described, the game was play tested against a small number of people who answered a questionnaire focusing on user experience, learning motivation and game design. The results are attached separately as well as the analysis. I believe that with further development this game-based approach can be a powerful tool to gamify common learning tools and increase learning motivation and appreciation.

Keywords: game-based learning; games; education; learning; mathematics; gamification.

JEL Classification: C69; C88; C92.

Game-based learning (GBL) is the use of video games to support teaching and learning (Perrotta et al., 2013). Now more than ever, mathematical skills play a growing role in our lives, as the foundation of much of computer science and data science and indeed a lot of the modern technology that drives much of our lifestyle. Despite this, a large number of students look at mathematics in a negative light. Games are a ubiquitous part of human culture, and there is no doubt that they have a great potential for educational purposes. In recent years, video games have grown to over $100 billion a year industry (Vilches, 2011) and have become the preferred entertainment method for a lot of individuals, due to their accessibility through multiple platforms and catering to all tastes and experience.

Games also have the ability to motivate the players intrinsically (Kebritchi and Hirumi, 2010), and it is no surprise that educators are trying to use them to improve instruction.

The video game industry has been growing at an accelerated pace for many years and for some has become an important part of modern culture. One of the advantages of GBL is in its intrinsic entertainment value, as the main function of a game is to entertain and teach (Annetta, et al., 2009; Hays, 2005; Lee and Peng, 2006; Lieberman, 2006; Moreno and Mayer, 2007; Rieber, 2005; Tobias and Fletcher, 2007, 2008.) It is not surprising that the application of video games to the education field has been explored. In fact, some believe that there are inherent benefits to using video-games for learning (Gee, 2007). There are several ways to borrow successful techniques from game-design and incorporate them into the learning context. Focusing on the game-design techniques that are most suitable for learning will result in a measurable increase in short term mathematical performance, as defined by accuracy in a time-based assessment, and in increases in intrinsic motivation, perhaps an even more valuable metric (Mayer, 2014). This is because motivated learners are more likely to make the effort needed to understand what is being taught as well as how it can be applied into their own lives (Omrod, 2014.)

There is a growing body of work in the area of game-based learning, focusing on different aspects such as meta-cognitive strategies (Kim et al., 2009,) the effects on attitudes towards mathematics (Çankaya and Karamete, 2009) or the psychology of learning mathematics (Sedighian et al., 1996). There was also a large body of work focusing on motivation and achievement (Mansureh Kebritchi et al., 2010) or motivation in areas different than mathematics (Tüzün et al., 2009.) There has also been a good amount of research on some of the feedback mechanisms I am interested in, such as achievements (Tsai et al., 2016,) badges (Alaswad, 2015) and contextualized learning (Hwang et al., 2015.)

Finally, there is also analysis on GBL focused on mathematics education (Byun and Joung, 2018) as well a number of literature reviews (Hussein et al., 2021) and (Pan et al., 2022.) Most studies focus on why a certain aspect of game-based learning works or doesn't work in their study group, but few if any consolidate the most effective techniques, particularly in one domain of GBL and education.

It stands as no surprise that games can be used to teach and are being used for education-al purposes. Every game at a minimum teaches you how to play itself, so there is an implicit understanding of learning whenever we play a game for the first time. It is the

Both approaches have their own strengths and weaknesses and should be assessed on an individual basis to determine the type of experience best suited to the needs of the individual learner.

Serious games are games in which education is the main goal and not entertainment (Ahmed and Sutton, 2017). There are serious games that simulate real life situations or teach real-world skills. Examples include medical training simulations that teach students how to perform medical procedures safely, firefighter training simulators that teach them how to operate in dangerous situations, and air traffic controller training simulators that pro-vide training in airport procedures.

Finally, simulations attempt to imitate reality, recreating it for the user to experience (Cai, Goei and Trooster, 2016). They are in some ways an enhancement of serious games and in another a focus of their scope. They can be entertaining but recreating the original experience is their focus. Typically, they are used for training and for enabling experiences that might be hard inaccessible at any given time. (Ahmed and Sutton, 2017.)

5.1.2. Principles, Characteristics and Mechanisms of Games based Learning

There are several game design elements that are well suited for educational games, such as player collaboration, player-generated content, feedback and replicability. Being able to tailor the difficulty level to the player is a hallmark of modern game design and it is exactly between too much challenge and too little challenge that the learner can achieve balance, when it is equal to his skills. This is what is called a state of flow (Csikszent, 1990) and it is described as a state of constant engagement and optimal experience. Clearly achieving this state would be favorable to the player and so it is important that we start with clarity in design and goals, and that feedback is provided to the player so that they can improve and overcome the particular challenge (Bateman and Boon, 2006.)

There are 5 principles to GBL, which are: (1) intrinsic motivation, (2) learning through fun, (3) authenticity, (4) independent play and (5) learning by doing (Perrotta et al., 2013). Intrinsic motivation is one area where most of the research agrees has the potential to reflect positive gains. Simply speaking the game motivates the player through its systems and the player in turn is driven to continue playing (and learning) perhaps without explicit learning objectives. Furthermore, the gains in motivation can be carried outside of games, improving the players perspective not just on educational games but on learning in general.

5.2. Creating a Digital Game-Based Learning Game focused on Arithmetic Training

The idea that children learn by playing is not a controversial one. Indeed, Children should be active in their learning experience (Bird and Edwards, 2014), and by constructing a game where they can interact and receive feedback, the hope is that the learning cycle is sublimated by the form of game play, and that learning will occur without a conscious effort.

Learning through play does not require the player to have a specific goal in mind or to complete a specific task in order to receive feedback. For a player to gain the most from the experience they must develop their intuition and become knowledgeable about the game world in which they interact within (DeSouza and Jagmohan, 2005). Educational games that use simulation or problem solving require a high level of interaction between the user and the computer system. These interactions must be seamless and intuitive to ensure an enjoyable and engaging user experience. This is why it is important for the designer of the game to understand the specific needs of the learner and create an environment where they can develop the necessary skills and knowledge to become successful (DeSouza and Jagmohan, 2005). Another important aspect of a game-based learning environment is the extent to which users are allowed to explore the environment and interact with content at their own pace. This will allow the learners to progress through the curriculum at their own rate and focus on areas of difficulty so that they have a better understanding of any concepts that they find difficult (Lee and Tsang, 2009). This also means that there will be no pressure for the player to complete a level of the game before they can move on to the next one.

Previous research has shown that people generally perform better in a game if they have a strong sense of control in their experience (Blumenfeld et al., 2003.) This means that they have the opportunity to set their own goals and make decisions about how to accomplish them. For example, if the player has access to a variety of different power-ups then they can choose the one that they feel is most effective and use it to pursue their goals throughout the game. The game will also provide them with feedback that will help them to adapt and adjust their strategy to achieve their goals. By allowing players to determine their own goals in this way the game promotes learning and engagement by providing them with an opportunity to achieve a sense of mastery over their situation (Blumenfeld et al., 2003). This allows them to develop a deeper understanding of the

The game captures the performance of each student and stores it in a local file. The con-tents are stored in a cloud repository anonymized, in order to better aggregate the data. The questionnaire was administered separately. Motivational measurement was done by measuring four major attributes, in line with Keller's ARCS (Attention, Relevance, Confidence and Satisfaction) model.

Attention refers to if the student's interest levels increased or not during the activity. Relevance refers to whether the activity is perceived to be important to the student. Confidence refers to whether the student thinks they will be successful. Satisfaction refers to the payoff that the student expects to obtain from the activity.

5.3.1. Experiments. Playtest Script

Background

"You are stranded in a space base, and the only way to get home is to successfully repair the robots in the base so they can help you repair your spaceship and you can get home. In the first level, broken robots will spawn and attack if you get too close! To repair them, you will have to lock on to a robot, answer the question on their screen and pick the correct answer! This will disable the robot. Try to disable as many robots before the time runs out."

The first screen describes how to play. Press F1 to disable or enable the help screen. Try to disable as many robots before the time runs out and don't let the enemies take all your health away. You have 4 levels to play where you must disable all the robots to continue. Between levels you will be teleported into the base where you can buy power-ups for the next level. Do not let the enemies touch you or surround you, if they do, they will harm you and if you lose all your health, you will be disabled. Levels are roughly 2 minutes long so the entire experience should take less than 10 minutes to play. Each level will have different types of arithmetic problems.

Questionnaire

Questionnaire: User Experience. Answer 1-5 depending on how strongly you agree with the sentiment: 1, I strongly disagree, 3, neither agree nor disagree, 5 strongly agree:

1. How well do you understand the controls?
2. Can you lock onto an enemy and solve the equation?
3. Can you disable all the robots before the time runs out?
4. Are you dying to the robots?

5. Did you have a problem with the control scheme?
6. Did you encounter any bugs or problems?

Questionnaire: Learning Motivation. Answer 1-5 depending on how strongly you agree with the sentiment: 1, I strongly disagree, 3, neither agree nor disagree, 5 strongly agree:

1. Do you agree math games are a good way to learn math?
2. Did you have fun while playing the game?
3. Would you play again to improve your score?
4. Were the math puzzles you solved too hard?
5. Was the number of enemies appropriate?

Questionnaire: Design Specific

1. Does navigating the world support the implementation of game feel?
2. Is the difficulty level appropriate?
3. Are the powerups enhancing the game experience?
4. Is the goal of the game clear?

5.3.2. Playtest Results

This document consolidates the results of our play test as well as the justification of those questions and the analysis of the results. The author plays tested with 10 different individuals going over 15 different questions, spanning areas like design, user experience and user motivation.

Justifying Playtesting Questions. Design Questions:

- Does navigating the world support the implementation of game feel?

A lot of the design choices made were around the implementation of the “Game Feel” requirement so I was sensitive to feedback in this area. This question required explaining to the player what constitutes game feel.

- Is the difficulty level appropriate?

There was some tuning of the difficulty prior to playtesting, and the overall time per level was increased and the number of enemies was drastically reduced as a result.

- Are the powerups enhancing the game experience?

I spent a lot of time working on “interesting choices" by allowing the player to collect and buy power-ups throughout the game. Once the player has the power-ups, do they under-

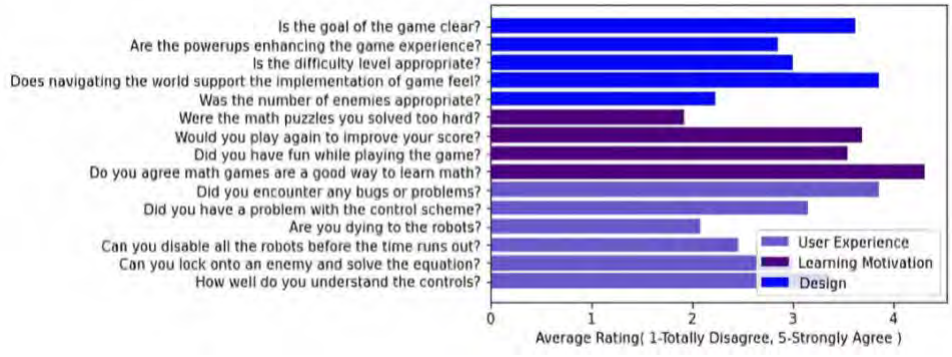
5.3.3. Approach to Testing Design Questions and Playtest Methods

Ran the game for 10 minutes with each player and asked them to complete the survey in the end. They answered all the questions with a 5-point scale. After they answered, I asked clarifying questions to get additional insight. Through these clarifying questions, I discovered that once the controls were understood the difficulty was appropriate and even tended to be a bit easy. In particular, the early levels need to be adjusted to increase the difficulty from the second level on and playtest that in the future.

I asked the users about the power ups and discovered that the over-abundance made them unremarkable. It was also clear from the play test that they needed more of a tutorial with the power-ups to understand how to use them to evade enemies (with the raised platform power-up) or kill enemies easier (with the slow time power-up). The game was moving too quickly for the play testers to learn how to use the power-ups during the game. This will be an area of focus for future work.

The answers to the questions and additional feedback received leads us to believe that the goal of the game is well understood by the players. It helps that the objective of the game is very straightforward and there is no unnecessary complexity. The results from the play test survey were broken down into three distinct graphs. The first graph focuses on the questions split into the three categories I was targeting (user experience, learning motivation, and design). The second graph shows all the responses for each question to highlight which areas need further focus.

Figure 5.1. User perception by category



The highest rating from the questions is in the learning motivation category. The play-testers felt that the puzzles for each level were an appropriate testing difficulty and strongly agreed the questions are an effective way to learn math. It was also clear that

solving the math problems this way was an enjoyable experience. The lowest rating received was in the user experience category. I found that the play-testers rarely died from the robots and it was easy to disable them all before the time ran out.

The strongest responses here showed that the math problems for the play-testers were not too difficult, were a good way to learn math, and that they didn't die from the robots (this prompted us to improve the experience with the robots to have more of them and chase the player more). The goal of the game was shown to be clear to the play-testers (disabling the robots in the time given). I also found that the play-testers enjoyed jumping around the world and on top of things to escape the robots.

Figure 5.2. Frequency of survey responses

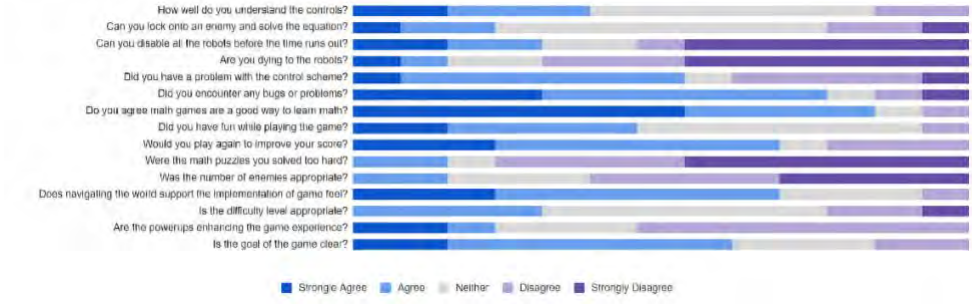
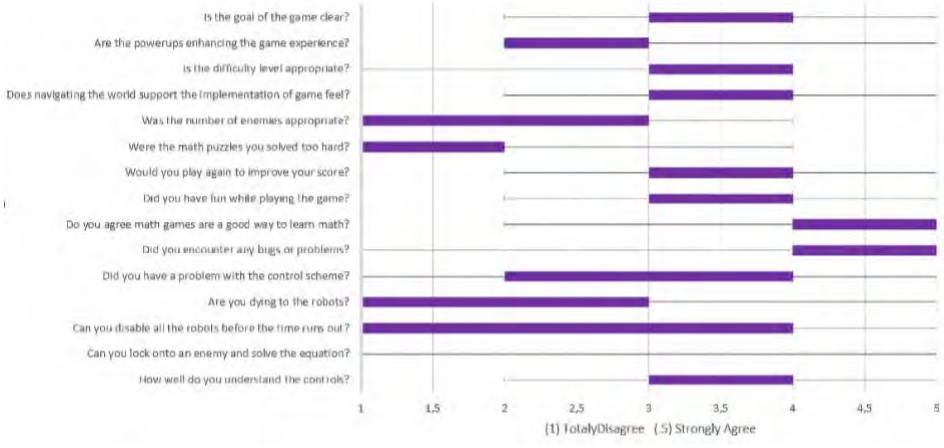


Figure 5.3. General perception of the game



The general perception of the game shows that there are two biggest items to address in the future, the numbers of robots and the number of bugs, which represents the biggest flaws among the play testers. Additionally, the answers varied greatly from one

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Credit Authorship Contribution Statement

The author would like to acknowledge the contribution of the team above in the creation of the Tables and Figured used.

