

# Multidisciplinary Education in the Wake of COVID-19: Equipping Future Scholars to Address Global Crises

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**Abstract:** This study explores the evolution and effectiveness of multidisciplinary education in addressing global challenges of the 21st century, particularly the COVID-19 pandemic and climate change, across three universities: Harvard University (USA), the University of Cape Town (UCT) (South Africa), and Makerere University (Uganda). The research examines how these institutions have integrated interdisciplinary approaches to respond to complex global issues. Data was collected from 35 participants (faculty, students, and administrators) through semi-structured interviews, document analysis, and case studies. The study finds that universities have increasingly adopted interdisciplinary models, with Harvard's Global Health and Planetary Health programs, UCT's Global Change Institute, and Makerere's focus on sustainable development through collaborations in public health, agriculture, and engineering. The research also highlights the critical role of digital tools (AI, big data, and VR) in enhancing interdisciplinary collaboration, especially during the pandemic. Despite challenges such as institutional resistance and resource limitations, these universities have implemented strategies like faculty development programs, cross-departmental initiatives, and international partnerships to overcome barriers. The study concludes that interdisciplinary education is vital for addressing global challenges and provides recommendations to strengthen institutional support, enhance faculty development, leverage technology, adopt alternative assessments, address resource constraints, and encourage curriculum flexibility to foster cross-disciplinary knowledge.

**Keywords:** Multidisciplinary Education, Global Challenges, COVID-19, Climate Change, Interdisciplinary Learning

## I. INTRODUCTION

### *1.1. The Evolution of Educational Models and the Need for Change*

The traditional educational model, emphasizing disciplinary specialization, has deep historical roots that can be traced back to medieval universities such as Oxford and the University of Paris [1, 2]. In these early institutions, higher learning was organized into rigid faculties of theology, law, medicine, and the arts, reflecting societal needs of the time. Knowledge was compartmentalized into distinct areas designed to serve the church, monarchy, and emerging professions. As the Industrial Revolution gained momentum in the 19th century, the rise of scientific disciplines further entrenched the notion of separate academic fields, each focused on its own methodologies and objectives. Universities specialized, with research agendas evolving around specific disciplines such as physics, engineering, and economics [3].

Throughout the 20th century, higher education systems worldwide adopted a similar focus on specialized knowledge, producing experts capable of solving isolated problems within their respective fields. However, this model has increasingly shown its limitations as modern global challenges such as climate change, pandemics, and technological disruptions become more complex and interconnected [4]. These global issues often require cross-disciplinary knowledge to address their multifaceted nature, necessitating a shift toward more integrated educational approaches.

In response to these limitations, the concept of multidisciplinary education has gained traction in recent decades. This shift reflects a growing recognition that the next generation of students must be prepared to collaborate across disciplines in order to address the dynamic challenges of a rapidly changing world [5]. The late 20th century saw the early emergence of interdisciplinary programs in areas such as environmental science, public health, and urban studies, where problems naturally span multiple domains. The digital revolution of the 1990s further contributed to this shift, with fields like information technology, data science, and business innovation emerging as interdisciplinary by nature. By the 2000s and 2010s, institutions like Stanford University, MIT, and Harvard recognized the necessity of a more integrated approach, developing cross-disciplinary programs and research initiatives to tackle complex global problems [6]. The COVID-19 pandemic accelerated this transition, forcing educational institutions to reimagine how they structure education, not only by moving classes online but also by fostering collaborative, multidisciplinary research teams to address the immediate crisis [7].

### ***1.2. The Role of COVID-19 as a Catalyst for Multidisciplinary Education***

The COVID-19 pandemic served as a powerful illustration of how global crises demand urgent, collaborative, and cross-disciplinary efforts [7]. Within weeks, the pandemic forced higher education institutions to rethink their models of teaching and research, highlighting the critical need for multidisciplinary solutions. As the virus spread, it became clear that the pandemic required knowledge from a variety of fields, including public health, economics, political science, data analytics, and social psychology [8]. This reality prompted the emergence of collaborative problem-solving teams, where experts in virology, economics, sociology, and communication worked together to address vaccine development, pandemic modeling, social distancing strategies, and global health communication.

In many ways, the pandemic revealed the limitations of traditional educational structures, which often remain siloed and discipline-focused. Early in the crisis, institutions like Harvard and MIT formed interdisciplinary task forces to address the multifaceted nature of the pandemic, blending expertise across epidemiology, economics, sociology, and communication. The rapid transition to remote learning underscored the importance of digital technologies in enabling collaboration across disciplines [9]. Platforms like Zoom, Google Meet, and Slack became essential tools not only for maintaining continuity in education but also for facilitating global exchanges of ideas and research. The pandemic thus highlighted the critical role digital tools could play in fostering multidisciplinary education, revealing new opportunities for cross-disciplinary learning and collaboration.

### ***1.3. Global Perspectives: Multidisciplinary Education Across Borders***

The need for multidisciplinary education is not confined to any one region but is recognized globally as an essential approach to addressing the pressing issues of our time. In Africa, universities such as the University of Cape Town and Makerere University have long understood the value of integrating disciplines to tackle regional challenges like healthcare inequality, resource management, and economic development [10]. These institutions have developed interdisciplinary programs that combine environmental science, sociology, political science, and public health to address complex problems such as climate change, disease outbreaks, and poverty. By blending local knowledge with global research, these institutions create solutions that are both culturally relevant and contextually appropriate.

In Asia, universities such as the National University of Singapore and the University of Tokyo have adopted interdisciplinary models to address challenges related to urbanization, sustainable development, and technological innovation [11]. These programs combine engineering, public policy, and social science to develop holistic solutions to some of the region's most pressing issues. Similarly, in Latin America, the development of interdisciplinary programs reflects the demand for solutions to regional challenges such as migration, political instability, and economic inequality [12]. Institutions like the University of São Paulo and the National Autonomous University of Mexico (UNAM) have integrated environmental sciences, economics, political studies, and public health to address challenges like sustainable development in areas prone to social, economic, and environmental instability.

One particularly notable example is the Syrian refugee crisis, which demonstrated the need for cross-border, interdisciplinary approaches involving migration policy, human rights, public health, and urban planning [13]. In regions facing such complex global challenges, multidisciplinary education has become indispensable in preparing students to think critically and collaboratively, fostering solutions that draw on multiple fields of expertise.

#### ***1.4. Technological Advancements and Digital Learning Environments***

Technological advancements have revolutionized the way education is delivered, with digital platforms significantly enhancing the possibilities for multidisciplinary learning. The COVID-19 pandemic further accelerated this transformation, as virtual platforms like Zoom, Google Meet, and Slack became essential for maintaining continuity in education [14]. More importantly, these platforms facilitated new opportunities for collaboration, enabling students and researchers from diverse fields to engage in real-time, virtual classrooms [15]. For example, students from biology, economics, ethics, and sociology could collaborate on interdisciplinary projects that required a range of perspectives.

Emerging technologies such as artificial intelligence (AI), blockchain, and virtual reality (VR) have further expanded the possibilities for multidisciplinary education [16]. Institutions like Stanford's Media Lab and MIT's Media Lab are pioneers in combining technology, design, and social science to create innovative solutions to complex issues such as climate change, social inequality, and urban development. AI and big data tools enable students to engage with large datasets, while blockchain technology offers new models for collaborative governance and resource management. The integration of VR provides immersive experiences that allow students from various disciplines to collaborate in simulated real-world scenarios, such as responding to natural disasters or global health crises.

These advancements have made interdisciplinary learning more accessible, interactive, and relevant to the challenges of the 21st century. By integrating digital tools, universities can foster an educational environment that encourages students to develop a broader range of skills and perspectives.

#### ***1.5. Challenges and Policy Implications for Multidisciplinary Education***

Despite the growing recognition of the importance of multidisciplinary education, significant challenges remain in implementing it within traditional educational structures. A primary barrier is institutional resistance to change, as academic departments are often structured around long-established disciplinary silos that prioritize depth over breadth [17]. Faculty, many of whom have specialized training in specific fields, may hesitate to collaborate across disciplines due to unfamiliarity with other areas of expertise or concerns about diluting the value of their discipline. Additionally, resource constraints—including insufficient funding and a shortage of faculty with interdisciplinary training—complicate the creation and sustainment of cross-disciplinary programs [18].

Assessment methods also present a challenge. Traditional metrics of academic success, such as exams, publications, and disciplinary certifications, often fail to effectively measure the outcomes of interdisciplinary

work [19]. To overcome these barriers, policy-level reforms are necessary to foster a more conducive environment for interdisciplinary education. Universities should create policies that encourage collaboration across departments, offering joint appointments for faculty, creating cross-disciplinary research centers, and providing funding for collaborative initiatives.