Conflict of Interest Statement

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Chapter 6.

Exploring the Implementation of Online Learning at the Higher Institutions of Ethiopia: The Case of American College of Technology & Harambee University

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Abstract

Growing involvement of the Internet and digital media are shaping the present context of distance education (DE) and reconstructing the ways education is being provided globally. Whereas the generations of DE have counted to 5 phases, online learning has received the third generation in its development (Heydenrych and Prinsloo, 2010), and it is only recently that the approach has been practiced in Ethiopia giving accreditations to five HLIs to run the system to teach MBA courses. For its implementation to be successful, the system of online learning requires its practitioners to have got intensive professional development.

This study believed that the proposed HLIs used the conventional school instructors while implementing the online learning program and doubted that there would be problems (that might arise from the lack of appropriate training, long-lived biases, short of tech skills, etc.) in satisfying the stakeholders taking part in the program. This study was meant to explore the experiences of American College of Technology (ACT) and Harambee University (HU) how they implemented the online learning program for the courses they provided to their MBA students.

The study employed mixed methods design to get responses to the research questions and the ICDE rubric was also applied to triangulate the results generated for validity. The target population comprised of students, instructors, and coordinators of the aforementioned HLIs who were engaged in the online MBA program. In total, 200 senior students, all 18 instructors and 2 coordinators from the two institutions were targeted for

the study. And according to Raosoft sample size calculator, assuming 5% margin of error (95% confidence level), the sample size for students grew to 132 and though questionnaires were sent to all 132 students, only 90 of them returned filling the questionnaires. The responses collected using questionnaires consisting of both closed and open-ended questions were analysed using IBM SPSS version 28 software and the results generated were interpreted accordingly.

The study found out that in two of the HLIs, the syllabuses of the courses were organized as required by HERQA, and the contents were delivered partly only in audio formats. Two of the institutions managed to use MOODLE to develop the LMS whereby students could access courses electronically; however, the study revealed reasonable differences among the institutions regarding the interactions students were supposed to have with their instructors, the institution, and fellow students. Students need periodical feedback to remain in their learning being motivated and complete their course with all satisfaction that put them at par with the conventional schooling.

Keywords: online learning; digital content; learning management system; modular object-oriented dynamic learning environment.

JEL Classification: I23; O33; O36.

Growing involvement of the Internet and digital media are shaping the present context of distance education. Garrison (2000) proposed that the concern with overcoming distance as a geographical reality, a strong focus of earlier distance education models, would be replaced by a greater focus on the teaching and learning process itself; a review of recent literature readily supports this point. But it is not so much the realization of an absence of distance in contemporary discussion of online distance education as the recognition that we are increasingly focused on models of learning and their application to distance education that signal the change of emphasis in this digital age. The approach has moved from models of distance education to models for distance education.

In reviewing recent work on online distance education, this researcher has found a number of authors who provided frameworks for theories of learning and linked them to pedagogical models to create a model of learning design for online learning, most frequently referred to as e-learning. The emphasis on e-learning, rather than on distance education, reflects a change from serving those with difficulty accessing education, to the

use of technologies in learning. The more ubiquitous the web, the less need to focus on the penalties of distance.

Furthermore, the recognition that digital literacy is an important attribute for all school students makes it unsurprising that increasing numbers of institutions are including aspects of technology within classroom settings (Erwin and Mohammed, 2022). Currently, providing opportunities for students without coming on campus is less about providing access to disadvantaged learners than it is about providing flexibility and convenience. Consequently, models of distance education, which examined aspects of where learning was to be encouraged and supported without a teacher's presence, have been replaced by e-learning models of how learning can be best enabled with technologies.

6.1. Background Research of Online Education

Online Education

According to Remtulla (2007, e-learning is a grand solution for the future education. E-learning pioneer (Luskin, 2001) explains that the letter e in the e-learning represents the words: e‘ as exiting, energetic, enthusiastic, emotional, extended, and educational. E-learning is an educational technological tool which embraces self-motivation, communication, efficiency, and technology. With the power of www, learning has become to be easily accessible only on condition you have internet connection and knowledge of handling computer. Education has become accessible online anytime and anywhere. Learners have been not only sharing files, but information has been exchanged across the web worldwide in a single click. Information and communication technologies (ICT), internet-based applications like WWW, e-mail, teleconferencing, Computer Supported Collaborative Learning (CSCL) and learning management systems (LMS) are building their bases in the field of learning. The rapid developments in technology and pedagogies redefined the structure of education and its processes. E-learning has enabled the learners to interact ‘face to face’ all over the world breaking geographical barriers as it is most efficient method of distributing information in a cost-efficient method and can reach large scale virtually at same time (Bernard 2001). Time is no more constrained. Just in Time approach makes e-learning truly global (Spector and Davidson 2000, as cited in Oswal and Narayanappa, 2018).

Table 6.1. Recommendations and principles to guide digitization in education

Recommendations	Principles		
	Put the most marginalized at the center	Free, high quality digital content	Pedagogical, innovative and change oriented
Ensure connectivity and digital learning opportunities for all.	✓	✓	✓
Build and maintain robust, free, public digital learning content and platforms.	✓	✓	✓
Focus on how technology can accelerate learning by enabling evidence-based instructional practice at scale.	✓	✓	✓

Source*:* Mathias et al. (2023, 271)

According to the UN policy brief, Covid-19 pandemic has accelerated the pace of digital transformation. In so doing, it is opening the opportunities for advancing social progress and fostering social inclusion, while simultaneously exacerbating the risk of increased inequalities and exclusion of those who are not digitally connected. And it is in recognizant of this gap that UN 2030 agenda has been designed giving maximum attention to higher education digitization among its twelve issues that are considered to meet the SDGs and it is believed can address the study made by Bos-ton Consulting Group in 2020 which shows that globally only about 30% of companies navigate a digital transformation successfully and universities navigate by far less.

Models for Online Distance Education

A model with wide support from both practitioners and researchers is the community of inquiry framework (Garrison, Anderson, and Archer 2000). Its publication coincided with the growing acceptance of computer conferencing to enable student interaction in groups, while retaining the options for asynchronous participation denied by video- and audio-conferencing, for example. It also built upon earlier work of Anderson and Garrison (1998), which saw dialogue and debate as essential for establishing and supporting learning. The model defines three major components of a virtual learning environment as aspects of a community of inquiry: teaching presence (instructional activities required to facilitate learning), social presence (activities that support discussion and dialogue for learning), and cognitive presence (the learning resulting from the interactions in the community).

Research questions

- Did the online courses comprise of detailed syllabuses?
- How did the HLIs deliver the course content to the online learners?
- What type of interactions did the faculty use with their online students?
- What mechanisms did the HLIs use to create opportunities for the provision of feedback to the Online learners?
- What platform did the HLIs employ to assess students' online learning?

Ethical issues

This study employed self-administered survey questionnaires, and hence anonymity of the respondents could easily be secured as this researcher was completely separated from the respondents and there was no possibility for the researcher to know to whom surveys were distributed and no identifying marks were placed on the returned questionnaires. On same degree, this study guaranteed respondents to be confident of the responses they provided as they were promised their names would not be disclosed in any report, paper, or public forum. Initially, principals of four Higher Learning Private Institutions (HLPIs) gave their consents in signed papers to participate in the study, gradually, however, two of them declined their participation. And it is ethical to keep their anonymity secured.

A descriptive survey design was used to answer the main research question as the major purpose of descriptive research is describing the state of affairs as it exists, it answers the who, what, where, when and the how questions. The study employed mixed methods design to get responses to the research questions and the ICDE rubric was also applied to triangulate the results generated for validity.

Three types of questionnaires consisting of both closed and open-ended questions were used to collect data from the sample students, instructors and coordinators. The closed questions were built on a 5 values Likert scales (named after its deviser, Rensis Likert, 1932) to enable respondents to give systematic and logical responses to the given questions or statements.

This study was supposed to be carried at four of the HLPIs which are running the online learning program for MBA students. However, gradually two of the HLPIs failed to show interest to participate in the study and as a result, only remaining two HLPIs, ACT

and Harambee University conceded their participation and provided the required responses to the questionnaires distributed using the platform Google Forms.

The responses collected from the respondents' using questionnaires were organized based on their types, categorized into themes and then codes were established accordingly. Then the codes were fed to the computer to analyse the responses using IBM SPSS 28 version. Next, Interpretation was made for the results generated from the analyses.

The questions were constructed based on the checklist prepared by the then HERQA now referred as Education and Training Authority (ETA) and were made to have been orientated to the International Council for Distance and Open Education rubric that provides criteria to identify best practices in online course design and delivery.

Respondent students were senior MBA students attending their learning via online program at the aforementioned private higher learning institutions. Respondent instructors were those who conducted the provision of the courses to the MBA students; and the coordinators were those principals managing the online program to the students attending their MBA programs. According to the information obtained from the principals of the institutions, about 100 senior students (from each institution) were actively attending their learning. That is the target population was found to be close to 200.

The study applied Raosoft sample size calculator to determine the sample size believed to be captured randomly and obtained the size 132 assuming 5% margin of error (95% confidence level). Questionnaires were sent to all the 132 senior students (dividing into equal parts, 66 to each institution); however, only 44 students from HU and 45 from ACT, in total 89 students from both HLPIs replied to the questionnaires. Accordingly, the response rate grew to 67.4% as shown in Table 6.2.

Table 6.2. Sources of data, target population, sample sizes and response rates

Respondents	Target population alongside sample sizes & response rates						
	ACT			HU			RR
	TP	SS	AR	TP	SS	AR	
Students	100	80	45	100	80	44	67.4%
Instructors	8	8	5	10	10	5	55.6%
Institutions	1	1	1	1	1	1	100%

Note: TP = Target population, SS = Sample size, AS = Active response, RR= Response rate

6.3. Analysis and Interpretation of Quantitative and Qualitative Data

Analysis and interpretation of quantitative data

Under this section, the responses of respondents to closed-ended questions which are supposed to assess the implementation of the online learning program are analysed using IBM SPSS version 28 software. The questions were referring to the nature of the syllabuses of the courses, the show of the delivery of the course content, the type of interactions students were exposed to encouraging learning, how students were receiving feedbacks for their requests and trials and the way assessments were carried out or managed.

As one of the objectives of the study has been meant to see whether there is a difference in the perceptions of students, instructors, and coordinators of the two institutions about the implementation of the program, the t- test has been found relevant for the analyses of variance. According to Triola, the t-test (Student's t-test) is probably the most used statistical data analysis for hypothesis testing (two groups). The t-test assesses whether the means of two groups are statistically different from each other. t-tests are various in types; however, for this study *independent samples t –test* – is used as it compares the mean scores (on some continuous variable) for two different groups of participants coming from two HLPIs and it is used to analyse the differences of the perceptions of the aforementioned respondents.

The study maintains the following assumptions as required while applying the t-test:

- data are obtained from a normally distributed population;
- data are measured at least at the interval level;
- variances in these populations are roughly equal (homogeneity of variance);
- scores are independent (because they come from different people).

Responses of students

- *In relation to detailed syllabuses of the courses*

The respondent students were required to share their opinions regarding whether they were provided with syllabuses for the courses they attended and the how of the structure of the syllabuses (if any). The responses of the students are displayed in Table 6.3. In all the tables following where quantitative data (distribution of level of agreements of the respondents) are displayed, values of degree of freedom, t-statistics and two-tailed p for the responses are also presented.

As it is shown in Table 6.3, except for the highlighted statements, the results of the independent sample t-test, for which the value of the probability ($p \geq 0.05$), indicate that the students of the two institutions do not differ significantly in their experiences and the differences between the two means is by chance. When we refer to the highlighted statements in pair, for which $p < 0.05$, however, the results of the independent sample t-test differ significantly and the differences between the two means is not by chance as there are clear evidences from the table showing significant differences in the ways course objectives were addressed; in making accessible course outlines online; in making available instructions suggesting what the course is supposed to do to the learner and how to deal with assignments; and regarding the provision of information about a system that was meant to provide support to students.

- *In relation to the delivery of course content*

The same respondent students were also made to answer questions that referred about the organization of the reading materials, how of the delivery of the contents of the courses they attended. Respondents' responses are organized and analysed in Table 6.4. The results of the independent sample t-test, for those statements with $p \geq 0.05$, signify that students of the two institutions do not differ significantly in their understanding of the preparation, organization of the course materials and in the provision of required information that would enable the student to do research projects and web quests. And the differences between the two means is accidental. However, the results of the independent sample t-test differ significantly for the highlighted statements ($p < 0.05$) and the differences between the two means is not accidental. This is evidenced by the markable differences analysed in relation to the line spacing of texts of reading materials being accessible on a computer screen; the attendance of students for streaming video, YouTube, PPT presentations and their exposures in browsing the links that the institutions advised to visit; and in the incorporation of animations, Self-Paced Modules and Video Clips in the presentations of online learning programs.

Table 6.4. Reflection of students on the delivery of the contents of the course they attended

Statements	Institution	Level of agreement					Total, %	df	t (df)	2-s p
		SA	A	N	DA	SDA	n, %			
		n, %	n, %	n, %	n, %	n, %				
The course materials were presented in a small, manageable units or modules.	HU	10,22.7	25,56.8	3,6.8	6,13.6	-	44,100.0	88	-.585	.560
	ACT	9,20.0	17,37.8	19,42.2	-	-	45,100.0			
The course materials were well-organized and easy to navigate.	HU	14,31.8	8,18.2	10,22.7	12,27.3	-	44,100.0	88	-.768	.445
	ACT	8,17.8	8,17.8	11,24.4	18,40.0	-	45,100.0			
File naming systems were consistent so that I was able to recognize when a file is a lecture, supplemental reading, and assignment.	HU	9,20.5	21,47.7	1,2.3	13,29.5	-	44,100.0	88	-1.729	.087
	ACT	7,15.6	8,17.8	11,24.4	19,42.2	-	45,100.0			
Font colours and styles used in the learning materials were consistent.	HU	9,20.5	27,61.4	1,2.3	7,15.9	-	44,100.0	88	-.926	.357
	ACT	17,37.8	8,17.8	2,4.4	18,40.0	-	45,100.0			
Line spacing of text were exciting and often easy to read on a computer screen.	HU	11,25.0	24,54.5	7,15.9	2,4.5	-	44,100.0	88	-2.600	.011
	ACT	9,20.0	16,35.6	2,4.4	18,40.0	-	45,100.0			
Reading texts were broken up using brief, concise sentences.	HU	8,18.2	18,40.9	11,25.0	7,15.9	-	44,100.0	88	1.859	.066
	ACT	6,13.3	26,57.8	13,28.9	-	-	45,100.0			
There were enough number of explanatory images inserted in the learning materials	HU	4,9.1	21,47.7	11,25.0	8,18.2	-	44,100.0	88	-.460	.647
	ACT	2,4.4	21,46.7	14,31.1	8,17.8	-	45,100.0			
The working files supposed to be learned were accessible in different formats: word, pdf, PPT and multimedia.	HU	14,31.8	22,50.0	2,4.5	6,13.6	-	44,100.0	88	-1.391	.168
	ACT	10,22.2	5,11.1	30,66.7	-	-	45,100.0			
I attended streaming video, YouTube, PPT presentations & browsed the assumed links.	HU	13,29.5	24,54.5	1,2.3	-	6,13.6	44,100.0	88	2.473	.015
	ACT	16,35.6	27,60,0	1,2.2	1,2.2	-	45,100.0			
I was required to do research projects and web quests.	HU	11,25.0	18,40.9	9,20.5	6,13.6	-	44,100.0	88	.170	.865
	ACT	6,13.3	28,62.2	3,6.7	8,17.8	-	45,100.0			
Animations, Self-Paced Modules and Video Clips were incorporated in the presentations.	HU	5,11.4	8,18.2	27,61.4	4,9.1	-	44,100.0	88	-2.388	.019
	ACT	1,2.2	10,22.2	13,28.9	21,46.7	-	45,100.0			

- *in relation to the type of interactions the institution used to reach students*

Respondent students were also requested to provide their opinions if they were actively engaged in their learning through creating media for interactions with the institutions, their instructors and with their friends, fellow students whenever they needed to do so. As it can easily be seen from the Table 6.5., the probability (p) < 0.05 for the highlighted statements that refer provisions of variety of communication options like email, discussion board, chat, web-conferencing, and telephone to get connected with other students; in enabling students to be engaged in cooperative learning environments; in the provision of advices to students to navigate links on the LMS to encourage students to exchange academic concerns; and in the provision of schedules of instructors when they would be able to communicate with their students on an individual basis via emails and telephones. Which means that the results of the t-test differ significantly and the differences between the two means is not by chance. Similarly, comparisons made between the statements not highlighted show that $p \geq 0.05$ which depicts that students of the two institutions do not differ significantly in their experiences of being consulted to do research works.

- *in relation to the provision of feedbacks to students' comments made while live sessions were made (if any), submitted assignments, exams, etc.*

Respondent students were also required to answer questions referring to the availability, nature, type of feedbacks they were given by their respective institution, coordinators of the program, and most importantly by their instructors (Table 6.6). Here too, $p < 0.05$ for the comparisons made on the experiences of the students regarding receiving clear feedbacks that could enrich their understanding and provide comments for better performance periodically using digital tools of LMS. This means that t-test differ significantly and the differences between the two means is not by chance. While 45.5% of the respondents of HU agreed to have received feedbacks via the e-platform, 79.9 % of students of ACT referred the opposite (with the inclusion of 11.1% of those who said nothing in this regard). Comparisons made in relation to the ways students were informed by their respective institution how they would be able to get feedback and when they could be hearing comments from the instructor show that ($p \geq 0.05$) students of the two institutions do not differ significantly in their experiences and the differences came of course by chance.

- *in relation to assessments managed to evaluate students' learning*

Last but not least, rather that assumes larger portion of the delivery of the program using the platform and supposed to challenge practitioners is assessing students' learning online. Students were required to share their opinions how they experienced assessments. Accordingly, respondent students were provided with five questions, having relevancy of assessment approaches, to answer their experiences while they took exams and some other assessments via the learning management system. The responses of the respondent students together with the kind of relationships found between the responses of the two institutions are displayed in Table 6.6.

Only for one statement, highlighted in Table 6.7, the independent sample t-test grew with $p \geq 0.05$ connoting the difference is not significant and it is assumed arising merely by chance. Which means that students of both institutions were provided a chance to suggest and to recommend on the improvement of delivery of the program though relatively 44.6% of students of ACT seemed to agree on the provision of same experiences.

However, analyses of students' responses, for the non-highlighted statements, depict that the results of the independent sample t-test differ significantly ($p < 0.05$). These are demonstrated by significance differences found out regarding their experiences in working on the to be marked self-tests consisting of multiple choice, fill in the blank, crosswords, matching/ordering, short answer, jumbled sentences (HU seemed to agree 90.9% while CT counted 20.0%.); in coming across with a continuous, non-graded, and self-paced assessments included in the learning materials that were supposed to help students assess their own progress of learning (HU seemed to agree 50.0% while ACT made it 17.7%); regarding the nature of the self-assessing question types: most of questions were in the form of multiple-choice tests and short-answer tests (HU seemed to agree 84.1% while HU, 42.2%); in receiving marked exams, papers, and assignments based on the schedule set by the institution (HU seemed to agree 63.7% while ACT grew with 46.7%); and in relation to the provision of instructions to fill in an electronic portfolio (e-portfolio) which was considered as part of assessment of students' learning (56.9% of HU agreed to have had it while 22.2% of ACT to have had the experience).

Table 6.7. Reflection of students on the availability, nature/types of assessments they experienced while they were attending the courses

Statements	Inst.	Level of agreement					Total, %	df	t (df)	2-s p
		SA	A	N	DA	SDA	n, %			
		n, %	n, %	n, %	n, %	n, %				
Exercises featuring multiple choice, fill in the blank, crosswords, matching/ordering, short answer, jumbled sentences were provided as self-tests supposed to be marked.	HU	6,13.6	34,77.3	1,2.3	3,6.8	-	44,100	88	-7.052	<.001
	ACT	2,4.4	7,15.6	15,33.3	20,44.4	1,2.2	45,100			
There were a continuous, non-graded, and self-paced assessments included in the learning materials to help students assess their own progress of learning.	HU	7,15.9	15,34.1	16,36.4	6,13.6	-	44,100	88	-3.870	<.001
	ACT	2,4.4	6,13.3	14,31.1	22,48.9	1,2.2	45,100			
Mostly, the self-assessing question types were in the form of multiple-choice tests and short-answer tests.	HU	7,15.9	30,68.2	1,2.3	6,13.6	-	44,100	88	-3.468	<.001
	ACT	4,8.9	15,33.3	4,8.9	21,46.7	1,2.2	45,100			
I received marked exams, papers, and assignments based on the schedule set by the institution.	HU	8,18.2	20,45.5	9,20.5	1,2.3	6,13.6	44,100	88	-2.031	.045
	ACT	4,8.9	17,37.8	3,6.7	9,20.0	12,26.7	45,100			
I was instructed to fill in an electronic portfolio (e-portfolio) considered as part of the assessment.	HU	5,11.4	20,45.5	11,25.0	7,15.9	1,2.3	44,100	88	-2.748	.007
	ACT	2,4.4	8,17.8	15,33.3	19,42.2	1,2.2	45,100			
I was advised to provide suggestions/recommendations on the improvement of delivery of the program.	HU	8,18.2	18,40.9	12,27.3	-	6,13.6	44,100	88	-1.285	.202
	ACT	3,6.7	18,40.0	3,6.7	20,44.4	1,2.2	45,100			

Statements	Inst.	Level of agreement					Total, %	df	t (df)	2-s p
		SA	A	N	DA	SDA	n, %			
		n,%	n,%	n,%	n,%	n, %				
S8	HU	-	-	3,60	2,40	-	5,100	8	-2.887	.020
	ACT	-	3,60	2,40	-	-	5,100			

Note: S1: There were a continuous, non-graded, and self-paced assessments included in the learning materials to help students assess their own progress of learning; S2: Mostly, the self-assessing question types were in the form of multiple-choice tests and short-answer tests; S3: There were cases where I used an electronic portfolio (e-portfolio) to assess student's learning; S4: I managed applying reflective journaling to evaluate students' learning; S5: Student lads' discussions were considered in assessing the depth of students' learning; S6: Students' case study discussion/writing was used to evaluate their learning; S7: Collaborative writing projects, assignments were part and parcel of the methods used in students' learning; S8: I required students to create podcasts to evaluate the skills they developed from their learning.

As it is easily seen in the table above, only for the statement that requested instructors whether they required their students to create podcasts/multimedia to evaluate the skills they developed from their learning that significant differences are registered. And this is explained by the value $p < 0.05$ which is meant to show the results of the independent sample t-test differ significantly. While 60% of ACT instructors agreed with the statement, none from HU seemed to agree. And when we consider the remaining parameters that are supposed to measure assessment types managed by the instructors, all instructors of ACT agreed to have included a continuous, non-graded, and self-paced assessments in the learning materials to help students assess their own progress of learning and that the self-assessing question types were in the form of multiple-choice tests and short-answer tests; besides to assuming case study discussion/writing to evaluate their learning. For same parameters, only 60% of HU instructors seemed to have agreed with the statements. Moreover, comparing the experiences of instructors with the parameters that require them the application of reflective journaling, student-led discussions and collaborative writing projects, assignments to evaluate the depth of their students' learning, while all ACT instructors agreed to have experienced them, only 60% of HU instructors managed to practice same measures. For the parameter that asked whether they used an electronic portfolio (e-portfolio) to assess student's learning, all instructors of the two institutions seemed to have similar positive experiences.

Institutions' responses

As compared to the first two respondents, the response rate of the institutions is beyond expectation (100%, as it is shown in Table 6.11) as 2 of the institutions recognized their responsibility. The responses provided by the two institutions are presented being categorized into 4 components and the analyses comparing the responses are in Tables 6.11., 6.12., 6.13. and Table 6.14. below.

As it is displayed in Table 6.11., except for the provision of a face-to-face session meant to introduce and train students regarding accessing resources, ways of submission of complains, request for support, in which only ACT managed to do it, in the rest of the experiences, both institutions believed to demonstrate all of them to effectively deliver the program.

Table 6.11. Reflection of the institutions regarding the delivery of the program

Statements	Inst.	Agreement type		
		Yes, %	No, %	Dilemma, %
Students were called for face-to-face contact to provide them training on how to access resources, ways of submission of complains, how they should request for support when connections are out.	HU	0, 0%	1,100%	0, 0%
	ACT	1,100%	0, 0%	0, 0%
Live sessions interrupted because of power disruption or connection problems were aired again to enable students capture them.	HU	1,100%	0, 0%	0, 0%
	ACT	1,100%	0, 0%	0, 0%
Did you send links to students to enable them be engaged in synchronized class session?	HU	1,100%	0, 0%	0, 0%
	ACT	1,100%	0, 0%	0, 0%
Students and instructors were made to access resources from the e-library.	HU	1,100%	0, 0%	0, 0%
	ACT	1,100%	0, 0%	0, 0%

Regarding the interactions that the institutions were supposed to have with their students, as Table 6.12 shows, both institutions reflected that their LMSs have been made to consist of a discussion forum to enable students to post their comments, questions to their instructors and responses to questions raised by the instructors and fellow students, instructors were trained to use the LMS for various activities; and links have been created to enable instructors and students to plug-in and drop comments for the improvement of the platforms.

Table 6.16. Experiences of the institutions in conducting exam online & making sure that students' problems were solved using the platform created

Questions	Inst.	Experiences of the institutions
How did you manage conducting examinations?	HU	It was provided online by using proctored exam system.
		Exam security was managed by activating camera.
	ACT	By using the learning management system and all the exams were evaluated digitally.
How did you make sure that students' problems were solved?	HU	By Collecting feedback online.
	ACT	By creating a discussion session at the end of each course.
		Every time before and after the class, challenges faced by students were collected and sent to the technical staff.
How did the institution manage holding the live missed sessions without affecting the schedule already established?	HU	All programs were recorded and disseminated to students by different mechanisms.
		So far, we didn't face citable problem.
	ACT	Students were informed to read the modules, PPTs. and listen to the recordings.
		Through arranging make up classes on the weekdays.

6.4. Discussions and Research Findings of Quantitative and Qualitative Analysis

Under this section, the findings of the study are discussed following the analyses made using quantitative and qualitative approaches and emphasis has been given to the dimensions that are in accord with ICDE rubric (which was manipulated for triangulation purpose).

Findings of quantitative analysis

- *Responses of students*
  - In relation to detailed syllabuses of the courses

As the analysis shows, students of the two institutions believed that the courses they took were made to consist of course titles, identifications, and course descriptions. They also reflected that recommended texts and readings besides to the course materials were made available to encourage their learning. Concerns related to research activities, grading policy, and ethical issues were given due attention to enable students stick to their learning. Regarding stating course objectives clearly, students of ACT felt better than HU students. However, in relation to provision of course outlines, instructions suggesting the availability of assignments & course expectation and informing students about a system

available designed to provide support to students, the experiences of HU students is found to be better than ACT students.

- In relation to the delivery of course content

Comparisons made between the two institutions shows that no significant difference was found in their understanding of the preparation, organization of the course materials and in the provision of required information that would enable the student to do research projects and web quests. However, regarding the layout and typography of texts in the reading materials, specially that referring to the exciting nature and arrangement of line spacing of texts to make reading easy on a computer screen, HR students seemed to have better experiences as compared to ACT students. Similarly, all students acknowledged the incorporation of animations, Self-Paced Modules and Video Clips in their online programs; however, ACT students seemed to have better experiences in attending streaming video, YouTube, PPT presentations and browsing the links provided to enrich their understanding.

- In relation to the type of interactions the institution used to reach students

In online learning platforms, learners are expected to have interactions with their instructors, colleagues and institutions to clear out doubts and keep learning motivated. Comparisons made in this regard, students of HU seemed to have better exposures in getting icebreaking activity held online to introduce one another in the learning community which helps learners to feel accepted and supported; in being actively engaged with the course materials; in receiving consultations to work on research, read academically relevant materials from e-library and the webs; in being engaged in cooperative learning environments; in getting advices on how to navigate links on the LMS to plug-in the forums like “Help” or “Assistance” that provide connectivity on the discussion board to encourage exchange of academic concerns; and in having schedules of instructors when they would be able to communicate with their students on an individual basis via emails and telephones. ACT students were found to be better, however, in getting a variety of communication options like email, discussion board, chat, web-conferencing, and telephone to get connected with other students.

- In relation to the provision of feedbacks to students' comments made while live sessions were made, submitted assignments, exams, etc.

As literatures revealed, online learners are encouraged to keep learning if they receive constructive feedbacks for their doubts, submitted assignments and examinations. In relation to this experience, HU students referred (by far better than ACT students) that they received clear feedbacks (enriching and commentary) periodically using email, comments attached to digital assignments on the LMS. Both seemed to have nearly similar experiences in getting information from their respective institution how they would be able to get feedback and when they could be hearing comments from the instructors.