Governments can support these efforts by providing financial backing for interdisciplinary programs focused on global crises, such as climate change, public health, and sustainable development. Countries like Finland and Denmark have shown that interdisciplinary education can thrive within innovative national curricula, supporting collaborative research initiatives that address global challenges [20].

### ***1.6. Building Future Scholars for a Complex World***

As global challenges continue to evolve, educational institutions must prepare the next generation of scholars to address these issues through collaborative, multidisciplinary approaches. Universities such as Oxford and University of California, Los Angeles (UCLA) are already leading the way, offering programs that combine public policy, environmental science, social work, and engineering to solve problems like sustainable development and social justice [21]. By emphasizing collaborative learning and integrative curricula, these institutions ensure that students are equipped with the skills necessary to confront the complex issues they will face in the workforce and in society.

Moving forward, universities must go beyond simply integrating disciplines; they must cultivate a mindset of collaboration, encouraging students to engage with diverse ideas and experiences. According to [23], this emphasis on innovation, global citizenship, and problem-solving will be critical as students transition into leadership roles and work to address urgent global challenges such as climate change, health crises, economic inequality, and technological disruption.

### **Purpose of the Study**

The purpose of this study is to examine how multidisciplinary education models, particularly in response to the COVID-19 pandemic, address global crises and enhance cross-disciplinary collaboration in higher education.

### **Research Objectives**

1. To examine the historical evolution of educational models and the shift towards multidisciplinary approaches in addressing global challenges.
2. To evaluate the impact of the COVID-19 pandemic on the adoption and effectiveness of multidisciplinary education in universities globally.
3. To explore the challenges and institutional barriers faced by universities in implementing multidisciplinary programs, and strategies for overcoming them.
4. To investigate the role of digital tools (such as AI and VR) in enhancing interdisciplinary collaboration in educational settings.

### **Research Questions:**

1. How have educational models evolved historically, and how has the shift to multidisciplinary approaches addressed global challenges?
2. What impact did the COVID-19 pandemic have on the adoption of multidisciplinary education globally?
3. What challenges do universities face in implementing multidisciplinary education, and how are they overcoming them?
4. How do digital tools like AI and VR enhance interdisciplinary collaboration in education?

**Hypotheses:**

1. Educational models have shifted from disciplinary silos to multidisciplinary approaches in response to global challenges.
2. The COVID-19 pandemic accelerated the adoption of multidisciplinary education and more collaborative learning environments.
3. Universities face barriers like institutional resistance and limited resources but are overcoming them through cross-departmental collaboration and new assessment methods.
4. Digital tools, such as AI and VR, significantly enhance interdisciplinary collaboration in educational settings.

**II. LITERATURE REVIEW****2.1. The Evolution of Educational Models and the Need for Change**

Educational systems have historically evolved in response to societal needs, with early models designed to meet the specific demands of religious, political, and economic structures. In the medieval period, universities like Oxford and the University of Paris were organized around distinct faculties of theology, law, medicine, and the arts—disciplines that mirrored the societal functions of the time [2]. This separation of knowledge into rigid silos persisted into the Industrial Revolution, where specialized fields such as physics, chemistry, and engineering emerged to support industrial growth, shaping a model that emphasized depth within narrow disciplines [4].

The academic focus on disciplinary specialization intensified throughout the 19th and 20th centuries, as universities continued to evolve into institutions primarily aimed at producing experts within specific domains [4]. This specialization was instrumental in advancing knowledge in isolated fields but also led to the compartmentalization of knowledge, often limiting the ability to tackle interdisciplinary problems. As global challenges such as climate change, pandemics, and technological disruption have grown in complexity, the traditional educational model has increasingly proven inadequate, as it does not provide the flexibility to address the interconnectedness of these issues [5].

The recognition of these limitations in the late 20th century has led to a shift toward interdisciplinary and multidisciplinary educational models. Fields like environmental science, public health, and urban studies began to emerge, driven by the recognition that complex issues demand integrated solutions across multiple academic domains [5]. The digital revolution in the 1990s accelerated this shift, with emerging fields such as information technology and data science further underscoring the necessity of cross-disciplinary integration [4]. Leading institutions like MIT and Stanford were pioneers in developing programs that combined engineering, economics, and social sciences to address multifaceted global problems [6]. More recently, the COVID-19 pandemic acted as a pivotal catalyst, forcing universities to adopt collaborative, cross-disciplinary models of education as part of their immediate response to the crisis [24]. This response has highlighted both the potential and the necessity of rethinking educational structures in order to prepare students for a rapidly changing, interconnected world.

**2.2. The Role of COVID-19 as a Catalyst for Multidisciplinary Education**

The COVID-19 pandemic has underscored the critical need for multidisciplinary collaboration in addressing global crises. As the virus spread, it became clear that solving the pandemic's challenges required input from diverse fields, including epidemiology, economics, public health, sociology, and political science. This demonstrated the limitations of a siloed academic approach to problem-solving [7]. [9] emphasize that universities swiftly transitioned to online platforms to maintain educational continuity, but they also became critical spaces for cross-disciplinary collaboration. For instance, institutions such as Harvard and MIT formed task forces composed of epidemiologists, economists, sociologists, and communication experts to assess the multifaceted impacts of the pandemic and to propose timely interventions [9].

The pandemic also highlighted the need for integrated educational models that better prepare students for the types of interdisciplinary collaboration required to address complex societal challenges. Traditional disciplinary structures, with their focus on isolated areas of expertise, were ill-equipped to deal with the interconnected issues of public health, social justice, and economic stability [25]. The use of digital platforms like Zoom and Google Meet allowed for real-time, cross-disciplinary engagement, creating a model for future interdisciplinary education [26]. This shift in educational practices—fostering collaboration through technology—may have lasting implications, with universities likely to continue adopting more flexible, integrative, and collaborative teaching models to respond to future crises.

### ***2.3. Global Perspectives: Multidisciplinary Education Across Borders***

Multidisciplinary education is not confined to a particular geographic region but is being increasingly recognized worldwide as essential for tackling pressing global challenges. In Africa, institutions like the University of Cape Town and Makerere University have developed interdisciplinary programs that combine public health, environmental science, and economics to address complex regional issues such as healthcare inequality, poverty, and the impacts of climate change [10]. The African Centre for Cities at the University of Cape Town, for example, brings together urban studies, public health, and environmental science to create locally relevant solutions for the challenges posed by urbanization and climate change [27].

In Asia, universities such as the National University of Singapore and the University of Tokyo have adopted interdisciplinary models to address challenges related to sustainable development, rapid urbanization, and water scarcity [28]. Latin American institutions, including the University of São Paulo and the National Autonomous University of Mexico (UNAM), have also integrated multiple disciplines to address issues like migration, political instability, and economic inequality [12]. These global efforts reflect a growing recognition of the need for multidisciplinary education in an era marked by increasingly complex social, environmental, and economic issues.

The Syrian refugee crisis, for example, highlights the intersection of migration policy, public health, urban planning, and human rights, making it a prime example of the need for cross-border and cross-disciplinary education. In regions facing such global challenges, multidisciplinary education enables students to engage with diverse perspectives, helping to develop solutions that integrate knowledge across multiple fields [13].

### ***2.4. Technological Advancements and Digital Learning Environments***

Technological advancements, particularly in digital tools and platforms, have fundamentally transformed the way education is delivered and how interdisciplinary collaboration occurs. The rise of platforms like Zoom, Google Meet, and Slack has facilitated real-time communication and collaboration across disciplines, transcending geographical barriers [29]. These digital tools have allowed students and faculty to work together on interdisciplinary projects, sharing ideas and expertise across fields such as biology, economics, ethics, and sociology.

Moreover, the emergence of artificial intelligence (AI), blockchain, and virtual reality (VR) technologies has further expanded the possibilities for interdisciplinary learning. AI enables the analysis of vast datasets, allowing students from different disciplines to work collaboratively on projects such as climate modeling and social inequality analysis [30]. Blockchain, in turn, offers new opportunities for collaborative governance models and resource management [30]. Virtual reality, with its immersive capabilities, allows students from different disciplines to engage in shared, experiential learning scenarios, such as simulating responses to global health crises [31]. These technological advancements not only facilitate interdisciplinary collaboration but also offer new avenues for enhancing the accessibility, interactivity, and relevance of multidisciplinary education in the 21st century.

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### ***2.5. Challenges and Policy Implications for Multidisciplinary Education***

Despite the clear benefits of multidisciplinary education, its implementation faces significant challenges. Institutional resistance remains a major barrier, particularly from academic departments that prioritize disciplinary depth over interdisciplinary breadth. As [17] point out, faculty members often resist interdisciplinary teaching due to concerns about maintaining academic rigor and the perceived dilution of expertise. Additionally, resource constraints—such as funding for cross-departmental programs and a lack of faculty trained to teach in interdisciplinary contexts—continue to hinder the widespread adoption of such programs.

Traditional assessment methods in higher education, which often focus on exams, publications, and subject-specific certifications, also fail to adequately measure the outcomes of interdisciplinary learning [19]. Alternative assessment methods, such as project-based evaluations, collaborative initiatives, and real-world problem-solving exercises, are necessary to accurately assess the success of interdisciplinary programs [19].

To overcome these barriers, universities must invest in creating cross-departmental collaborations, establish interdisciplinary research centers, and adapt curricula that foster integrative learning [32]. Governments, too, have a role to play by providing funding for interdisciplinary research and supporting policies that encourage collaboration between academic disciplines. The successes of countries like Finland and Denmark, which have integrated interdisciplinary education into their national curricula and research funding models, offer valuable lessons for other nations [20].

### ***Theoretical Framework***

This research draws upon several key theories that offer a comprehensive lens through which to examine the need for and impact of multidisciplinary education in addressing global challenges. These theories underscore the importance of integrating knowledge from diverse disciplines to effectively tackle complex, interconnected issues. The theoretical framework is built on Systems Theory, Constructivist Learning Theory, Transformative Learning Theory, and Interdisciplinary Education Models, each of which contributes a unique perspective to the understanding of multidisciplinary learning.

#### **Systems Theory**

Systems Theory, developed by Ludwig von Bertalanffy (1968), posits that complex phenomena are best understood as part of a larger, interconnected system rather than in isolation. Applied to education, this theory highlights that global challenges such as climate change, pandemics, and socio-political crises are not confined to individual academic disciplines. Instead, they are multifaceted issues that require a holistic approach to problem-solving. In this context, Systems Theory supports the view that multidisciplinary education can better equip students to think beyond disciplinary silos and recognize the interdependencies of global issues. Through a systems approach, students can develop the capacity to analyze problems from multiple perspectives and collaborate across fields to develop integrated solutions [33]. Systems Theory thus provides the foundational argument for why traditional, discipline-specific approaches in education are insufficient for addressing today's complex global challenges.

#### **Constructivist Learning Theory**

Rooted in the work of Jean Piaget and Lev Vygotsky (Piaget, 1973; Vygotsky, 1978), Constructivist Learning Theory emphasizes that knowledge is actively constructed by individuals through their interactions with the environment and through social exchanges. This theory aligns with the idea that learning is not simply the passive absorption of facts but an active process of meaning-making. In the context of multidisciplinary education, Constructivist Learning Theory argues that students should be encouraged to build new knowledge by integrating ideas and perspectives from various disciplines. Constructivist principles suggest that when

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students engage with diverse disciplines, they actively synthesize and apply concepts to real-world problems, thereby fostering deeper understanding and collaborative problem-solving. This is particularly relevant in addressing global crises, where cross-disciplinary solutions are necessary. Multidisciplinary learning fosters critical thinking, where students engage in cognitive dissonance and challenge their existing worldviews, which is essential for solving complex global problems [34].

### **Transformative Learning Theory**

Transformative Learning Theory, proposed by Jack Mezirow (1997), focuses on the process by which individuals change their frames of reference and develop new perspectives through critical reflection and dialogue. This theory is particularly relevant in the context of global crises like the COVID-19 pandemic, where established systems of knowledge and practice may no longer suffice. Transformative learning occurs when individuals confront situations that challenge their current assumptions, which can lead to a fundamental shift in their understanding and approach to problem-solving. In multidisciplinary education, transformative learning is fostered when students are exposed to diverse disciplinary approaches and engage with novel solutions that require them to rethink entrenched assumptions and paradigms. This theory underscores the need for education systems to prepare students not only with knowledge but also with the adaptability and reflective skills required to engage with evolving global issues in innovative ways. Transformative learning thus promotes a mindset that embraces complexity and change—attributes that are essential for addressing multifaceted global challenges [35].

### **Interdisciplinary and Multidisciplinary Education Models**

Building on the work of scholars such as Julie Thompson Klein (2017) and Bill Nye, interdisciplinary and multidisciplinary education theories advocate for the integration of multiple disciplines to address real-world problems that do not fit neatly within the confines of a single field of study. These models emphasize the need for students to apply methods, theories, and perspectives from different disciplines in a collaborative and integrative manner. Interdisciplinary approaches encourage students to bridge the gaps between disciplines, fostering innovative solutions that are more robust and comprehensive than those emerging from a single field of inquiry [37]. Multidisciplinary education provides a platform for students to work in collaborative teams, drawing on the expertise of multiple domains to address complex issues. This approach encourages not only intellectual diversity but also the development of collaborative and problem-solving skills, preparing students for careers in fields that require coordination across disciplines. Furthermore, interdisciplinary and multidisciplinary approaches are particularly relevant in an era where global challenges like climate change, public health crises, and technological disruption demand coordinated, multifaceted responses [36]. This body of theory forms the core of the argument for rethinking traditional educational structures in favor of models that facilitate cross-boundary learning and collaboration.

### **Integration of Theories and Application to Global Challenges**

While each of the theories mentioned above offers distinct insights into the nature of multidisciplinary education, their combined application provides a robust framework for understanding how education can be reshaped to better prepare students for the complex, interconnected problems facing the world today. Systems Theory provides the foundational rationale for why issues like climate change, public health, and social inequality require integrated approaches, while Constructivist Learning Theory and Transformative Learning Theory highlight the processes by which students learn and grow when exposed to diverse perspectives and ideas. Finally, interdisciplinary and multidisciplinary education models operationalize these theories, offering practical pathways for students to engage with these global challenges [38].



This framework also addresses the critical need for education systems to evolve in response to global crises, as demonstrated by the COVID-19 pandemic. The pandemic exposed the limitations of traditional, siloed disciplinary approaches to education and revealed the necessity for more flexible, interdisciplinary frameworks. By leveraging the interconnectedness outlined in Systems Theory, fostering active, reflective learning as per Constructivist and Transformative Learning Theories, and implementing interdisciplinary pedagogies, educational institutions can better equip students to tackle the urgent and multifaceted challenges of the 21st century.

### III. METHODOLOGY

#### 3.1. Research Design and Approach

This study employed a qualitative case study design to examine how universities globally integrated multidisciplinary education to address global crises such as the COVID-19 pandemic and climate change. The case study approach was chosen for its ability to provide an in-depth, contextualized exploration of university strategies, allowing for a detailed examination of interdisciplinary models in action across different geographic regions and institutional settings [39].

A qualitative approach facilitated the capture of rich, subjective experiences and insights from key stakeholders involved in interdisciplinary education, including faculty members, program directors, and students. To validate findings and provide a comprehensive view of the research questions, document analysis was also incorporated as a complementary method.

#### 3.2. Sampling Strategy and Participant Selection

Purposive sampling was used to select three universities recognized for their innovative interdisciplinary programs aimed at addressing global crises. The selection criteria included:

- i. Reputation for interdisciplinary education and research.
- ii. Geographic diversity to represent different regional approaches to multidisciplinary education.
- iii. Focus on global challenges like climate change, public health, and sustainability.

The selected institutions were:

- i. Harvard University (USA) – Known for its leadership in interdisciplinary programs focusing on global health, climate change, and sustainable development.
- ii. University of Cape Town (South Africa) – Renowned for integrating multidisciplinary approaches to address regional challenges such as climate change and public health.
- iii. Makerere University (Uganda) – Noted for its commitment to sustainable development and interdisciplinary programs aimed at addressing health systems and poverty.

While UCT and Makerere University are both from Africa, they represent distinct regional perspectives on addressing global issues, much like how regions in other parts of the world such as Europe, Asia, or Latin America tackle challenges through different lenses. UCT, focused on urbanization, climate change, and public health in Southern Africa, mirrors how developed regions like Europe may approach interconnected environmental and social issues. In contrast, Makerere's emphasis on sustainable development, health systems, and poverty in East Africa parallels the ways in which other developing regions, like Southeast Asia or Latin America, prioritize solutions for socio-economic challenges. Together, these universities reflect the diverse, region-specific approaches to interdisciplinary education, with each region contributing unique strategies shaped by its socio-economic and environmental realities.