- In relation to assessments managed to evaluate students' learning

Best practices in online learning programs have made assessment/evaluation approaches central with respect to which the KPIs (Key Performance Indicators) of the system are supposed to be figured out. Comparisons made under this dimension shows that HU students to have better experiences in engaging themselves with a continuous, non-graded, and self-paced assessments questions, prepared in the form of multiple-choice tests and short-answer test, included in the learning materials thought to assess their own progress of learning. Similarly, HU students seemed to have good experiences in receiving marked exams, papers, and assignments based on the schedule set by the institution and to have got instructions to fill in electronic portfolios (e-portfolios) considered as part of the assessment approach.

- *Responses of instructors*
  - Regarding effective use of the platform to support students' learning

As one of the key stakeholders, experiences of instructors are also considered for effective management of the online learning system. Hence, regarding their experiences in getting a mechanism established on the LMS to track students' progress to identify and assist at-risk students promptly, while HU instructors seemed to lack, all ACT instructors agreed to have had. However, referring to other dimensions that are believed to measure the degree of exposure of instructors to the online platform, they seemed to have similar understanding.

Respondent students understand that the system of online learning is rooted on the accessibility of internet. However, they felt that connection is still a problem of the country that the institutions share and learned the difficultness to hold synchronous and asynchronous programs and to access recommended materials from e-library. They also complained that the order of the program was constantly fluctuating which made it difficult for them to easily know what follows what and created time lag in delivering a given course and cover the entire content on time.

- In relation to the appropriateness of the system

Most of the respondent students believed that online learning platform has enabled them to study without being interrupted from their work. Relatively, larger number of students from HU referred that the LMS was very simple to understand, and their online learning was mostly better than the way they used to learn at the conventional campus. Most students of the two institutions suggested that the system is a good start and better be integrated with the regular classes too. Significant number of students from HU suggested that the programs should be up to date and focus on problem solving approaches.

Larger number of respondents of both institutions believed that though all learning materials and enough tutors were available, it is still necessary to facilitate for students to have a one-to-one engagement with their instructors on periodic basis so that they can get support from the latter which will foster their motivation to learning.

- *Institutions' suggestions*

As a part of a qualitative data, the institutions were required to provide their opinions in answering to open-ended question that were supposed to collect information regarding the program. Both institutions suggested that the online learning program is an innovative experience, however, most of the students and some instructors were facing difficulties to easily get into the system and they believed that adequate awareness creation should have been given in advance.

The responsible government institution supposed to follow how the system is being applied by HLIs needs to have well versed experts in every component of the program (instructional designing, ICT expertise, program coordination, etc.) and be willing to provide training to the institutions to acquaint them with the intended strategy and provision of online learning program.

examination, keeps safe exam browser, and invites human proctoring by applying AI (Artificial Intelligence).

Candidate authentication: the platform eliminates any impersonation risk using multi-factor authentication using OTP (One-time Password), Aadhar (demographic and biometric details) or IP (Internet Protocol), followed by ID authentication. It also involves facial recognition by taking the candidates' pictures and ID proof to avoid impersonation.

Safe Exam Browser: it prevents candidates from accessing the internet. Once enabled, this feature detects and ends the test for the examinees who browse away from the test window and open multiple tabs on the browser.

Artificial Intelligence and human proctoring: they enable monitoring of candidates' behaviour and actions for suspicious activities. Proctoring technologies combine the latest advances in AI-based and remote live proctoring to eliminate the risk of cheating.

- *Regarding instructors who are recruited to provide online education*

The institutions should make sure that the instructors are flexible, innovative, and creative as challenges that learners face are quite different from that of a traditional classroom. It is obvious that those instructors providing online education in the HLIs of Ethiopia are staffs of the traditional classes. It is advisable to track faculty in emerging e-learning fields as it gives significant correlation between faculty engagement and course success. However, where there are not experts with the required knowledge and skills, HLIs need to invest in training the faculty to enable them function accordingly.

Digital literacy can play the role of taking distance out from distance education and gradually converge it into ODeL. This could be, however, possible if the online courses are made to comprise of detailed syllabuses and the courses are provided using appropriate digital platforms to be able to interact with their instructors, institutions, and fellow students. It is also required that they receive constructive feedback through a system that is either synchronized or asynchronized to the LMS from their instructors and program coordinators and should be aware of the platform used to assess their progress of learning. All these are possible provided that the instructors are well versed with ICT and accept that ODeL is the future paradigm taking much of the space of the education arena.

Credit Authorship Contribution Statement

This work was conceived, worked out and made available for publication by the corresponding author, TESSEMA, Aderajew Mihret and hence the credit and ownership go to Mr. TESSEMA, Aderajew Mihret (PhD candidate, UNISA).

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Conflict of Interest Statement

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Chapter 7.

Language and Literature Education in the Era of Global Connectivity: Navigating Multilingualism, Cultural Diversity, and Technological Advancements

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Abstract

In an era of global connectivity, language and literature education faces the challenge of navigating multilingualism, cultural diversity, and technological advancements. This paper explores the challenges and opportunities in language and literature education in the era of global connectivity. Through a qualitative research approach, interviews, focus group discussions, and classroom observations were conducted with 30 Arts and Sciences students and teachers. The findings reveal significant themes related to cultural diversity, multilingualism, and the integration of technology in language learning.

The study emphasizes the importance of inclusive pedagogies, critical thinking development, and the incorporation of authentic and diverse literary works. Recommendations are provided for educators and policymakers to promote intercultural understanding and enhance language and literature education. The limitations of the study suggest areas for future research, including long-term language proficiency and diverse contextual considerations. Overall, this paper calls for ongoing innovation and collaboration to meet the evolving needs of language and literature education in an interconnected world.

Keywords: cultural diversity; era of global connectivity; language and literature education; multilingualism; technological advancements; qualitative research approach.

JEL Classification: I20; O33.

Language and literature education in the digital age is a subject of increasing importance in today's interconnected world. The rapid advancements in technology and the global connectivity it affords have transformed the way we communicate, access information, and interact with literature (Kress, 2020). This evolution brings both challenges and opportunities for language and literature educators as they navigate the complexities of multilingualism, cultural diversity, and technological advancements (Stanley, 2019). Understanding how language and literature education can effectively adapt to this era of global connectivity is essential to equip learners with the necessary skills and competencies for their future engagement in a diverse and interconnected world.

However, despite the transformative potential of global connectivity, there is a need to critically examine the implications and complexities it poses for language and literature education. Educators face the challenge of effectively responding to the demands of global connectivity while honoring cultural diversity, promoting multilingualism, and harnessing the potential of technology in pedagogical practices (Celce-Murcia, Brinton and Snow, 2020). It is important to explore the intersection of language and literature education with these key aspects to develop a comprehensive understanding of the strategies and approaches that can enhance language and literature learning experiences in the digital age.

The central research question of this study is: How can language and literature education adapt to the era of global connectivity, specifically in relation to navigating multilingualism, cultural diversity, and technological advancements?

This study aims to achieve the following objectives:

- Explore the impact of global connectivity on language and literature education in terms of pedagogical practices, learning outcomes, and student engagement.
- Examine the challenges and opportunities presented by multilingualism and cultural diversity in language and literature education, focusing on fostering inclusive and culturally responsive teaching practices.
- Investigate the role of technology in enhancing language and literature education in the era of global connectivity, exploring effective integration strategies and digital tools.
- Identify innovative pedagogical approaches and strategies for navigating multilingualism, cultural diversity, and technological advancements in language and literature education.

This chapter is organized as follows: The Literature Review section provides a comprehensive review of existing scholarship on language and literature education in the context of global connectivity, incorporating key theories such as sociocultural theory, critical literacy theory, and multiliteracies theory (Cope and Kalantzis, 2020). The Methodology section outlines the research design, data collection methods, and analysis techniques employed in this study. The Findings and Discussion section presents the results of the study, providing an in-depth analysis of the data collected. The Implications and Recommendations section discusses the practical implications of the study's findings and offers recommendations for language and literature educators. The last section summarizes the key findings, implications, and recommendations discussed in the paper and suggests avenues for future research. Examining language and literature education in the era of global connectivity, the whole study aims to contribute to the advancement of pedagogical practices and inform decision-making processes, ultimately enhancing language and literature education in the evolving educational landscape.

7.1. State-of-the-Art Language and Literature Education in the Digital Age

Language and literature education in the digital age is a dynamic and multifaceted field that encompasses the study of language proficiency, literary analysis, cultural understanding, and technological integration. As the world becomes increasingly interconnected, language and literature educators face the challenge of preparing learners to navigate the complexities of a globalized society. This literature review, conducted by the researcher, aims to provide a comprehensive overview of the current state of language and literature education, exploring key themes such as multilingualism, cultural diversity, technology, and the challenges and opportunities in the field (Seidenberg, 2020). By examining the historical context, gaps in the literature, and the impact of multilingualism and cultural diversity, this review seeks to shed light on the evolving landscape of language and literature education and inform pedagogical practices in the digital era. Additionally, the review will explore the role of technology in language learning and discuss the challenges and opportunities that educators encounter in their pursuit of effective language and literature instruction. Through this review, the researcher aims to contribute to the ongoing dialogue surrounding language and literature education, fostering an inclusive and forward-thinking approach that prepares learners to thrive in an interconnected world (Calkins, 2020).

On this premise, the researcher feels obligated to present significant insights and reviews taken from empirical studies.

Studies published in 2020, offer valuable insights into various aspects of language and literacy education in the contemporary era. G. Kress (2020) explores the impact of new media technologies on reading, writing, and communication. "Teaching English as a Second or Foreign Language" (2020) by Celce-Murcia, Brinton, and Snow provides practical guidance for educators engaged in English language teaching, covering pedagogical approaches, assessment, and cultural considerations. Cope and Kalantzis, (2020) emphasizes the need for education to adapt to changing modes, cultures, and contexts. "The Art of Teaching Writing" by Calkins (2020) offers practical strategies and inspiration for effective writing instruction. "Language at the Speed of Sight" (2020) by M. S. Seidenberg examines reading difficulties and provides evidence-based insights into promoting literacy. Collectively, these sources contribute to the understanding of language and literacy education, addressing topics such as new media, language teaching methodologies, multiliteracies, writing instruction, and reading difficulties. They serve as valuable resources for educators, researchers, and individuals interested in enhancing language and literacy practices in today's evolving educational landscape.

Further, these sources delve into various aspects of language and education in the digital age. Thomas (2019) explores innovative pedagogical approaches for teaching literature in the digital era. "Globalization and language education: Trends in applied linguistics" by Block (2018) examines the impact of globalization on language education, discussing key trends in the field of applied linguistics. Byram and Wagner (2018) focuses on developing intercultural communicative competence in language learners, offering theoretical insights and practical applications.

Lankshear and Knobel (2019) explores literacy practices in the digital era, providing a comprehensive understanding of digital textual practices and their implications for teaching and learning. "Foundations of Bilingual Education and Bilingualism", 6th edition by Baker (2019) examines the fundamental principles and practices of bilingual education, emphasizing the importance of linguistic diversity and the benefits of bilingualism. These sources collectively contribute to the understanding of language education in the digital age, addressing topics such as pedagogical models, globalization, intercultural competence, digital literacy, and bilingual education.

be navigated to ensure equitable access to education and the promotion of linguistic and cultural diversity.

Embracing Cultural Diversity in the Curriculum: Cultural diversity plays a crucial role in language and literature education. It fosters inclusivity, promotes empathy, and expands learners' cultural knowledge. By integrating diverse literary texts, incorporating authentic cultural materials, and providing opportunities for students to share their own cultural experiences, educators can create an inclusive and enriching language and literature curriculum that celebrates diversity and promotes intercultural understanding (Baker, 2019).

Role of Technology in Language Learning: Technology has revolutionized language learning and provides new avenues for language and literature education. Digital tools, online platforms, and multimedia resources offer opportunities for authentic language use, interactive engagement, and the exploration of diverse literary works (Andrews, 2020). Technology also enables personalized learning experiences, promotes collaboration, and facilitates access to a wide range of language and literary resources.

Challenges and Opportunities in Language and Literature Education: The current landscape of language and literature education presents both challenges and opportunities. Challenges include the need for effective teacher training, the integration of technology in pedagogical practices, and the continuous adaptation to changing educational contexts (Journal of Language and Literacy Education (JoLLE). However, opportunities lie in the ability to harness technology for meaningful learning experiences, to foster intercultural competence through diverse texts, and to develop critical literacy skills that empower learners to navigate a complex and interconnected world.

This review highlighted the historical development of language and literature education and explores its current state. It identifies gaps in the literature, particularly in understanding the impact of multilingualism and effectively embracing cultural diversity. The review emphasizes the role of technology in language learning and examines the challenges and opportunities present in language and literature education. By addressing these key points, the literature review provides a comprehensive understanding of the current landscape of language and literature education in the era of global connectivity in the local context.

7.2. Comprehensive and In-Depth Exploration of Language and Literature Education

The research methodology employed in this study aims to provide a comprehensive and in-depth exploration of language and literature education in the era of global connectivity. This section presents an overview of the qualitative research approach, research questions, data collection methods, participant selection, and validity and reliability measures adopted in this study.

Qualitative Research Approach: This study adopted a qualitative research approach to explore the complexities of language and literature education in the era of global connectivity. A qualitative approach allowed for an in-depth understanding of the experiences, perspectives, and practices of educators and students (Creswell & Poth, 2018). It sought to capture rich, contextualized data that goes beyond statistical analysis and provides nuanced insights into the research questions at hand.

Research Questions

The research questions guiding this study are as follows:

Q1: How do language and literature educators navigate multilingualism, cultural diversity, and technological advancements in their teaching practices?

Q2: What are the challenges and opportunities encountered by language and literature educators in the era of global connectivity?

Q3: How do students perceive the role of language and literature education in developing their language proficiency, critical thinking skills, and cultural awareness?

While this study focused on research questions rather than hypotheses, the researcher anticipated that educators and students faced challenges related to the integration of technology, cultural diversity, and multilingualism, while also identifying opportunities for inclusive pedagogical practices and enhanced learning outcomes (Merriam, 2018).

Data Collection Methods: To gather comprehensive and diverse data, multiple data collection methods were employed, including:

- Interviews with Educators and Students: Semi-structured interviews were conducted with language and literature educators and students. These interviews provided a platform for participants to share their perspectives, experiences, and insights regarding language and literature education in the

that the research outcomes are applicable and informed by the voices of those actively shaping the field. By involving a diverse group of 30 language and literature students and educators, the study aims to capture a comprehensive range of experiences, perspectives, and backgrounds, facilitating a deeper understanding of the impact of global connectivity on language and literature education. Finally, selecting a group size of 30 is practical in terms of time, resources, and the study's scope, allowing for meaningful engagement, data collection, and analysis while still providing valuable insights into the research topic (Merriam, 2018).

Validity and Reliability Measures: To ensure the validity of the study, multiple strategies were employed. These include triangulation of data sources, member checking, and peer debriefing. Triangulation involved using multiple data collection methods and sources to corroborate findings. Member checking involved sharing the findings with participants to ensure accuracy and alignment with their experiences. Peer debriefing involved seeking input and feedback from other researchers or experts in the field to enhance the rigor and credibility of the study (Merriam, 2018). These measures contributed to the overall reliability and validity of the research findings. By employing a qualitative research approach, utilizing various data collection methods, and implementing validity and reliability measures, this study aimed to provide a robust and comprehensive understanding of language and literature education in the era of global connectivity.