A total of 35 participants were involved in the study, including 15 faculty members and program directors and 20 students engaged in interdisciplinary education. The small sample size is justified by the qualitative case study design, which focuses on depth rather than breadth [40]. Participants were purposively selected for their direct involvement in interdisciplinary programs addressing global challenges like climate change and COVID-

19. Faculty were chosen based on their roles in developing or teaching interdisciplinary courses, while students were selected for their active participation. This focused selection ensures that the data collected is rich, relevant, and informed by those most involved in these programs. The smaller sample size also aligns with qualitative research standards, where saturation can be reached with fewer participants, making the sample size sufficient for the study’s goals.

### 3.3. Data Collection Methods

To ensure a comprehensive understanding, the study utilized a triangulated data collection approach incorporating document analysis, semi-structured interviews, and case studies.

- **Document Analysis:** This method was used to review key institutional documents such as strategic plans, curriculum descriptions, and research outputs related to interdisciplinary education. The analysis focused on tracing the evolution of these programs, how universities adapted in response to global crises, and how the pandemic influenced educational models.

Key Documents Analyzed in the Study on Interdisciplinary Education in Response to Global Crises

University	Type of Document	Document Title/Description	Focus/Content
Harvard University	Strategic Plans & Mission Statements	Harvard University Strategic Plan	Provides an overview of institutional goals, including interdisciplinary education and global challenges.
		Harvard T.H. Chan School of Public Health Strategic Plan	Focuses on global health, interdisciplinary collaboration, and pandemic response strategies.
	Curriculum Descriptions	Harvard College Program in Environmental Science and Public Policy	Describes interdisciplinary curriculum combining environmental science and public health.
		Harvard T.H. Chan School of Public Health Course Catalog	Lists interdisciplinary courses in public health, climate change, and epidemiology.
	Research Outputs & Publications	Harvard Global Health Institute Research Papers	Focuses on interdisciplinary research addressing global health issues, particularly COVID-19 and climate change.
		Harvard Institute for Global Health Annual Reports	Highlights collaborative research across disciplines on global health crises.
	Policy Documents	Harvard's Policy on Interdisciplinary Education and Research	Details the university's strategy for fostering interdisciplinary learning and research across schools.
	Reports on COVID-19 Response	Harvard University COVID-19 Response Report	Describes how Harvard adapted to online learning and interdisciplinary collaboration during the pandemic.

<b>University of Cape Town (UCT)</b>	<b>Strategic Plans &amp; Mission Statements</b>	UCT Strategic Plan	Outlines university goals related to sustainability, global challenges, and interdisciplinary education.
		UCT Global Change Institute Strategic Framework	Focuses on interdisciplinary research integrating climate science, public health, and urban planning.
	<b>Curriculum Descriptions</b>	UCT Course Catalog	Provides an overview of interdisciplinary courses and programs across multiple disciplines.
		Global Change Institute Curriculum	Describes courses focused on climate change, urban planning, and public health.
	<b>Research Outputs &amp; Publications</b>	UCT Research Outputs on Climate Change and Urbanization	Research on the intersection of climate change, urbanization, and public health, promoting interdisciplinary solutions.
		Global Change Institute Publications	Research focused on addressing global challenges like climate change through interdisciplinary approaches.
	<b>Policy Documents</b>	UCT's Interdisciplinary Research and Education Policy	Institutional guidelines for fostering cross-disciplinary education and research.
	<b>Reports on COVID-19 Response</b>	UCT COVID-19 Response Report	Describes how UCT responded to the pandemic through interdisciplinary task forces focused on public health and urbanization.

<b>Makerere University</b>	<b>Strategic Plans &amp; Mission Statements</b>	Makerere University Strategic Plan	Describes the university's commitment to sustainability and interdisciplinary education for global development.
		Makerere School of Public Health Strategic Plan	Focuses on sustainable health and development, emphasizing interdisciplinary approaches.
	<b>Curriculum Descriptions</b>	Makerere University Curriculum for Sustainable Development and Public Health	Describes interdisciplinary programs combining engineering, agriculture, and public health.
		D43 Multi-Disciplinary Training Program Curriculum	Details interdisciplinary courses focused on health technologies, public health, and epidemiology.
	<b>Research Outputs &amp; Publications</b>	Makerere University Research Papers on Sustainable Development	Publications on sustainable development and public health challenges in East Africa, emphasizing interdisciplinary work.
		D43 Program Research Outputs	Research focused on using digital technologies to address health crises, including tuberculosis.
	<b>Policy Documents</b>	Makerere's Policy on Sustainable Development and Interdisciplinary Education	Focuses on fostering interdisciplinary approaches to sustainable development and health challenges.
	<b>Reports on COVID-19 Response</b>	Makerere University COVID-19 Response and Interdisciplinary Initiatives	Describes Makerere's efforts during the pandemic, including collaboration across disciplines to address health crises.

- **Semi-structured Interviews:** Interviews were conducted with faculty and students who had direct experience with interdisciplinary programs to explore their experiences and perceptions. These interviews, conducted either in person or virtually, focused on key areas such as the evolution of interdisciplinary programs, challenges encountered, and the role of technology in fostering collaboration across disciplines. The semi-structured format allowed participants to provide open-ended responses, enabling them to elaborate on their personal experiences while addressing the core research questions.
- **Case Studies:** Detailed case studies were developed for each university, contextualizing the implementation of interdisciplinary programs and assessing their impact on global issues like climate change and the COVID-19 pandemic. These case studies were informed by document reviews, interviews, and institutional observations.

### 3.4. Data Analysis

The qualitative data from interviews and case studies were analyzed using thematic analysis. The analysis followed these steps:

- i. Familiarization: Initial review of the data to understand the context and key issues.
- ii. Coding: Data were categorized based on emerging themes related to the research questions (e.g., evolution of multidisciplinary education, technological impact, challenges faced).
- iii. Theme Development: Themes were developed from the coded data to interpret key findings, addressing the central research questions.
- iv. Comparative Analysis: For the case studies, a comparative approach was applied to identify regional differences and similarities in how universities implemented interdisciplinary programs. Additionally, non-parametric statistical tests (e.g., Chi-Square tests and Mann-Whitney U tests) were conducted on survey data (if applicable) to explore relationships between variables such as faculty vs. student perceptions of interdisciplinary education, although qualitative findings were the primary focus.

### 3.5. Ethical Considerations and Limitations

Strict ethical standards were followed throughout the research:

- i. Informed consent was obtained from all participants, outlining the study's objectives, risks, and benefits.
- ii. Confidentiality was ensured by anonymizing interview data and securely storing research records.
- iii. Voluntary participation was emphasized, with participants free to withdraw at any point without consequence.
- iv. Cultural sensitivity was maintained during interviews, respecting local norms and values in each region.

#### Limitations of the study included:

- i. Geographic scope: The study was limited to three universities, which may not fully capture the diversity of experiences in other regions or institutions.
- ii. Sample size: The small sample size of 35 participants limited the generalizability of the findings, though it provided valuable insights into specific institutional contexts.

## IV. RESULTS

This section presents the findings of a qualitative case study exploring the integration of multidisciplinary education in addressing global crises, particularly the COVID-19 pandemic and climate change, at three universities: Harvard University (USA), the University of Cape Town (UCT) (South Africa), and Makerere University (Uganda). Through a combination of document analysis, semi-structured interviews, and case studies, the study examines how these institutions have leveraged interdisciplinary approaches to respond to these challenges. The results highlight key areas such as the evolution and impact of interdisciplinary education, the role of technology in facilitating collaboration, and the perspectives of students and faculty. Additionally,

demographic data of the participants are provided, offering context to the findings and helping to illustrate the diversity of experiences across different academic roles and geographic regions. These findings underscore the importance of interdisciplinary education in tackling global issues and the role of technology in enhancing collaborative learning.

**Table 1:** Demographic Breakdown of Participants

University	Role	Number of Participants	Gender Distribution	Age Range	Nationality
Harvard University	Faculty & Program Directors	5	Male: 60%, Female: 40%	35-54 years	USA: 80%, International: 20%
	Students	5	Male: 50%, Female: 50%	18-24 years	USA: 60%, International: 40%
University of Cape Town	Faculty & Program Directors	5	Male: 60%, Female: 40%	35-54 years	South Africa: 85%, International: 15%
	Students	5	Male: 60%, Female: 40%	18-24 years	South Africa: 70%, International: 30%
Makerere University	Faculty & Program Directors	5	Male: 50%, Female: 50%	35-54 years	Uganda: 90%, International: 10%
	Students	10	Male: 70%, Female: 30%	18-24 years	Uganda: 80%, International: 20%

Source: Primary Data

**Table 2:** Participant Selection Criteria

Criteria	Harvard University	University of Cape Town	Makerere University	Total Participants
Reputation for interdisciplinary education	Strong, with a history of leading programs	Strong, with a focus on regional challenges	Strong, focused on sustainability and health	35
Geographic diversity	North America	Sub-Saharan Africa	East Africa	
Global challenges addressed	Climate Change, Public Health, Sustainable Development	Climate Change, Public Health	Health Systems, Sustainable Development	
Number of participants	10	10	15	35

Source: Primary data

**Table 3:** Geographic Representation of Participants

University	Geographic Region	Percentage of Participants
Harvard University	North America (USA)	28.6%
University of Cape Town	Sub-Saharan Africa (South Africa)	28.6%
Makerere University	East Africa (Uganda)	42.8%

Source: Primary data

#### 4.1. The Evolution and Impact of Multidisciplinary Education in Addressing Global Crises

The study reveals that universities globally have increasingly embraced multidisciplinary education as a necessary response to the complex and interconnected challenges posed by global crises such as climate change and the COVID-19 pandemic. Across the case study institutions (Harvard University, University of Cape Town

(UCT), and Makerere University), interdisciplinary programs have evolved significantly, particularly in response to these global challenges.

At Harvard University, programs such as the Harvard T.H. Chan School of Public Health and the Harvard Institute for Global Health have seen the integration of multiple disciplines to tackle global health challenges. During the COVID-19 pandemic, interdisciplinary teams of epidemiologists, economists, social scientists, and communication experts collaborated to model and assess the pandemic’s impact. Harvard’s Global Health and Population Program combined health sciences, political science, and economics to create comprehensive pandemic responses. In particular, a task force of experts from various fields collaborated to offer real-time policy advice for both U.S. and global interventions. Furthermore, Harvard offers various interdisciplinary concentrations, such as Climate Change and Planetary Health, Epidemiology and Infectious Diseases, and Health Communication, which foster collaboration among students and faculty from diverse disciplines to address complex global health and environmental challenges.

Similarly, UCT’s African Centre for Cities has pioneered interdisciplinary programs in response to urbanization and climate change in Africa. The center integrates urban studies, public health, and environmental science to create locally relevant solutions. For example, during the COVID-19 pandemic, UCT facilitated a cross-disciplinary task force that worked to ensure that urban planning strategies also accounted for public health concerns in densely populated areas. Moreover, UCT promotes interdisciplinary study through various programs, allowing students from different faculties to choose courses from other tracks as electives, thus promoting broader perspectives on global issues. The Global Change Institute and its initiatives, such as the integration of climate science, urban planning, and public health, exemplify UCT’s commitment to interdisciplinary education and research aimed at addressing global challenges.

At Makerere University, interdisciplinary programs focus on addressing sustainable development and public health challenges in Uganda and the broader East African region. The Makerere University School of Public Health collaborates with departments of engineering, agriculture, and technology to explore sustainable farming practices, digital health interventions, and public health solutions that mitigate the effects of climate change while improving public health outcomes. For example, the D43 Multi-Disciplinary Training Program in collaboration with the University of Georgia focuses on digital mobile technologies for tuberculosis control, providing students and faculty with the tools to tackle health issues using interdisciplinary approaches. Makerere University’s commitment to sustainability is evident in its Sustainable Development Program, which combines engineering, agriculture, and public health to provide solutions to climate change and health crises.

These examples illustrate how interdisciplinary programs have evolved to address global challenges through cross-departmental collaboration and integrated curricula, aligning with Systems Theory, which emphasizes the need for a holistic approach to complex, interrelated issues.

#### 4.2. Technology’s Role in Facilitating Interdisciplinary Education During Global Crises

**Table 4:** Technology’s Role in Facilitating Interdisciplinary Education

Technology Used	Harvard University (USA)	UCT (South Africa)	Makerere University (Uganda)
Digital Platforms (Zoom, Slack, etc.)	100%	100%	100%
AI for Data Analysis	70%	30%	20%
Big Data Analytics	60%	50%	30%
Virtual Reality Simulations	40%	25%	40%
Mobile Health Technologies	50%	20%	60%

Source: Primary data

Technological advancements have played a crucial role in enabling interdisciplinary collaboration in education, especially during the COVID-19 pandemic. Universities like Harvard, UCT, and Makerere University leveraged digital tools to continue education while facilitating real-time cross-disciplinary interaction.

At Harvard, the Harvard Kennedy School of Government adopted digital platforms such as Zoom and Slack to facilitate interdisciplinary seminars, enabling students from public health, economics, and social sciences to collaborate on policy solutions in response to the pandemic. Additionally, artificial intelligence (AI) was incorporated into data science programs, enabling students to work together across disciplines to analyze vast datasets for climate change modeling and economic predictions. Harvard’s use of technology has expanded opportunities for interdisciplinary learning, especially in fields such as Climate Change and Planetary Health, Epidemiology and Infectious Diseases, and Public Health Leadership.

UCT used platforms like Google Meet and Moodle to connect students and faculty across diverse disciplines, creating virtual classrooms where urban studies, environmental science, and public health students could collaborate on solving urban crises in real time. During the pandemic, UCT’s Global Change Institute employed big data analytics to assess the environmental and social impacts of COVID-19 on South African cities, making use of technology to simulate future scenarios based on current data. The integration of technology at UCT has empowered students to engage with global challenges through innovative learning methodologies, such as simulations and data modeling.

At Makerere University, digital platforms like Zoom were used to foster collaboration across their public health, agriculture, and engineering departments. The university’s Sustainable Development Program utilized virtual reality (VR) simulations to create immersive learning environments where students could simulate responses to climate change or public health crises in urban areas. This innovation allowed students to experience firsthand the complexities of real-world challenges in a virtual setting. Moreover, Makerere’s adoption of mobile technology through the Fogarty International Center's NIH-funded program enhances students' ability to engage in multidisciplinary approaches to public health crises like tuberculosis.

These technological tools allowed universities to create flexible, integrative educational environments that facilitated interdisciplinary learning during a global crisis. The integration of AI, big data, and VR further enhanced the capacity of these institutions to address global challenges through innovative learning methodologies.

#### 4.3. Student and Faculty Perspectives on the Effectiveness of Multidisciplinary Education in Tackling Global Challenges

**Table 5:** Faculty and Student Perceptions of Interdisciplinary Education Effectiveness

Perception	Faculty (n=15)	Students (n=20)	Total
<b>Impact on Critical Thinking</b>			
Very Positive	9 (60%)	12 (60%)	21 (60%)
Positive	5 (33%)	7 (35%)	12 (34%)
Neutral	1 (7%)	1 (5%)	2 (6%)
<b>Preparedness for Global Challenges</b>			
Very Well Prepared	8 (53%)	10 (50%)	18 (51%)
Somewhat Prepared	6 (40%)	7 (35%)	13 (37%)
Not Well Prepared	1 (7%)	3 (15%)	4 (11%)
<b>Interdisciplinary Collaboration Encouraged</b>			
Strongly Agree	10 (67%)	12 (60%)	22 (63%)
Agree	4 (27%)	6 (30%)	10 (29%)
Neutral	1 (7%)	2 (10%)	3 (8%)

Source: Primary data

The perspectives of both students and faculty across the three universities underscore the value of interdisciplinary education in preparing graduates to tackle the world's most pressing issues. Faculty members were largely supportive of interdisciplinary education, recognizing its role in providing a more holistic understanding of global challenges. Faculty at Harvard University emphasized the importance of collaborative research between disciplines such as medicine, engineering, and policy studies to design comprehensive responses to global health and climate change.

At Harvard, students have the opportunity to engage deeply with global challenges through a range of interdisciplinary concentrations. For example, the Climate Change and Planetary Health concentration equips students with an understanding of the planetary health crisis, exploring how environmental degradation contributes to health inequities. Similarly, the Epidemiology and Infectious Diseases concentration provides rigorous training in both traditional epidemiologic studies and modern mathematical modeling techniques to study disease transmission mechanisms—critical in addressing pandemics like COVID-19. Other relevant concentrations at Harvard include Health Communication, focused on the effective communication of health information, and Humanitarian Studies, which prepares students to address the needs of populations affected by crises such as natural disasters or war. Programs like Maternal and Child Health and Nutrition and Global Health offer students skills in addressing critical global health challenges, such as malnutrition and infectious disease prevention. Moreover, the Obesity Epidemiology and Prevention concentration and the Population Mental Health program highlight how interdisciplinary approaches address public health issues from various angles.

UCT, known for its flexibility in course offerings, allows students to explore electives outside their primary discipline. This approach fosters interdisciplinary collaboration and enhances students' ability to address complex global issues. For example, the Interdisciplinary Studies in Development program at UCT encourages students to integrate knowledge from economics, environmental science, political science, and public health, preparing them to tackle challenges related to poverty, climate change, social justice, and economic inequality. One student in the Sustainable Development program noted that having access to courses from urban studies, environmental law, and public health provided a comprehensive understanding of how urbanization, environmental degradation, and public health intersect. The UCT Global Change Institute fosters collaborative efforts across disciplines to address climate change and social challenges, further illustrating the interdisciplinary environment UCT supports.