7.3. Key Findings and Some Discussions Derived from the Interpretation and Analysis of the Data

Findings

This section of the paper presents the results and key insights derived from the study on language and literature education in the era of global connectivity. This section aims to provide a concise overview of the main findings, highlighting the significant themes that emerged from the interviews, focus group discussions, and classroom observations. Through the interpretation and analysis of the data, the findings shed light on important aspects such as the impact of multilingualism and cultural diversity, the integration of technology in language learning, and the challenges and opportunities faced by educators in this context (Canagarajah and Sengupta, 2020). By summarizing the main findings, this section provides a foundation for the subsequent discussion, where the implications and recommendations for language and literature education will be explored in more depth.

significance of multilingualism and cultural diversity in fostering inclusive and meaningful learning experiences. Furthermore, the findings shed light on the evolving trends in language and literature education and the role of technology in enhancing language learning outcomes.

Discussion

This part of this paper presents a comprehensive analysis and interpretation of the findings from the study on language and literature education in the era of global connectivity. This section aims to provide insights into the implications of the findings, address the research questions, offer recommendations for educators and policymakers, and acknowledge the limitations of the study.

Through an examination of the key themes and insights derived from the data, this discussion sheds light on the evolving landscape of language and literature education, taking into account the impact of multilingualism, cultural diversity, and technology (Lent & Evans, 2019. The discussion provides a critical analysis of the findings, explores their significance in the context of language and literature education, and highlights actionable recommendations for educators and policymakers. Additionally, the discussion section acknowledges the limitations of the study, underscoring the need for further research and exploration in this field. By engaging with the findings in this discussion, the researcher aims to contribute to the ongoing discourse surrounding effective language and literature education in an interconnected world.

The findings of this study shed light on various aspects of language and literature education in the era of global connectivity. Through the interpretation of the findings, it becomes evident that language and literature education has evolved to embrace cultural diversity, integrate technology, and address the challenges and opportunities presented by multilingualism. The participants emphasized the importance of creating inclusive learning environments, fostering critical thinking skills, and promoting intercultural understanding. The integration of technology was recognized as a valuable tool to enhance language learning experiences (Ferris and Hedgcock, 2019). These interpretations highlight the dynamic nature of language and literature education, reflecting the evolving needs of learners in a globalized world.

The research questions posed in this study have been addressed through the findings. The first research question explored how language and literature educators

navigate multilingualism, cultural diversity, and technological advancements. The findings indicate that educators incorporate diverse texts, foster cultural awareness, and utilize technology to enhance instructional practices. The second research question focused on the challenges and opportunities encountered in the era of global connectivity. The findings highlight the importance of addressing digital literacy, promoting inclusive pedagogies, and preparing students to engage in a globalized society. The third research question investigated students' perceptions of language and literature education. The findings demonstrate that students value the opportunity to explore different perspectives, develop critical thinking skills, and enhance their cultural awareness through language and literature education (Hernandez, n.d.)

The implications of the findings have significant ramifications for language and literature education. Firstly, there is a need for curriculum development that embraces cultural diversity and incorporates diverse texts, voices, and perspectives. Educators should be encouraged to utilize technology effectively, integrating digital tools and online resources into their instructional practices. Furthermore, promoting critical thinking skills and intercultural understanding should be prioritized to foster students' global citizenship competencies (Bernardo, 2020). The findings emphasize the importance of creating inclusive and engaging learning environments that value students' linguistic and cultural backgrounds.

Based on the findings, several recommendations can be made for educators and policymakers in language and literature education. Firstly, professional development opportunities should be provided to educators to enhance their digital literacy skills and pedagogical practices. It is essential to invest in resources that support the integration of technology and cultural diversity in the curriculum. Policymakers should prioritize policies that promote cultural responsiveness, multilingualism, and the integration of technology in language and literature education (Canilao-Baltazar and Pamilar, 2020). Collaboration between educators, policymakers, and stakeholders is crucial to ensure effective implementation of these recommendations.

While this study contributes valuable insights, it is important to acknowledge its limitations. Firstly, the study was conducted in a specific context with a limited number of participants, which may limit the generalizability of the findings. The study also relied on self-report data and participant perspectives, which may introduce potential biases (Gonzales, 2021). Additionally, the time constraints of the study may have limited the depth

of data collection and analysis. These limitations suggest the need for further research in diverse contexts and with larger sample sizes to validate and expand upon the findings.

Overall, the discussion of the findings provides an interpretation of the research findings, addresses the research questions, highlights the implications for language and literature education, offers recommendations for educators and policymakers, and acknowledges the limitations of the study. These insights contribute to the ongoing dialogue surrounding language and literature education in the era of global connectivity and provide a foundation for further research and development in the field.

7.4. Contributions and Future Directions for Language and Literature Education

This chapter aims to recap the research question and objectives, summarize the key findings, highlight the contribution to the field, discuss future directions for language and literature education, and offer closing remarks. By presenting a succinct overview of the main points discussed throughout the paper, the conclusion provides a final synthesis of the research and offers insights into the implications and significance of the study. Through this concluding section, the research findings are contextualized, and recommendations for future research and practice are outlined (David and Torres-Yu, 2020). The conclusion serves as a final reflection on the importance of language and literature education in an interconnected world and underscores the ongoing need for effective pedagogical practices that embrace diversity, foster critical thinking, and leverage technology.

This study aimed to investigate language and literature education in the era of global connectivity, navigating multilingualism, cultural diversity, and technological advancements. The research questions explored how educators navigate these challenges, the impact on students' language proficiency and critical thinking skills, and the role of technology in enhancing language learning (Johnson and Smith, 2020). The objectives were to provide insights into effective pedagogical practices, highlight the challenges and opportunities, and explore the implications for language and literature education.

Summary of Findings

The findings of this study revealed several important insights. Participants emphasized the need for inclusive pedagogies that embrace cultural diversity and promote critical thinking skills. The integration of technology was recognized as a valuable tool to enhance language learning experiences (Chen & Lin, 2020). Multilingualism was seen as a valuable resource, fostering intercultural understanding and enriching classrooms. The study also identified key trends, such as the shift towards a more communicative approach and the importance of authentic materials in the curriculum.

Contribution to the Field

This study makes a significant contribution to the field of language and literature education. It provides a comprehensive understanding of the challenges and opportunities faced by educators and students in the era of global connectivity. The findings shed light on the importance of cultural diversity, multilingualism, and the effective integration of technology (Wang and Canagarajah, 2020). By exploring the implications of these findings, this study offers valuable insights for educators, policymakers, and curriculum developers in enhancing language and literature education practices.

Future Directions for Language and Literature Education

Based on the findings, several future directions for language and literature education can be suggested. Educators can further explore the potential of technology in fostering language proficiency and critical thinking skills. Emphasizing the integration of culturally diverse texts and resources can contribute to a more inclusive curriculum. Professional development programs can be designed to enhance educators' digital literacy skills and pedagogical practices (Li and Ramirez, 2020). Additionally, further research is needed to investigate the long-term impact of language and literature education on students' language proficiency, cultural awareness, and intercultural competence.

Overall, this study highlights the importance of language and literature education in the era of global connectivity. By addressing the research questions, summarizing the findings, and exploring the implications, this study contributes to the ongoing dialogue in the field. Language and literature education plays a crucial role in developing students' language skills, critical thinking abilities, and intercultural competencies. It is essential for educators, policymakers, and stakeholders to collaborate and implement effective pedagogical practices that embrace cultural diversity, integrate technology, and prepare

students for an interconnected world. Through continued research, innovation, and collaboration, we can further enhance language and literature education to meet the evolving needs of learners in the globalized society of today and tomorrow.

Credit Authorship Contribution Statement

Edgar R. Eslit, declares that is the sole author of the article titled "Language and Literature Education in the Era of Global Connectivity: Navigating Multilingualism, Cultural Diversity, and Technological Advancements". Edgar R. Eslit, has conceptualized and designed the study, conducted all aspects of the research, including data collection and analysis, and authored the entire manuscript.

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Conflict of Interest Statement

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. No conflict of interest with anyone can be seen in the process.

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Chapter 8.

Student Performance in E-learning Systems: An Empirical Study

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Abstract

This research paper focuses on using a convolutional neural network to assess student performance and addresses the impact of the COVID-19 pandemic on education. It introduces a two-step system that combines robust Bayesian model averaging with a frequentist approach for estimating parameters in a multinomial logistic regression model. The authors provide an empirical example illustrating the application of this system in analysing student performance. They also explore strategies to improve e-learning tools by addressing technological factors. The paper contributes to educational evaluation and policy analysis by incorporating deep learning systems and addressing the challenges posed by the pandemic.

Keywords: machine learning; student performance; Bayesian inference; e-learning platforms; logistic regression; variable selection procedure.

JEL Classification: I25.

The global Covid-19 pandemic, persisting for over three years, has left an indelible mark on education worldwide. In the past couple of years, as a response to the challenges posed by the pandemic, the utilization of online technology for educational purposes has surged dramatically. This shift has enabled students to engage in coursework and examinations from remote locations, transcending the boundaries of the traditional

physical classroom setting (O'Reilly and Creagh, 2015). Distance learning, a hallmark of this digital transformation, empowers individuals to acquire knowledge at their convenience, irrespective of geographical constraints, often proving more effective than conventional pedagogical methods.

The broad acceptance of online learning programs by both public and private educational institutions has further incentivized the development of learning platforms designed to streamline courses and reduce training costs. Nonetheless, the online learning environment poses unique challenges, notably a higher potential for distractions as students are surrounded by their home environments. Consequently, understanding the impact of online education on learning efficiency has emerged as a pivotal research area, as student engagement has long been a focal point of educational inquiry. Several studies have posited that student engagement can be enhanced through judicious instructional interventions, meticulous course design, and prompt feedback (Naim et al., 2021).

Assessing student engagement fundamentally starts with the observation of facial expressions. Facial expressions are potent indicators of human emotional and cognitive states (Picard, 1997). Facial Expression Recognition (FER) has garnered significant attention due to its applicability in human-computer interaction and affective computing, propelled by advances in machine learning and deep learning, driven by the surge in Big Data (Chen et al., 2019; Penczynski, 2019). Researchers have increasingly embraced deep learning methodologies, such as Convolutional Neural Networks (CNNs), capitalizing on their prowess in computer vision, yielding commendable performance (Khan et al., 2019; Naim and Alahmari, 2020).

The article focuses on deep learning approaches and introduces the Two-step Robust Bayesian Multiclass (TRBM) procedure, which addresses challenges like model uncertainty and overfitting. By employing a hierarchical robust Bayesian approach and informative priors, TRBM enables accurate predictions and effective variable selection. The empirical analysis assesses student attention and attendance in e-learning courses using facial recognition, emphasizing the benefits of digital web technologies for accessible high-quality education. Overall, the research enhances our understanding of online education's impact, emphasizes the importance of measuring student engagement, and presents an advanced methodology for facial expression recognition in online learning, contributing to the improvement of e-learning platforms.

The remainder of this paper unfolds as follows: Section 1 displays a non-technical summary with discussion with related works. Section 2 illustrates an overview on e-learning systems and educational platforms. Section 3 displays the methodology discussing in depth the Bayesian procedure, the empirical model, and the inference analysis addressed in this study. Section 4 focuses on the dynamic analysis illustrating the prior specification strategy and posterior distributions according to the Bayesian inference. Section 5 emphasizes the usefulness and robustness of the estimation procedure by describing an empirical study. Concluding remarks summarize the main results achieved from a methodological and policy perspectives.

8.1. Discussions within Related Studies

The COVID-19 pandemic has greatly influenced education worldwide, leading to a rise in online learning. Measuring student engagement in remote learning environments has become a challenge, and FER has emerged as a valuable tool. Deep learning methods, particularly CNNs, have significantly advanced FER by eliminating manual feature extraction and achieving high accuracy.

Many methods have been developed for automatic FER, which can be broadly categorized into traditional and deep learning approaches. Recent research trends have leaned toward the supremacy of Deep CNNs, given their capacity to outperform traditional methods and facilitate analysis without a priori knowledge of the underlying process model (Heinrich et al., 2021). Unlike traditional approaches, deep learning methods, exemplified by CNNs, employ an end-to-end training paradigm, wherein an intricate network structure with millions of adaptable parameters learns valuable features autonomously from extensive data, obviating the need for handcrafted features.

Various machine learning techniques have been harnessed for facial expression recognition in computer vision, with these facial expressions serving as direct proxies for the perceived engagement of online learners (Pons and Masip, 2017). For instance, Yang et al. (2017) amalgamated two CNNs trained separately on grayscale and Local Binary Patterns (LBP) images, while Hasani and Mahoor (2017) integrated CNN with Conditional Random Fields (CRF) to capture both spatial and temporal relations within facial images.

In the realm of economics, both unsupervised and supervised Machine Learning (ML) techniques are indispensable for reducing the dimensionality of large parameter spaces. Unsupervised methods extract generative features from unlabelled data for exploratory purposes, exemplified by models like latent Dirichlet allocation (Blei et al.,

2003), hierarchical Poisson factorization (Gopalan et al., 2015), diffuse prior distributions in large model classes (Athey and Imbens (2015, 2016)), and Principal Component Analysis and related approaches (Tipping and Bishop (1999)).

Supervised ML techniques, on the other hand, categorize and group factors via labelled datasets to predict outcomes accurately, with methods such as Least Absolute Shrinkage and Selection Operator (Varian, 2014), Ridge regression (Hoerl and Kennard, 1970), Random Forest (Breiman, 2001), and Support Vector Machines (Awad and Khanna, 2015).

Nonetheless, these algorithms, despite their utility, grapple with challenges such as model uncertainty, overfitting, and endogeneity, necessitating innovative solutions (Miller, 1984; Madigan and Raftery, 1994; Breiman, 1992, 1995; Gelfand and Dey, 1994). In this context, the methodology proposed in this article offers a novel approach, the Two-step Robust Bayesian Multiclass (TRBM) procedure, which addresses these issues by combining a Bayesian strategy for predictor selection with a frequentist procedure for multinomial logistic regression parameter estimation. The robustness of this method is underscored by employing informative priors tailored to potential outcomes.

8.2. E-learning Systems and Educational Platforms: An Overview

Online education and educational platforms have witnessed substantial growth in recent decades, buoyed by technological advancements and the pervasive reach of the Internet. In 2022, the e-Learning market's size surpassed $399.3 billion (Global Market Insight, 2022), with an impressive array of over 600,000 mobile education apps available on the App Store and Google Play (Khalimonchuk, 2022). The COVID-19 pandemic and associated lockdowns have expedited the transition from traditional to digital learning environments (Taglietti, 2021). These platforms empower educators and learners alike by providing access to course materials on various devices, fostering sustainable learning (Zardari et al., 2021). As these platforms ascend in prominence, it becomes imperative to comprehend their impact on User Experience (UX), engagement, and the emotional-cognitive sphere.

An effective e-learning system must prioritize usability and immersion to prevent users from encountering negative emotional and cognitive states while engaging with educational content. Consequently, research into UX in e-learning and AI is burgeoning and demands further exploration (Gartner Market Guide for K-12 Education Learning Management Systems, 2022; Şahin et al., 2022). It has been established that students'

The first step builds on and improve the Pacifico's (2020) analysis, who develops a ROB procedure implementing BMS and BMA to shrink large model space and parameter space when studying the dynamics of the economy in either time-invariant moderate data or time-varying high dimensional multivariate data. The methodological contribution consists of generalize the strategy to a multiclass decomposition problem to predict the probability of different possible outcomes of a categorically distributed dependent variable. In ML classification problems, multiclass or multinomial decomposition generally refers to the problem of classifying outcomes into more than two classes. The usefulness applying Bayesian inference is to find a set of predictors with highly strong explanatory powers on the outcomes of interest. Thus, a variable selection procedure is entailed highlighting the best subset of model solutions (or combination of predictors) predicting the outcome of interest. Here, best stands for the capability of the BMS to arrange and then estimate the model better fitting the data dealing with endogeneity issues, structural model uncertainty, and overfitting that affect standard shrinking procedures. More precisely, endogeneity issues entail due to unobserved heterogeneity (because of not directly measured factors) and omitted variables (because of not directly observed predictors), structural model uncertainty occurs when one or more model misspecification problems occur leading biased estimation, and overfitting problems refer when preferring multiple models (two or more predictors) than simple ones showing higher predictive capability. These problems would increase in a multiclass context.

The TRBM addresses the aforementioned issues by running a variable selection through MCIP priors. The latter are a generalization of the CIP priors developed in Pacifico (2020) since they are designed for any possible outcome solution to design all best parameters' distributions and estimating them by means of MCMC integrations. The contribution stands for simultaneously moving through multiclass model space and parameter space. By construction, only best submodel solutions with highly large significance will be selected, where significance stands for multiclass models having statistically significant predictive capability on the potential outcomes. Final best submodel solution chosen predicting the outcomes will correspond to the one with higher lBF.

Given the final best sample, the second step involves estimating a multinomial logistic regression to evaluate how the mean values of the potential predictors affect the outcomes (predicted probabilities). In ML and facial recognition e-learning platform, natural images are formed by the interaction of multiple factors related to different characteristics of individuals and scenario (see, e.g., Chellappa et al., 1995, Moses et al., 1996, and Turk

and Pentland, 1991). Thus, a generalized logistic regression version is entailed facing to multiclass problems and evaluating the average effect of changes in predictors on the change in the probability of different outcomes (known as marginal effects).

8.3.1. Bayesian Methods and MCMC Algorithms: First Step

The baseline model is:

$$Y_i = \theta_0 + \sum_{j=1}^{k} \theta_j x_{ji} + \varepsilon_i \quad 8.1$$

where Y_i is a $(n * 1)$ vector denoting the outcomes of a categorically distributed dependent variable with more than two levels, with i = 1, 2, …, n, θ_0 denotes a constant term, $X = (x_{1i}, x_{2i}, \dots, x_{ki})'$ is a $(n * k)$ matrix including observable continuous and/or discrete covariates, with j = 1, 2, …, k denoting the predictors (or covariates), $\theta_j = (\theta_1, \theta_2, \dots, \theta_k)$ is a $(k * 1)$ vector of unknown regression coefficients for k potential covariates, and $\varepsilon_i \sim N(0, \sigma^2)$ is a $(n * 1)$ vector of disturbances, with σ to be an unknown positive scalar. Here, the error component is assumed independent and identically distributed (i.i.d.) and homoskedastic.

The variable selection problem arises when there is some unknown subset of predictors X_{ik} with regression coefficients so small that it would be preferable to ignore them. Throughout this paper, I use two auxiliary indicator variables. The first corresponds to a vector χ_{ji}, containing every possible 2^m subset choices, with $\chi_{ji} = 0$ if θ_j is small (absence of k-th covariate in the model given i) and $\chi_{ji} = 1$ if θ_j is sufficiently large (presence of k-th covariate in the model given i). The second is a vector β_{ji}, corresponding to the regression parameter θ_j when it is sufficiently large (presence of predictors x_{ji} in the procedure for every i); conversely, the predictor x_{ji} will be dropped by the system.

Given the model in equation (1), the full model class set is:

$$\mathcal{F} = \{M_{ji} : M_{ji} \subset \mathcal{F}, M_{ji} \in \mathcal{M}, j \in K, \theta_0 + \theta_1 x_{1i} + \theta_2 x_{2i} + \cdots + \theta_k x_{ki} + \varepsilon_i\} \quad 8.2$$

where M_{ji} denotes a countable collection of candidate multiclass models containing the vector of the unknown parameters θ for n possible outcomes.

$$\mathrm{lBF}_{\xi,\tilde{j}} = \log\left\{\frac{\pi(M_{\xi i}|Y_i=n)}{\pi(M_{ji}|Y_i=n)}\right\} \quad 8.11$$

In this study, the scale of evidence used for interpreting the lBF in (8.11) is a generalized version of Kass and Raftery (1995):

$$\begin{cases} 0.00 \le \mathrm{lBF}_{\xi,\tilde{j}} \le 4.99 & \text{no evidence for submodel } M_{\xi i} \\ 5.00 \le \mathrm{lBF}_{\xi,\tilde{j}} \le 9.99 & \text{moderate evidence for submodel } M_{\xi i} \\ 10.00 \le \mathrm{lBF}_{\xi,\tilde{j}} \le 14.99 & \text{strong evidence for submodel } M_{\xi i} \\ \mathrm{lBF}_{\xi,\tilde{j}} \ge 15.00 & \text{very strong evidence for submodel } M_{\xi i} \end{cases} \quad 8.12$$

8.3.3. Prior Assumptions and MCMC Algorithms

All observable variables in (8.1) are hierarchically modelled via Multiclass Conjugate Informative Proper (MCIP) priors:

$$\pi(\beta, \sigma^2, \chi|Y) = \pi(\beta|\sigma^2, \chi) * \pi(\sigma^2|\chi, \beta) * \pi(\chi) \quad 8.13$$

The main thrust of the MCIP priors is analytically margining out of β and σ^2 from $\pi(\beta, \sigma^2, \chi|Y)$. Thus, the equation (13) can be rewritten as:

$$\pi(\beta|\chi) = N(\mu_\chi, \Sigma_\chi) \quad 8.14$$

$$\pi(\chi) = w_{|\chi|} * \binom{j}{|\chi|}^{-1} \quad 8.15$$

$$\pi(\sigma^2|\chi) = IG\left(\frac{\omega}{2}, \frac{v}{2}\right) \quad 8.16$$

with $N(.)$ and $IG(.)$ standing for Normal and independent Inverse-Gamma distributions, respectively, μ_χ is a hyperparameter for the auxiliary regression coefficients β_{ji}, $\Sigma_\chi = \Gamma_\chi \otimes V_\chi$ denotes the $[(k+1) * (k+1)$ covariance matrix, $w_{|\chi|}$ refers to the model prior choice related to the sum of the PMPs (or Prior Inclusion Probabilities) with respect to the model size $|\chi|$, through which the β_{ji}'s will require a non-0 estimate or the θ_{ji}'s should be included in the model, and ω and v are hyperparameters to be chosen in order to decrease with the size of the final selected subset $M_{\xi i}$. In this way, one would weight more according to model size and – setting $w_{|\chi|}$ large for smaller $|\chi|$ – assign more weight to parsimonious models. Moreover, the use of independent $IG(.)$ distribution allows cross-equation independence of the coefficient distributions.

The covariance matrix in (8.14) is obtained from two components: $V_k = (\sigma^2 * I_k)$, where σ^2 denotes the residual variance for the χ-th model, and the diagonal matrix $\Gamma_\chi = \text{diag}\left(I_k, a^2_{\chi_{1i}}\Sigma'_{x'_{1i}x_{1i}}, a^2_{\chi_{2i}}\Sigma'_{x'_{2i}x_{2i}}, \dots, a^2_{\chi_{ki}}\Sigma'_{x'_{ki}x_{ki}}\right)$, where $a^2_{\chi_{ji}}$ is a hyperparameter equal to 0 whether $\chi_{ji} = 0$ and equal to 1 otherwise, and $\Sigma'_{x_{ji}x_{ji}} = \frac{1}{2}\left(x'_{ji}x_{ji}\right)^{-1}$. Here, the k-th diagonal element of Γ_χ is appropriately set to be small or large according to whether $\chi_{ji} = 0$ or $\chi_{ji} = 1$, respectively.

All hyperparameters are known. More precisely, collecting them in a vector ψ, where $\psi = (\mu_\chi, w_{|\chi|}, \omega, v)$, they are treated as fixed and are either obtained from the data to tune the prior to the specific applications (such as $\mu_\chi, w_{|\chi|}, \omega$) or selected a priori to produce relatively loose priors (such as v). Here, μ_χ and $w_{|\chi|}$ are restricted to a benchmark prior $\max(k * n, |\chi|)$ according to the non-0 components of regression parameter θ_{ji}. This latter corresponds to a generalization of the standard objective prior of Zellner (1986).

Let $|\chi|$ be the model size, an ergodic Markov Chain (MC) to obtain posterior distributions is:

$$\beta^{(0)}, \sigma^{(0)}, \chi^{(0)}, \beta^{(1)}, \sigma^{(1)}, \chi^{(1)}, \beta^{(2)}, \sigma^{(2)}, \chi^{(2)}, \dots, \xrightarrow{d} \pi(\beta, \sigma^2, \chi|Y) \quad 8.17$$

where: $\beta^{(0)}$, $\sigma^{(0)}$, and $\chi^{(0)}$ are automatically assigned to the model selection procedure in absence of any relationship between potential predictors, with $\sigma^{(0)}$ denoting the full variance of Y. The MC sequence in (17) converges in distribution to the full posterior $\pi(\beta, \sigma^2, \chi|Y)$ and corresponds to an auxiliary Gibbs sequence. According to the variable selection procedure, in large problems (e.g., when k is more than 15), this latter would provide useful and faster information performing more with respect to model size.

A mixed-effects multinomial logistic regression model is useful in this context for analysing longitudinal nominal or ordinal response data. The model is parameterized to allow flexibility in the choice of contrasts used to represent comparisons across the response categories. Estimation is achieved using a maximum marginal likelihood solution that uses quadrature to numerically integrate over the distribution of random effects.

8.4. Real-Case Study

8.4.1. MOOC-based E-learning Platform

The e-learning platform for MOOC-based courses utilizes facial coding to measure student effectiveness and satisfaction in online learning. Through a webcam, the system performs various functions, including identity recognition, detection of strangers in the webcam's range, monitoring attention level through head and gaze orientation, recording satisfaction levels, identifying actions that bypass analysis systems or access other pages during lessons, and mapping modified data.

During the initial login phase, the system encodes the student's facial features as numerical metadata for subsequent validation. Prior to capturing the photo, users must acknowledge privacy terms and give consent. The system sets a threshold of acceptability, automatically discarding images below the threshold and requesting a retake.

Once the face-coding phase is complete, students can browse and access courses on the platform. When opening a video course, consent for activating the webcam is required again to monitor the student throughout the course. The system detects the presence of other individuals or distracting objects in the room, interrupting video playback. Anomalies in biometric data or focus loss also prompt the system to pause video playback.

At regular intervals, images are captured to analyse arousal, valence, attention level through gaze analysis, and student emotions. Attention anomalies trigger video pauses or webcam recalibration suggestions. Emotive analysis utilizes the Facial Coding System by Ekman. The platform ensures that the lesson page remains in focus and blocks video playback if it detects a loss of focus.

To progress to the next video or the course's final page, the user must complete a minimum number of attention checks. Failure to meet the requirements may require rewatching the video or retaking tests. Upon completing the course, users can download their certificates and track their progress on their profiles. Administrators and teachers have access to in-depth statistics, including attention, authentication, and satisfaction levels, allowing them to monitor course performance.

In summary, the e-learning platform incorporates facial coding to measure student engagement and satisfaction. It utilizes webcam monitoring, facial recognition, and various analysis techniques to ensure user attention, authentication, and compliance with course requirements.

These results are useful in guiding both policy makers and education providers. For policy makers, the opportunities arising from combining online training modules with traditional training are evident. This implies regulatory evolution that facilitates the introduction of hybrid modes in both secondary and undergraduate education. Regulatory evolution must necessarily be accompanied by an investment policy that enables colleges and universities to operate professionally and, in a manner, appropriate to evolving technological standards.

For individual educational institutions, be they secondary schools and universities, it will be important not only to upgrade the IT infrastructure and equipment, but also to train the administrative and teaching staff, making it possible to create up-to-date, high-level courses, as well as to make it possible for publics who cannot afford residential or full-time attendance to attend. Online modalities could then be useful in strengthening actions to support the reduction of school dropout, a very pronounced phenomenon in some countries. Lastly, especially for the European school and university sphere, the provision of online courses will go a long way toward promoting the internationalization and mobility of students not only from Europe, but also and especially from Asia and Africa. In this sense, online could help increase the competitiveness of education systems and their attractiveness. It will especially benefit those countries that already express tourist attractiveness and in particular those universities located in cities less traversed by tourist flows.

This research presents a two-step robust Bayesian variable selection procedure in a multinomial logistic regression to assess student performance using a convolutional neural network. The methodology combines a Bayesian strategy for predictor selection with a frequentist estimation procedure for parameter estimation. Conjugate informative proper mixture priors are used for designing parameter distributions, and MCMC algorithms are employed for constructing posterior distributions. The empirical application involves monitoring and evaluating student attention and attendance in training courses using an e-learning platform. The analysis, based on a survey of 56 students, highlights the benefits of e-learning systems in providing access to high-quality education. The robust Bayesian inference approach demonstrates effective performance in high-dimensional settings, emphasizing the importance of investment policies to support professional operation of educational institutions in the context of online and traditional training integration.

Credit Authorship Contribution Statement:

All authors have contributed to this work. Antonio Pacifico conducted experiments, analysed data, and contributed to the writing and editing of the manuscript. Luca Giraldi played a significant role in the experimental design, data analysis, and manuscript preparation. Elena Cedrola contributed equally to the experimental work, data analysis, and manuscript writing. The corresponding author is responsible for ensuring that the descriptions are accurate and agreed by all authors.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Chapter 9.

The Impact of Government Expenditure on Education in the Environmental, Social and Governance Models at World Level

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Abstract

In this chapter, we estimated the value of Government Expenditure on Education (GEE) in the context of Environmental, Social and Governance (ESG) dataset of the World Bank. We used data from 193 countries in the period 2011-2020. We used Panel Data with Fixed Effects, Panel Data with Random Effects, Pooled Ordinary Least Squares-OLS, and Weighted Least Squares-WLS. Our results show that the value of GEE is positively associated among others to "Case of Death, by communicable disease and maternal, prenatal and nutrition conditions", and "Unemployment", and negatively associated among others to "Hospital Beds" and "Government Effectiveness".