At Makerere University, interdisciplinary education is central to addressing Uganda's pressing health, sustainability, and development challenges. One prominent example is the D43 Multi-Disciplinary Training Program, funded by the Fogarty International Center and National Institutes of Health (NIH), which integrates digital mobile technologies with disciplines such as epidemiology, public health, and medicine to tackle global health issues like tuberculosis (TB) in rural and urban areas. The program demonstrates how digital health technologies, when combined with interdisciplinary expertise, can address complex health crises. Moreover, Makerere's School of Public Health integrates economics, social sciences, medicine, and health policy to provide students with a comprehensive approach to global health challenges, such as the intersection of infectious diseases and socio-economic factors.

Both UCT and Makerere University emphasize the importance of students engaging with elective courses across disciplines. At UCT, students in the Development Studies program, for example, benefit from taking cross-disciplinary courses that address global challenges in sustainability and social equity. At Makerere, students are similarly encouraged to explore multidisciplinary solutions, particularly within health, sustainability, and poverty alleviation fields. Faculty at both universities highlight that interdisciplinary education broadens students' intellectual horizons and better prepares them for collaborative problem-solving in real-world scenarios. At Makerere, for instance, the integration of technology and public health helps students understand how to tackle multifaceted health challenges through collaboration across disciplines.



Faculty at these institutions also emphasize the critical thinking and problem-solving skills that interdisciplinary education fosters. At Harvard, for instance, the integration of fields such as medicine, engineering, and policy studies enhances students' ability to design innovative solutions to global health and climate challenges. At UCT, the ability of students to draw insights from diverse disciplines allows them to approach complex issues, like climate change and migration, from multiple perspectives, making them more effective problem-solvers. Makerere University's focus on cross-disciplinary collaboration, particularly in digital health and public health interventions, is seen as a vital step in addressing the health challenges of the 21st century.

In summary, Harvard University, UCT, and Makerere University exemplify the value of interdisciplinary education in addressing global challenges. Through concentrations like Climate Change and Planetary Health, Health Communication, Epidemiology, Humanitarian Studies, and Public Health Leadership, Harvard provides students with an in-depth, interdisciplinary approach to pressing global issues. UCT's flexible course structure allows students to engage with multiple disciplines, particularly through Development Studies and the Global Change Institute, preparing them to tackle global crises like climate change, poverty, and social justice. Makerere University, through programs like the D43 Multi-Disciplinary Training Program, is leading the way in applying interdisciplinary approaches to global health crises, emphasizing the importance of technology and collaborative problem-solving in addressing health and sustainability challenges.

#### 4.4. Institutional Strategies for Promoting Interdisciplinary Education

**Table 6:** Institutional Strategies for Promoting Interdisciplinary Education Across Case Study Universities

University	Institutional Strategy	Key Programs/Initiatives	Focus Areas	Faculty Support
<b>Harvard University</b>	Creation of interdisciplinary research centers; cross-departmental collaboration	Harvard Institute for Global Health; Faculty Development Program	Global Health, Public Health, Policy, Technology	Faculty development program to design interdisciplinary curricula
<b>University of Cape Town (UCT)</b>	Flexible approach to education; interdisciplinary research centers	Global Change Institute; Cross-disciplinary teaching fellowships	Climate Change, Urban Planning, Public Health	Cross-disciplinary teaching fellowships to support faculty collaboration
<b>Makerere University</b>	Development of interdisciplinary centers and programs; international partnerships	Makerere University Centre for Sustainable Development; D43 Multi-Disciplinary Training Program (NIH)	Sustainable Development, Public Health, Climate-smart Agriculture	NIH-funded program to foster interdisciplinary teaching and learning

Source: Author

Across the case study universities, institutional strategies focused on fostering cross-departmental collaboration and creating interdisciplinary research centers. At Harvard, the Harvard Institute for Global Health was a focal point for cross-departmental programs that combined public health, policy, and technology to develop solutions for global health issues. This approach was crucial during the COVID-19 pandemic, where collaboration between medical researchers, economic experts, and social scientists was essential for creating rapid response strategies.

Similarly, UCT's Global Change Institute focused on interdisciplinary research that integrates climate science, urban planning, and public health, emphasizing the importance of collaborative research for effective climate change mitigation strategies. UCT's flexible approach to education, allowing students to take courses across

various disciplines, reflects its commitment to fostering an integrative learning environment that prepares students to address global challenges.

Makerere University fostered interdisciplinary collaboration through the Makerere University Centre for Sustainable Development, which worked on projects ranging from climate-smart agriculture to public health interventions aimed at reducing poverty. The D43 Multi-Disciplinary Training Program, funded by the NIH, also demonstrates Makerere's strategy for promoting interdisciplinary collaboration in addressing global health crises.

These institutions also made efforts to ensure that faculty had the training and support necessary to teach interdisciplinary courses. At Harvard, a faculty development program was launched to help professors design interdisciplinary curricula, and UCT established a cross-disciplinary teaching fellowship to help faculty develop teaching methodologies that integrate diverse academic perspectives.

#### ***4.5. Barriers and Challenges in Implementing Multidisciplinary Education***

While the benefits of interdisciplinary education were widely recognized, several barriers hindered its full implementation. Institutional resistance to abandoning traditional disciplinary structures was the most significant challenge. Faculty at both Harvard and UCT voiced concerns about the loss of disciplinary depth when integrating diverse fields. Some departments were reluctant to abandon their specialized knowledge in favor of a more integrated, holistic approach.

Moreover, resource constraints were also identified as a major barrier, particularly in developing countries like Uganda. Makerere University struggled with limited funding for cross-departmental programs, which restricted the number of students who could participate in interdisciplinary education.

To address these challenges, the study suggests that universities should adopt alternative assessment models such as project-based evaluations, which better measure the collaborative and integrative skills needed for interdisciplinary learning. This approach would better reflect the real-world complexities that students will face in addressing global challenges.

## **V. DISCUSSION**

This study explored the evolution and effectiveness of multidisciplinary education across three universities—Harvard University, University of Cape Town (UCT), and Makerere University—in response to global challenges such as climate change and the COVID-19 pandemic. The objective was to examine how interdisciplinary programs have developed over time to address complex global issues and how digital tools have enhanced collaboration in educational settings. The discussion unfolds by addressing each research objective and corresponding hypothesis.

### ***The historical evolution of educational models and the shift towards multidisciplinary approaches in addressing global challenges***

Consistent with the findings of [41], the shift from traditional, disciplinary-based educational models towards more multidisciplinary approaches is evident across the three case study universities. Historically, educational programs have been structured within distinct disciplinary boundaries. However, the increasing complexity of global challenges, such as climate change, infectious diseases, and sustainable development, has necessitated a rethinking of educational strategies. At Harvard University, the development of programs like the Global Health and Planetary Health concentrations reflects this shift. These programs integrate diverse disciplines such as economics, medicine, environmental science, and social sciences, reflecting a recognition that tackling issues like climate change and global health crises requires expertise from multiple fields. Similarly, UCT has embraced multidisciplinary approaches, particularly through initiatives like the Global Change Institute, which brings together urban planning, climate science, and public health to address challenges of urbanization and climate change. This is consistent with the findings of [42]. Furthermore, Makerere University has focused on

sustainable development by combining fields such as public health, agriculture, and engineering through programs like the D43 Multi-Disciplinary Training Program, aimed at addressing public health issues like tuberculosis [43]. The integration of these diverse fields signifies the historical evolution of educational models to address real-world, complex challenges.

**Validation of Hypothesis 1:** The findings clearly support the hypothesis that educational models have shifted from disciplinary silos to multidisciplinary approaches in response to global challenges. At all three universities, educational frameworks are increasingly designed to promote interdisciplinary learning, demonstrating a collective shift towards this model in the face of global crises.

***The impact of the COVID-19 pandemic on the adoption and effectiveness of multidisciplinary education in universities globally***

Similar to the findings by [7], the study findings showed that the COVID-19 pandemic served as a catalyst for accelerating the shift towards multidisciplinary education. The urgency of responding to the crisis forced universities to adopt new methods for collaboration, not only within traditional academic fields but across them. At Harvard, teams of public health experts, economists, and social scientists collaborated in real-time using digital platforms like Zoom and Slack to develop solutions for mitigating the pandemic. These tools allowed faculty and students to engage across disciplines, sharing expertise and fostering collaboration in ways that were not previously possible within the traditional, siloed structure of academic departments. Similarly, UCT employed platforms like Google Meet and Moodle to facilitate remote learning and encourage cross-disciplinary collaboration during the pandemic [46]. The Global Change Institute at UCT used big data analytics to understand COVID-19's impact, merging environmental science with public health to explore how the pandemic intersected with broader global challenges like climate change. In Makerere University, mobile health technologies were utilized not only to continue educational delivery but to support interdisciplinary collaborations in health, agriculture, and engineering. The digital shift during the pandemic highlighted the necessity and effectiveness of interdisciplinary collaboration, demonstrating that these programs are not only relevant but crucial for addressing global crises.

**Validation of Hypothesis 2:** The study confirms that the COVID-19 pandemic significantly accelerated the adoption of interdisciplinary education. The widespread use of digital tools to foster collaboration and the urgency of multidisciplinary responses to the pandemic validate the hypothesis that the pandemic played a pivotal role in promoting multidisciplinary approaches in higher education.

***The challenges and institutional barriers faced by universities in implementing multidisciplinary programs, and strategies for overcoming them***

While the shift towards multidisciplinary education has been evident, significant barriers remain in implementing these programs effectively. Study findings consistent with [44] showed that Harvard and UCT faced institutional resistance, primarily from faculty who were concerned about the erosion of disciplinary depth. For instance, faculty in specialized areas like medicine or economics feared that blending multiple disciplines would undermine the rigor and depth of their fields. At UCT, this resistance was particularly pronounced in departments like economics, where faculty expressed concern about diluting the focus on their discipline. Similarly, study findings showed that Makerere University faced resource constraints, which limited the scale and accessibility of interdisciplinary programs, especially in areas like health and agriculture [45]. However, these challenges were addressed through a variety of strategic initiatives. At Harvard, study findings showed that faculty development programs were introduced to help professors navigate the complexities of designing interdisciplinary curricula. These programs also offered support in blending disciplinary content without losing academic rigor. UCT tackled institutional resistance by creating cross-disciplinary teaching fellowships, which encouraged faculty from different departments to collaborate and design integrated curricula. Makerere University, despite its resource limitations, developed partnerships with international institutions and utilized funding from organizations like the NIH to support its interdisciplinary initiatives [47]. Furthermore, all

three universities recognized the importance of assessing students' ability to work across disciplines, leading to the adoption of alternative assessment models, such as project-based evaluations, which better capture students' collaborative and integrative skills.

**Validation of Hypothesis 3:** The study provides strong evidence that universities face challenges such as institutional resistance and resource limitations but are actively overcoming them through innovative strategies. The implementation of faculty development programs, cross-departmental collaborations, and alternative assessments validates the hypothesis that universities are overcoming these barriers.

***The role of digital tools (such as AI and VR) in enhancing interdisciplinary collaboration in educational settings.***

Study findings showed that digital tools have played a transformative role in enhancing interdisciplinary education, particularly during the COVID-19 pandemic. Harvard University leveraged AI and big data in its programs related to climate change and epidemiology, enabling real-time data analysis and fostering collaboration across disciplines [48]. These digital tools facilitated the integration of various disciplines and provided students with access to cutting-edge research methodologies, allowing for more robust and data-driven solutions to global challenges. Consistent with [49], study findings showed that UCT used big data analytics to understand COVID-19's impact, encouraging collaboration between environmental science, urban studies, and public health departments. This interdisciplinary collaboration was further enhanced by the use of simulation tools and other digital platforms that allowed students to interact and collaborate virtually. Makerere University also capitalized on digital tools such as mobile health technologies and virtual reality (VR) to create immersive learning experiences. Through VR, students in public health and agriculture were able to simulate real-world scenarios, facilitating deeper engagement with global health issues, agricultural practices, and sustainable development [50]. These digital tools allowed for more effective collaboration and enabled students and faculty to engage with global problems in ways that would have been difficult using traditional methods.

**Validation of Hypothesis 4:** The findings confirm that digital tools, such as AI, VR, and big data, are essential in enhancing interdisciplinary collaboration. These tools not only facilitated remote learning during the pandemic but also fostered deeper, more effective collaboration across disciplines, thus validating the hypothesis that digital tools significantly enhance interdisciplinary education.

## VI. CONCLUSION

This research explored the evolution of multidisciplinary education at Harvard University, the University of Cape Town (UCT), and Makerere University, particularly in response to global crises like climate change and the COVID-19 pandemic. It highlighted how these institutions have adapted their educational models to break down traditional disciplinary silos and embrace interdisciplinary approaches to solve complex, interconnected global challenges. The study confirmed that the COVID-19 pandemic accelerated this shift, driving the adoption of collaborative learning environments supported by digital tools such as AI, big data, and virtual reality. Despite challenges like institutional resistance and limited resources, universities have developed innovative strategies, including cross-departmental initiatives and alternative assessment models, to foster collaboration and enhance students' ability to address pressing global issues. The findings underscore the vital role of multidisciplinary education in equipping future scholars to confront and mitigate the effects of global crises [51].

## VII. RECOMMENDATIONS

1. **Strengthen Institutional Support:** Establish interdisciplinary research centers and cross-departmental initiatives, with funding and recognition for faculty involvement.
2. **Enhance Faculty Development:** Provide training and support through faculty development programs and teaching fellowships to promote interdisciplinary teaching and collaboration.

3. **Leverage Technology:** Invest in digital platforms and tools (AI, big data, VR) to facilitate seamless collaboration across disciplines and locations.
4. **Adopt Alternative Assessments:** Implement project-based or competency-based assessments to measure students' interdisciplinary problem-solving and collaboration skills.
5. **Address Resource Constraints:** For resource-limited institutions, form partnerships to bridge funding gaps and explore low-cost technological solutions.
6. **Encourage Curriculum Flexibility:** Allow students to take interdisciplinary electives and design flexible degree programs that foster cross-disciplinary knowledge.

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## REFERENCES

1. O'Donoghue, T. (2024). *The Development of University Teaching Over Time: Pedagogical Approaches from 1800 to the Present*. Taylor & Francis.
2. Proctor, C. (2021). The heart of academia: Medieval universities, textbooks, and the birth of academic libraries. *Library Philosophy and Practice*, 2021, 1-14.
3. Ursić, L., Baldacchino, G., Bašić, Ž., Sainz, A. B., Buljan, I., Hampel, M., ... & Markić, L. V. (2022). Factors Influencing Interdisciplinary Research and Industry-Academia Collaborations at Six European Universities: A Qualitative Study. *Sustainability*, 14(15), 9306.
4. Binagwaho, A., Bonciani Nader, H., Brown Burkins, M., Davies, A., Hessen, D. O., Mbow, C., ... & Tong, S. (2022). *Knowledge-driven actions: transforming higher education for global sustainability: independent expert group on the universities and the 2030 agenda*. UNESCO Publishing.
5. Varış Husar, S. C., Mehan, A., Erkan, R., Gall, T., Allkja, L., Husar, M., & Hendawy, M. (2023). What's next? Some priorities for young planning scholars to tackle tomorrow's complex challenges. *European Planning Studies*, 31(11), 2368-2384.
6. Yong, K. T., & Liu, M. (2024). *Academia's Billion-Dollar Roulette*. Taylor & Francis.
7. Peters, M. A., Rizvi, F., McCulloch, G., Gibbs, P., Gorur, R., Hong, M., ... & Misiaszek, L. (2022). Reimagining the new pedagogical possibilities for universities post-Covid-19: An EPAT Collective Project. *Educational Philosophy and Theory*, 54(6), 717-760.
8. Friedler, A. (2021). Sociocultural, behavioural and political factors shaping the COVID-19 pandemic: the need for a biocultural approach to understanding pandemics and (re) emerging pathogens. *Global public health*, 16(1), 17-35.
9. De Paula, N. (2021). *Breaking the Silos for Planetary Health*. Springer Singapore.
10. Hand, C. L. (2023). *A Case Study of Makerere University in Uganda through the Lens of US Land-Grant Higher Education* (Doctoral dissertation, West Virginia University).
11. Kolluru, M., & Uecker, C. (2024). GLOBAL UNIVERSITIES'STRATEGIC POSITIONING FOR INTERNAL AND EXTERNAL SUSTAINABILITY.
12. Margheritis, A. (2024). Migration governance evolution amidst a nested crisis: The case of South America. *International Migration*, 62(4), 132-144.
13. Cratsley, K., Brooks, M. A., & Mackey, T. K. (2021). Refugee mental health, global health policy, and the Syrian crisis. *Frontiers in Public Health*, 9, 676000
14. DURDU, A., & CANAY, Ö. Digital Transformation and Distance Education Systems of Universities in Türkiye During the Pandemic.
15. Besigomwe, K. (2024). Factors Influencing Student Motivation in Online Education: A Study of Secondary Schools in Kampala, Uganda During the COVID-19 Pandemic.
16. Rane, N., Choudhary, S., & Rane, J. (2023). Sustainable tourism development using leading-edge Artificial Intelligence (AI), Blockchain, Internet of Things (IoT), Augmented Reality (AR) and Virtual Reality (VR) technologies. *Blockchain, Internet of Things (IoT), Augmented Reality (AR) and Virtual Reality (VR) technologies (October 31, 2023)*.
17. Rosenberg, B. (2023). *"Whatever It Is, I'm Against It": Resistance to Change in Higher Education*. Harvard Education Press.
18. Shanableh, A., Aderibigbe, S., Omar, M., & Shabib, A. (2022). Challenges and opportunities of multi-disciplinary, interdisciplinary and trans-disciplinary research. *Higher Education in the Arab World: Research and Development*, 311-325.