Furthermore, we applied the k-Means algorithm optimized with the Elbow method and we found the presence of four clusters. Finally, we confronted eight machine learning algorithms for the prediction of the future value of GEE. We found that the polynomial regression is the best predictive algorithm. The polynomial regression predicts an increase in GEE of 7.09% on average for the analysed countries.

Keywords: collective decision-making; education; legislatures and voting behaviour; corruption; policy formulation.

JEL Classification: D70; D72; D73; D78.

Ample scientific studies have shown that the managerial training to the ESG issues and the ESG performance of companies are interrelated on micro-economic aspect. This study, on the contrary, analysed the macro-economic dimension of the relationship between investment in GEE and the impact in terms of ESG. It managed to reach out to a very large set of countries, i.e.,193, using the ESG dataset of the World Bank.

The role of education and managerial models in the management of public and private organizations is relevant. It is managerial training that tends to determine the ability of companies to perform well or badly based on certain criteria, for example in their choice between profit maximization or stakeholder maximization (Ferri and Leogrande, 2022, 2021, 2017, 2015). The investigation of the role of education is necessary for a better comprehension of the impacts of ESG models at world level (Costantiello and Leogrande, 2023; Leogrande et al., 2023; Leogrande, 2023, Laureti and Costantiello, 2023, 2022; Laureti et al., 2023).

However, it is necessary to distinguish between developing and industrialized countries. In developing countries, education has both the function of the formation of human capital and the function of promoting economic development and avoiding poverty. In medium-high per capita income countries, on the other hand, education can be a lever to increase awareness and application of ESG models in companies. It is very probable that in the future the ESG model will be included in the MBA programs and engineering disciplines to raise consciousness regarding the issues of environmental, social, and ethical sustainability.

9.1. Literature Review on Education in the Environmental, Social and Governance

The role of the education of the CEOs to ESG methodologies is very relevant to allow the application of governance models that may be ESG compliant. Universities and companies should invest in the formation of new managerial training systems capable of orienting CEOs towards the application of ESG models. CEOs with degree in engineering, economics, and natural science show less sensitivity toward ESG performance in a set of 285 German companies listed in German DAX and MDAX (Kutzschbach et al., 2020). Students that have attended ESG courses during their MBA show greater sensitivity to work in companies with strong ESG commitment (Yao, 2022). Directors that show greater interest in ESG values also produce deeper ESG disclosures in Islamic listed companies (Ramadhan et al., 2023). There is a positive relationship between corporate social

indicators are in fact made up of a complex structure that brings together various elements and may be missing of the depth to analyse the individual aspects in the field of ESG structures. For example, ESG models are criticized for not having the ability to correctly quantify the various dimensions of environmental sustainability (Clément et al., 2022).

Finally, we can observe that education is one of sectors in which ESG oriented found tends to invest. Private investors that follow the ESG approach tend to invest in ethical sector such as in education (Cojoianu et al., 2022). The interest of ESG based found for the education sector is due to the strategic role of universities and schools as a force to change mentality either the professional sphere or the general pop-culture.

9.2. Econometric Model to Estimate the Determinants of Government Expenditure on Education (GEE)

The formula which was applied in this study enabled the researchers to make an econometric analysis to estimate the determinants of the GEE value for 193 countries in the period between 2011 and 2020. The dataset used is the Environmental, Social and Governance (ESG) of the World Bank. The data were analysed using the Panel Data with Fixed Effects, Panel Data with Random Effects, Pooled OLS and WLS and the results are tabulated in Table 9.1.

Table 9.1. Distribution of relationships between GEE and the variables CD, UT, TMPA, FPI, EU, HB and GE as described by P-values

Estimations of the Government Expenditure and Education									
WLS			Pooled OLS		Fixed Effects		Random Effects		
Variables	Coefficient	P-value	Constant	P-value	Constant	P-value	Constant	P-value	Average
Constant	2,4095	***	3,5915	***	1,57607	**	2,2988	***	2,46896
GE	-0,4529	***	-0,47001	**	-0,14383	***	-1,1459	***	-0,55314
CD	0,1860	***	0,18895	***	0,11273	***	0,1181	***	0,15146
EU	0,0003	***	0,00027	***	0,00043	***	0,0004	***	0,00036
FPI	0,0748	***	0,05765	***	0,03029	***	0,0354	***	0,04954
HB	-0,4008	***	-0,52122	***	0,36931	***	0,1951	*	-0,0894
TMPA	0,0803	***	0,11136	***	0,13667	***	0,1296	***	0,11448
UT	0,0576	**	0,09108	**	0,25656	***	0,17	**	0,14379

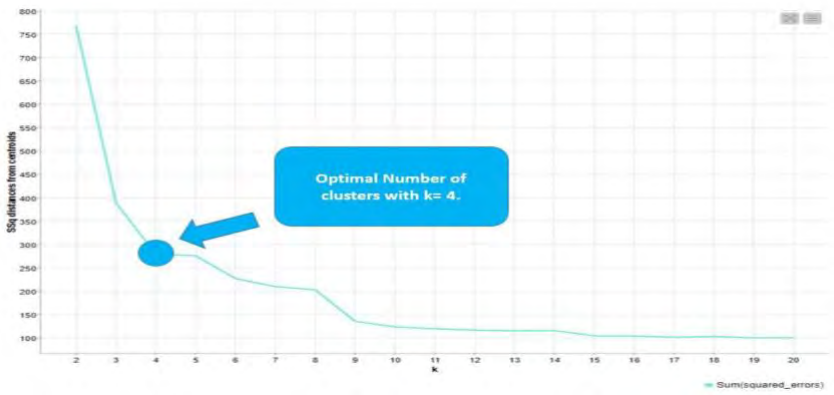
The results show that the value of GEE is associated with CD, UT, TMPA, FPI, EU, HB and GE. As the analysis shows, the positive relationship found between the value of

aggregate indicator; even though, in the long run, the investment in GEE should also increase the value of GE in low per capita income countries.

9.3. Cauterization with k-Means Algorithm Optimized with the Elbow Method

The other analysis the study made was considering a clustering with k-Means algorithm. The k-Means algorithm is unsupervised, and it is advised to indicate the optimal number of *k*, i.e., clusters (see Figure 9.1.). The study used the Elbow method to identify the optimal number of clusters and four clusters were found as a result; their rankings are given by C4 > C1 > C3 > C2, based on their GEE values.

Figure 9.1. Optimal number of clusters with k=4



Cluster 1 (C1). This group is ranked second in terms of GEE and consists of countries: Austria, Japan, Hungary, Czechia, Germany, Italy, Spain, United Kingdom, South Africa, Brazil, Australia, Tonga, Slovenia, Estonia, Montenegro, Algeria, New Zealand, Fiji, Ukraine, Morocco, Slovak Republic, Greece, Canada, Latvia, Poland, Russian Federation, Portugal, Bhutan, Croatia, Cabo Verde, Jordan, Tunisia, Kyrgyz Republic, Iraq, Bosnia and Herzegovina, Eswatini, Myanmar, Belize, Malta, Israel and Serbia. In this set, Brazil, South Africa, Morocco, and the Kyrgyz Republic invest most in education as percentage of GDP. The value of GEE in these countries is high for at least two reasons: first, these countries invest in education to participate in the knowledge economy and optimize their value added in the digital economy; second, these countries have low per capita income. In effect, countries with low per capita income tend to have a higher GEE. In fact, if we look within C1 countries, we see that countries with a higher per capita income have lower GEE than countries with lower per capita income. However, there are exceptions i.e., Ukraine, Vietnam, and Jordan. These countries with low average

in terms of GEE value. Sweden, Netherlands, Denmark, Namibia, Solomon Islands, Faroe Islands, Botswana, Iceland, Burundi, Aruba, Cuba, France, Finland, Belgium, Saudi Arabia, West Bank and Gaza, Seychelles, Mozambique, Brunei Darussalam, and Norway are categorized in this bunch. C4 is constituted of a group of countries concentrated above all in Europe with the addition of Saudi Arabia, Cuba, and some African countries. The Scandinavian countries have a long tradition of investment in the education and university system. France, Belgium, and the Netherlands also have high levels of GEE. The fact that European countries have higher levels of GEE is counterfactual. In effect, the level of GEE tends to be inversely associated to economic growth and high per-capita income. These European countries are the exceptions among countries with high GDP per capita. These countries have significantly benefited from the development of GEE. In fact, the economy of these European countries has efficiently acquired a hegemonic role in the context of the knowledge and innovation economy as demonstrated by the high ranks in terms of DESI score. Some considerations are necessary for the case of Cuba. Cuba is, in fact, an atypical case of a country with a low per capita income associated with a high level of human capital as demonstrated for example in the high professionalism achieved in the medical-pharmacological sector. The Cuban investment in education is a legacy of the communist regime of Fidel Castro who intended instruction as a force for the liberation of the people from oppression with significant benefits also for the national economy. The C4 countries are, therefore, leaders in terms of GEE for reasons related to the recognition of the strategic role of education for the development of the human capital and the promotion of economic growth at national level.

9.4. Predictions and Machine Learning for the Future Value of Government Expenditure on Education

The third and last type of analysis considered in this study was comparing *eight different machine-learning algorithms* for predicting the future value of the amount of GEE. 70% of the data was used to train the algorithms and the remaining 30% was used for prediction. Predicting government expenditure on education is a complex task, and many unforeseen events can influence the outcomes. While machine learning can provide insights and enhance predictions, it's essential to interpret the results cautiously and in the context of a broader understanding of socio-economic and political dynamics.

The researchers used the most efficient algorithm based on a maximization of the R-Squared value and a minimization of the value of the statistical errors, i.e., MAE, RMSE, and MSE. The types of machine-learning algorithms, their payoff values and rankings are displayed in Table 9.2. It is believed that the algorithm that scored the lowest rank was the "Best Predictor".

Table 9.2. Types of machine-learning algorithms, their payoff values and rankings

Machine-learning algorithms type	Payoff value	Remark
Polynomial Regression	4	Lowest payoff value i.e., best algorithm in the sense of prediction
Random Forest Regression	11	
Linear Regression	12	
Tree Ensemble Regression	14	
ANN-Artificial Neural Network	21	
Gradient Boosted Tree Regression	23	
Simple Regression Tree	27	
PNN-Probabilistic Neural Network	32	Highest payoff value i.e., worst algorithm in the sense of prediction

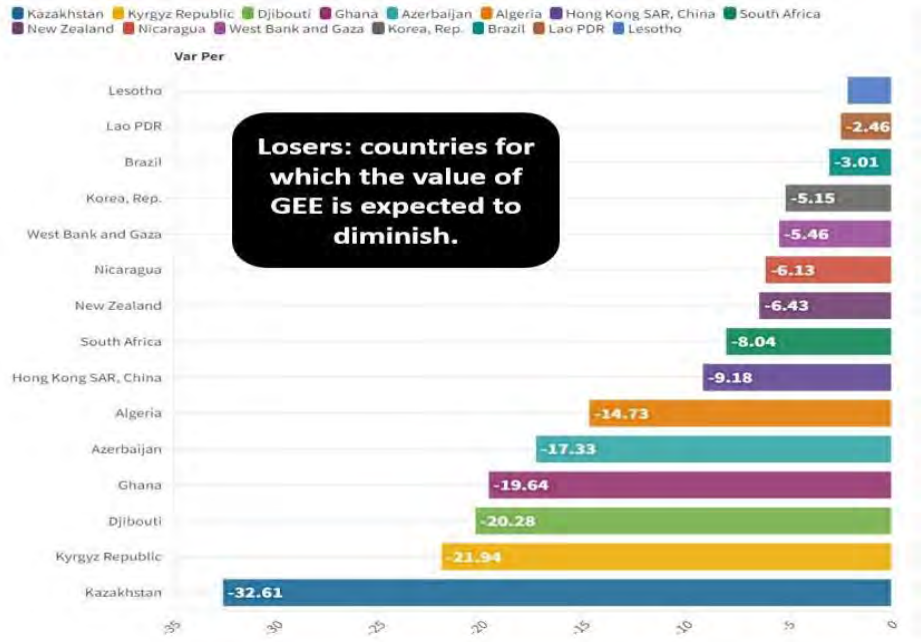
As it is indicated in Table 9.2, among the eight algorithms, the Polynomial Regression is the “Best Predictor”. The result of the analysis shows that polynomial regression, referring to values of R-squared and statistical errors, it is possible to identify countries for which is predicted and increase in GEE, i.e., winners. With the same prediction it is possible to find countries for which the value of GEE is expected to decrease i.e., losers.

Overall, by averaging between winners and losers’ countries, it appears that the mean value of GEE for the analysed countries is predicted to grow by 7.09%. If we consider winners countries in a ranking, then we found that South Sudan is in the first countries with an expected growth of GEE from 5.5 to 12.24 or equal to 6.69 equivalent to 120.55%. Ukraine is the second country with a variation from an amount of 13.09 up to 18.84 or equal to an amount of 5.76 units equal to 43.99%. Singapore is the third country with a variation from an amount of 11.81 up to 16.96 or equal to 5.15 equivalent to a value of 43.56%.

However, following the predictive analysis, it is also necessary to ask whether it is plausible that these countries have high growth rates in terms of GEE such as those identified above. Actually, at least within the analysed countries, there do not seem to exist political and economic conditions that can limit the growth of GEE. If we consider the

have a low level of GEE compared to the other countries that are considered losers. Since the value of GEE is already low, it is difficult for Azerbaijan, Lesotho, and Lao to further reduce its value. The value of GEE should instead increase for three reasons: *first,* it is already low and should achieve the average value of other similar countries, *second,* the investment of GEE in low per capita income tends to be greater, *third***,** Azerbaijan, Lesotho and Lao would increase the value of GEE to gain the economic advantages of digitization and the profits of high-tech sectors.

Figure 9.3. Losers: countries for which the value of GEE is expected to decrease



The aggregate value of GEE, for the countries analysis was conducted, is expected to grow on average of 7.09%. It is therefore necessary to investigate the economic meaning of the predicted value. It is believed that the prediction makes sense on an economic point of view for two reasons:

- Many countries, among those for which predictions were made, have low per capita income. These countries need to improve the level of GEE either to promote human capital either to trigger the economic development and growth;
- It is also understood that high per capita income countries need to improve GEE to better afford the challenges of artificial intelligence, digitalization and to strengthen the high-tech sector.

Declarations

Data Availability Statement. The data presented in this study are available on request from the corresponding author.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication.

Software

The authors have used the following software: Gretl for the econometric models, Orange for cauterization and network analysis, and KNIME for machine learning and predictions. They are all free version without licenses.

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Credit Authorship Contribution Statement

In this research work, all aspects of conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software development, supervision, validation, visualization, and the preparation of the original draft, as well as the subsequent review and editing, were jointly and equally contributed by Angelo Leogrande and Alberto Costantiello. This statement makes it clear that both authors have made an equal contribution to the research. It's essential to ensure transparency and fairness in authorship, especially when contributions are equal.

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APPENDIX Chapter 9

Table 9.3. Definition of variables

ACRONYM	Variables	Definition
GEE	Government expenditure on education, total (% of government expenditure)	General government expenditure on education (current, capital, and transfers) is expressed as a % of total general government expenditure on all sectors (including health, education, social services, etc.). It includes expenditure funded by transfers from international sources to government. General government usually refers to local, regional and central governments.
GE	Government Effectiveness	GE captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e., ranging from approximately -2.5 to 2.5.
CD	Cause of death, by communicable diseases	Cause of death refers to the share of all deaths for all ages by underlying causes. Communicable diseases

ACRONYM	Variables	Definition
	and maternal, prenatal and nutrition conditions (% of total)	and maternal, prenatal and nutrition conditions include infectious and parasitic diseases, respiratory infections, and nutritional deficiencies such as underweight and stunting.
EU	Energy use (kg of oil equivalent per capita)	Refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.
FPI	Food production index (20142016 = 100)	Food production index covers food crops that are considered edible and that contain nutrients. Coffee and tea are excluded because, although edible, they have no nutritive value.
HB	Hospital beds (per 1,000 people)	Hospital beds include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers. In most cases beds for both acute and chronic care are included.
TMPA	Terrestrial and marine protected areas (% of total territorial area)	Terrestrial protected areas are totally or partially protected areas of at least 1,000 hectares that are designated by national authorities as scientific reserves with limited public access and areas managed mainly for sustainable use. Marine protected areas are areas of intertidal or subtidal terrain-and overlying water and associated flora and fauna and historical and cultural features-that have been reserved by law or other effective means to protect part or all of the enclosed environment. Sites protected under local or provincial law are excluded.
UT	Unemployment, total (% of total labour force)	Refers to the share of the labour force that is without work but available for and seeking employment (modelled ILO estimate).

List of Tables

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List of Abbreviations

AI	Artificial Intelligence
AR	Augmented Reality
ACT	American College of Technology
BMS	Bayesian Model Selection
BMA	Bayesian Model Averaging
CBTs	Computer-based Tests
CD	Cause of death, by communicable diseases and maternal, prenatal and nutrition conditions (% of total)
CSCL	Computer Supported Collaborative Learning
ChatGPT	Chat Generative Pre-Trained Transformer
COL	Commonwealth of Learning
CNNs	Convolutional Neural Networks
DE	Distance Education
DRC	Democratic Republic of Congo
ETA	Education and Training Authority
EU	Energy use (kg of oil equivalent per capita)
FER	Facial Expression Recognition
FGD	Focused Group Discussions
FPI	Food production index (20142016 = 100)
GBL	Game-Based Learning
GE	Government Effectiveness
GEE	Government expenditure on education, total (% of government expenditure)

HB	Hospital beds (per 1,000 people)
HLIs	Higher Learning Institutions
HLPIs	Higher Learning Private Institutions
HERQA	Higher Education Relevance and Quality Assurance
HU	Harambee University
lBF	log Bayes Factor
ICDE	International Council for Open and Distance Education
IEP	Individualized Education Plans
ITeS	Information Technology enabled Services
KII	Key Informal Interviews
KPIs	Key Performance Indicators
K-12	From kindergarten to 12th grade
LMS	Learning management systems
MBA	Management of Business Administration
MC^{F}	Fully Enumerated Markov Chain Monte Carlo
MLR	Multinomial Logistic Regression
MOOCs	Massive Open Online Courses
MOODLE	Modular Object-Oriented Dynamic Learning Environment
MCIP	Multiclass Conjugate Informative Proper
MIT	Massachusetts Institute of Technology
MCMC	Monte Carlo Markov Chain
MOOCs	Massive Open Online Courses
ML	Machine Learning

NEP	New Education Policy
NLP	Natural Language Processing
OER	Open Educational Resources
ODeL	Open Distance e-Learning
OTP	One-time Password
PMPs	Posterior Model Probabilities
PBL	Project-Based Learning
ROB	Robust Open Bayesian
Q&A	Questions & Answers
SDGs	Sustainable Development Goals
SOLO	Structure of Observed Learning Outcomes
TMPA	Terrestrial and marine protected areas (% of total territorial area)
TRBM	Two-step Robust Bayesian Multiclass
UK	United Kingdom
VR	Virtual Reality
UT	Unemployment, total (% of total labour force)
UX	User Experience

List of Key Concepts

Key concepts	General description	Page(s)/ Page interval
Active Learning	A method of learning in which students are actively or experientially involved in the learning process and where there are different levels of active learning, depending on student involvement.	74.
Bayesian inference	Method used to make statistical inferences in which subjective probabilities are assigned to the distributions generating the data.	167, 171, 183.
Behavioural monitoring system	Refers to technological solutions that track and analyse individuals' behaviours, actions, and interactions to gather insights, detect patterns, and make informed decisions based on observed behaviour.	24.
Blended Learning	Mix of online and classroom learning. It requires students to be proficient in using online tools and the internet to enhance their learning experience.	60, 61.
Connectedness	Connectedness is when students feel that adults and peers care about their Learning and them as individuals.	74, 75.
Collaboration	A learning approach involves pupils working together on activities or learning tasks in a group that is small enough to ensure everyone participates. Pupils in the group may work on separate tasks contributing to a common overall outcome or work together on a shared task.	28, 62, 66, 74.
Co-creation	Co-creation is a process of student engagement that encourages students and staff members to move away from the curriculum as delivery to the curriculum as the joint making of meaning.	75.
Cyber Security	Refers to the information contents physically transmitted and stored in media, whereby their access and calculation for specific utilities can result in unjust social consequences, and /or undesired by the individuals the information concerns.	35.

Key concepts	General description	Page(s)/ Page interval
Cultural diversity	The variety of cultural backgrounds, traditions, and perspectives within educational settings and its influence on curriculum design and teaching strategies.	141, 149, 154.
Cultural sensitivity	Awareness and respect for cultural differences in language use, literary interpretation, and communication styles.	123-138.
Data analytics	The process of examining, cleaning, transforming, and interpreting large volumes of data to uncover valuable insights, patterns, trends, and correlations that can inform decision-making, improve processes, and drive innovation. It involves applying various techniques, tools, and algorithms to extract meaningful information from data and turn it into actionable knowledge.	25, 27.
Data-driven society	A social and economic environment where data collection, analysis, and utilization are integral to decision-making, innovation, and problem-solving across various sectors.	20, 21, 30.
Data-driven technology	The utilization of data, often in large quantities, to inform and influence technological processes, decisions, and outcomes. This approach involves collecting, analysing, and interpreting data to gain insights, make predictions, optimize operations, and drive innovation across various domains.	29.
Data ingestion	Process of collecting and importing data from various external sources into a target system or storage environment.	17-19.
Data integration	Process of combining and merging data from various sources into a unified and cohesive view	17-19.
Delivery of course content	The way in which educational content is conveyed from instructor to students.	112, 128, 134.
Detailed syllabuses	A document that outlines all the essential information about a college course. It lists the topics you will study, as well as the due dates of any coursework including tests, quizzes, or exams.	108, 111, 127.

Key concepts	General description	Page(s)/ Page interval
Digital content	Any type of media that an organization uses to engage with visitors, customers, or users of their website or applications, distributed by online delivery systems	106, 134, 154.
Digital learning	Learning which is facilitated by digital technology that gives students some element of flexibility and control over time, place, path and/or pace.	37, 38, 40, 41,58.
Digital transformation	It is process to create new data from using digital technologies used in every sphere of human activities, e.g., business processes, knowledge creation, learning, etc.	74, 106, 170.
Digitalization of learning	It is a process by which learning is facilitated and promoted using digital technologies	44.
Digital education	The electronic transformation of education by adopting digital technologies to support and promote learning and education	22, 36, 39, 40, 41, 46, 47, 53.
Digital literacy	The ability to navigate and critically assess digital information, fostering students' skills in a technology-driven educational landscape.	52, 104, 136, 154, 156-158.
Education equity	Ensuring fair and accessible education opportunities for all students, regardless of their cultural or socio-economic backgrounds.	39.
E-learning platform	Integrated set of interactive online services providing trainers and learners – involved in education with information and tools – to support and enhance education delivery and management.	166, 179, 181.
E-learning	The electronic model of learning	45, 46, 103-106, 168,
Education intelligence	Focuses on leveraging data to optimize educational processes, identify areas for improvement, and tailor educational experiences to the needs of students, teachers, and institutions.	21, 22.
Education 4.0	Education 4.0 is a technique of learning that is connected with the fourth industrial revolution and focuses on transforming the future of education through advanced technology and automation.	74.

Key concepts	General description	Page(s)/ Page interval
Game-based learning	Is a form of learning that uses games and simulations to help students learn.	79-86, 88, 96.
Gamification	Gamification is the concept of applying game design elements to non-game contexts in order to make it more appealing and fun. It is usually used in non-game contexts, like in marketing for example, where the elements of games are brought in to make the marketing activity more appealing to the user.	27, 81, 86.
Global connectivity	The interconnectedness of societies, cultures, and individuals worldwide due to advances in communication, transportation, and technology.	141, 142, 150, 152, 155.
Global citizenship	Fostering learners' understanding of their roles as responsible and culturally aware citizens in a globalized world.	147, 156.
Informatics	Informatics specifically refer to the satellite communication designs with the physical contents of information.	38-40.
Inclusive education	Creating an environment that accommodates diverse learners, including those with different linguistic backgrounds and abilities.	51, 141, 147, 153, 158.
Individual privacy	It requires any personal information about an individual to be processed securely and confidentially. In a school setting, this includes information relating to both staff and pupils.	15, 21, 23, 40.
Information asymmetry	On the physical characteristic of information, information asymmetry refers to the natural entropic process with the strengths of signals carrying the information; on the content generation in theory acceptance, information asymmetry refers to the qualitative and quantitative cognitive gaps between agents on the receptance spectrum.	35, 37, 40.
Information recall	The incorporation of multiple academic disciplines, such as technology, sociology, and psychology, to enrich language and literature education.	59.

Key concepts	General description	Page(s)/ Page interval
Interdisciplinary approaches	The incorporation of multiple academic disciplines, such as technology, sociology, and psychology, to enrich language and literature education.	39.
K-12 Education	K-12 education is the foundation of a student's academic career. It provides the basic knowledge and skills necessary for success in college and the workplace.	66, 168.
Language and literature education	The process of teaching and learning languages and literature, encompassing various methodologies, approaches, and pedagogical techniques.	141-157.
Language acquisition	The process of learning a new language, considering factors such as immersion, context, and socio-cultural influences.	151.
Learning and teaching	Teaching and Learning is an educational setting environment of instructors who provide content, objectives, and goals; learners who receive knowledge, performance, and produce outcomes	145.
Learning management system	It is a software tool that allows you to create, deliver, and report on training courses and programs.	20, 28, 29, 64, 104, 117, 127, 168.
Linguistic proficiency	The level of competency and fluency in a particular language, which impacts communication skills and language acquisition strategies.	143, 146, 148, 150, 158.
Literary analysis	The ability to navigate and critically assess digital information, fostering students' skills in a technology-driven educational landscape.	143, 151.
Logistic regression	Data analysis technique used to find the relationship between two data factors and then predict the value of one of them. The prediction has a finite number of outcomes like ‘yes’ or ‘no’.	168-171, 174, 175, 177, 182.
Machine learning	Use and development of algorithms and statistical methods to analyse and draw inferences from patters in data.	199, 200.
MCMC	Class of algorithms for sampling from a probability distribution in order to obtain a sample of the desired distribution by recording states from the chain.	166, 171, 173, 176, 183.

Key concepts	General description	Page(s)/ Page interval
m-Learning	Learning using mobile devices	45.
Multilingualism	The presence and use of multiple languages within a given context, highlighting the challenges and opportunities it presents for education.	141-158.
Neural cognitive	Neural cognitive refers to the cognitive neuroscience elements involved both in the natural processes of human psychiatric development and in the interactive developments between human and machines generating information.	36-40, 81, 107, 165, 166.
Open AI	OpenAI is an American artificial intelligence research laboratory consisting of the non-profit OpenAI, Inc.	46.
Online learning	Also known as distance education or eLearning, refers to the delivery of educational content and instruction through the internet. It allows students to take courses and earn degrees remotely, without the need to be physically present on campus.	13, 48, 74, 107, 108, 111, 128-134, 165, 179.
Provision of feedback	Through sharing audio-video recordings, encourage students' interaction, communicate clearly, offer actionable insights, and keep yourself updated technologically.	109,115, 129, 134.
Pedagogical practices	Various approaches and methods employed by educators to effectively teach languages and literature in diverse and digitally connected classrooms.	141, 143, 157, 158.
Personalized learning	Is designed to provide a customized educational experience optimized for each student.	13, 14, 21, 30, 62, 68.
Posterior probability	Probability conditioned on randomly observed data.	171-175, 182.
Posterior distributions	Empirical realization of a probability distribution based on a prior.	167, 177, 178, 183.
Prior assumptions	Assumption presumed to be true without any assessment of specific events or further proof.	176.
Project-based learning	Involves guiding students in identifying a real-world problem and developing a solution for it.	61, 66, 67.

Key concepts	General description	Page(s)/ Page interval
Safe exam browser	It is a web browser environment to carry out e-assessments safely. The software turns any computer temporarily into a secure workstation. It controls access to resources like system functions, other websites and applications and prevents unauthorized resources being used during an exam.	136.
Semiotics	The term is used broadly in the chapter, referring to any elements, such as linguistic, sound, imagery elements etc., that can induce human cognitive processes.	36.
Student interaction	It refers to interaction of students with content, interaction with the instructor, and interaction with peers	106.
Technological advancements	The integration of technological tools, digital resources, and online platforms in language and literature education to enhance learning experiences.	61, 141-143, 157.
Transmissive		59.
Variable selection procedure	Method used to choose among a large set of variables – included in a particular model – an appropriate subset better fitting the data and then removing those that are irrelevant or redundant.	171, 181, 183.

"Digital Future in Education: Paradoxes, Hopes, and Realities" is an exploration of the transformative power of technology in the area of education. This book provides a comprehensive and thought-provoking analysis of the complex interplay between technology and education, shedding light on the paradoxes, inspiring hopes, and confronting realities that define the digital landscape in learning.

The authors don't shy away from addressing the practical realities that educators and institutions face in their quest to embrace the digital future. Through real-world examples and case studies, the book provides a pragmatic view of the challenges and obstacles that must be overcome to ensure equitable access to quality education in a digital age.

PhD Hab. Professor Daniela Dănciulescu, University of Craiova, Romania

Book Series Coordinator

"Digital Future in Education: Paradoxes, Hopes and Realities" is not merely a contemplative discourse; it is also an example of hope. It highlights the inspiring stories of educators and institutions that have successfully leveraged technology to enhance learning outcomes and reach students in innovative ways. These stories serve as powerful examples of the positive impact of technology when wielded with purpose and vision.

The writing style is engaging and accessible, making it a valuable resource for educators, policymakers, and anyone interested in the future of education. The book's organization is well thought out, with each chapter building upon the previous one, creating a cohesive narrative that is easy to follow.

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