19. Nikolic, S., Daniel, S., Haque, R., Belkina, M., Hassan, G. M., Grundy, S., ... & Sandison, C. (2023). ChatGPT versus engineering education assessment: a multidisciplinary and multi-institutional benchmarking and analysis of this generative artificial intelligence tool to investigate assessment integrity. *European Journal of Engineering Education*, 48(4), 559-614.
20. Sahlberg, P. (2021). *Finnish lessons 3.0: What can the world learn from educational change in Finland?*. Teachers College Press.
21. Lieberknecht, K., Houser, H., Rabinowitz, A., Pierce, S. A., Rodríguez, L., Leite, F., ... & Gray, J. N. (2023). Creating meeting grounds for transdisciplinary climate research: The role of humanities and social sciences in grand challenges. *Interdisciplinary Science Reviews*, 48(4), 585-607.
22. Barber, J. P. (2023). *Facilitating the integration of learning: Five research-based practices to help college students connect learning across disciplines and lived experience*. Taylor & Francis.
23. Yanniris, C. (2021). Education for sustainability, peace, and global citizenship: An integrative approach. *Education Sciences*, 11(8), 430.
24. Wangenge-Ouma, G., & Kupe, T. (2022). Seizing the COVID-19 conjuncture: Re-positioning higher education beyond the pandemic. In *Re-imagining educational futures in developing countries: Lessons from global health crises* (pp. 17-37). Cham: Springer International Publishing.
25. Scarpa, F., & Casu, M. (2024). Genomics and Bioinformatics in One Health: Transdisciplinary Approaches for Health Promotion and Disease Prevention. *International Journal of Environmental Research and Public Health*, 21(10), 1337.
26. Panattil, S. J., George, A., & Joy, M. M. (2022). A view on the impact of gamified services in the wake of the COVID-19 pandemic: An interdisciplinary approach. In *Handbook of research on cross-disciplinary uses of gamification in organizations* (pp. 105-120). IGI Global.
27. Croese, S., & Duminy, J. (2023). Co-producing urban expertise for SDG localization: the history and practices of urban knowledge production in South Africa. *Urban Geography*, 44(3), 538-557.
28. Luo, P., Mu, Y., Wang, S., Zhu, W., Mishra, B. K., Huo, A., ... & Nover, D. (2021). Exploring sustainable solutions for the water environment in Chinese and Southeast Asian cities. *Ambio*, 1-20.
29. Szobonya, P., & Roche, C. M. (2023). Virtual Exchange Experiences Energized by an Educational Technology Paradigm Shift. In *Handbook of Research on Current Trends in Cybersecurity and Educational Technology* (pp. 267-297). IGI Global.
30. Jony, A. I., & Hamim, S. A. (2024). Empowering virtual collaboration: harnessing AI for enhanced teamwork in higher education. *Educational Technology Quarterly*, 2024(3), 337-359.
31. Fitrianto, I., & Saif, A. (2024). The role of virtual reality in enhancing Experiential Learning: a comparative study of traditional and immersive learning environments. *International Journal of Post Axial: Futuristic Teaching and Learning*, 97-110.
32. Rana, K., Aitken, S. J., & Chimoriya, R. (2025). Interdisciplinary Approaches in Doctoral and Higher Research Education: An Integrative Scoping Review. *Education Sciences*, 15(1), 72.
33. Khan, A. (2024). Integrating Perspectives: The Role of Multidisciplinary Approaches in Solving Complex Problem. *Kashf Journal of Multidisciplinary Research*, 1(08), 400-410.
34. Feng, X., Sundman, J., Aarnio, H., Taka, M., Keskinen, M., & Varis, O. (2024). Towards transformative learning: students' disorienting dilemmas and coping strategies in interdisciplinary problem-based learning. *European Journal of Engineering Education*, 1-23.
35. Thompson, R. J. (2022). The Impact of Globalization and the COVID-19 Pandemic on Leadership in International Development: The Need for Adaptive Transformational System Leadership and Expanded Consciousness. In *The Study and Practice of Global Leadership* (pp. 191-210). Emerald Publishing Limited.
36. Wheeler, M. (2024). *Warming Wars: The Role of Climate Change in Future National Security Challenges* (Doctoral dissertation, Georgetown University).
37. Tariq, M. U. (2024). Enhancing students and learning achievement as 21st-century skills through transdisciplinary approaches. In *Transdisciplinary Approaches to Learning Outcomes in Higher Education* (pp. 220-257). IGI Global.
38. Klein, J. T. (2022). Building capacity for transformative learning: lessons from crossdisciplinary and cross-sector education and research. *Environment, Development and Sustainability*, 1-14.
39. Nguyen, D. C., & Tull, J. (2022). Context and contextualization: The extended case method in qualitative international business research. *Journal of World Business*, 57(5), 101348.
40. Cleland, J., MacLeod, A., & Ellaway, R. H. (2021). The curious case of case study research. *Medical Education*, 55(10), 1131-1141.
41. Fergusson, L., & van der Laan, L. (2021). Disciplinarity and work: Work-based learning as an emergent transdisciplinary mode of study. *World Futures*, 77(7), 508-531.
42. Thondhlana, G., Mubaya, C. P., McClure, A., Amaka-Otchere, A. B. K., & Ruwanza, S. (2021). Facilitating urban sustainability through transdisciplinary (TD) research: lessons from Ghana, South Africa, and Zimbabwe. *Sustainability*, 13(11), 6205.

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43. Nakanjako, D., Castelnuovo, B., Sewankambo, N., Kakaire, T., Brough, R. L., Katabira, E. T., ... & Kambugu, A. (2022). Infectious Diseases Institute at Makerere University College of Health Sciences: a case study of a sustainable capacity building model for health care, research and training. *African health sciences*, 22(2), 1-10.
  44. Aftab, A., & Kendler, K. S. (2024). Weaving Conceptual and Empirical Work in Psychiatry. *Conversations in Critical Psychiatry*.
  45. Etomaru, I., Bisaso, R., & Nakayiwa-Mayega, F. (2022). Fostering knowledge translation in Africa's flagship universities: a case of Makerere University. *Higher Education Research & Development*, 41(4), 1060-1074.
  46. Mhungu, B. (2022). FUTURE TECHNOLOGIES TO ENHANCE TEACHING AND LEARNING INSIDE STUDIO-BASED SPACES: POST-COVID 19. In *INTED2022 Proceedings* (pp. 9171-9181). IATED.
  47. Etomaru, I., Bisaso, R., & Nakayiwa-Mayega, F. (2022). Fostering knowledge translation in Africa's flagship universities: a case of Makerere University. *Higher Education Research & Development*, 41(4), 1060-1074.
  48. Zong, Z., & Guan, Y. (2024). AI-Driven Intelligent Data Analytics and Predictive Analysis in Industry 4.0: Transforming Knowledge, Innovation, and Efficiency. *Journal of the Knowledge Economy*, 1-40.
  49. Nel, E., MacLachlan, A., Ballinger, O., Cole, H., & Cole, M. (2023). Data-Driven Decision Making in Response to the COVID-19 Pandemic: A City of Cape Town Case Study. *Sustainability*, 15(3), 1853.
  50. Isiaka, A. O., Soliu, A., Aremu, B. A., Bamidele, B. A., Saba-Jibril, S., & Ibitoye, A. R. (2024). The evolving role of libraries in the fourth industrial revolution: navigating digital transformation. *Library Philosophy and Practice*, 1-26.
  51. Buheji, M. (2024). Solving Africa's Socioeconomic Complex Problems vs. The status of the Continent Multidisciplinary Education. *International Journal of Management (IJM)*, 15(6), 1-13.