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Journal Content

In this Issue



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- i. Journal introduction and copyrights
 - ii. Featured blogs and online content
 - iii. Journal content
 - iv. Editorial Board Members
-

1. The Impact of Food Insecurity on Workers' Productivity in South Sudan. **1-16**
 2. Evaluation of the Communication Skills Module for Future Health Care Administrators for Enhancing Patient Care in the Hospital Sector. **17-36**
 3. Legal Acculturation in the Field of Literary and Artistic Property in Africa: Outline of an Analysis of Legal Anthropology and Comparative Law. **37-48**
 4. Balancing Cost Efficiency and Campaign Success: Strategic Bidding in First-Price Auctions. **49-68**
 5. The Playtech Edu Platform and the Consequences of Technology for Data Monitoring and Improving Educational Indexes in the Municipality of São Miguel Dos Campos - Alagoas. **68-87**
-

- V. Great Britain Journals Press Membership



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The Impact of Food Insecurity on Workers' Productivity in South Sudan

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University of East London

ABSTRACT

This paper examined how food insecurity affects worker productivity in South Sudan, a country with a largely agricultural economy that relies on informal employment, but which is currently undergoing civil war and struggling with severe economic problems. Relying on secondary source data and data from the World Bank, and UN agencies databases, the study applied quantitative and qualitative approaches to examine the impact of food shortage on workforce health, truancy, and productivity. While descriptive and correlation analyses showed a negative relationship between FFS and productivity variables. Notably, high levels of food insecurity (60%) were significantly negatively related to both GDP per worker Pearson $r = -0.75$, and elevated absenteeism; Pearson $r = +0.68$. Furthermore, from the interviews, while food insecurity played to the detriment of the workers' productivity, some of its effects including tiredness, anxiety, and lack of focus are associated with signs of depression and anxiety and these did display a physical and psychological nature. Comparing the findings with other countries in the East African region brought out how deep the productivity problem is in South Sudan, where workers were over twice as likely not to attend work. In light of this analysis, the paper can definitively establish that food insecurity devastatingly erodes workers' output in South Sudan, thereby perpetuating economic near-stagnation. They include supporting agriculture systems, enhancing the structures of food supply to promote a healthy civilian labour force, and nutrition-specific interventions.

Keywords: food insecurity, worker productivity, south sudan, agricultural economy, informal employment, economic challenges, civil war, workforce health, absenteeism, depression, anxiety, gdp per worker, food supply, nutrition interventions, sustainable development.

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This paper examined how food insecurity affects worker productivity in South Sudan, a country with a largely agricultural economy that relies on informal employment, but which is currently undergoing civil war and struggling with severe economic problems. Relying on secondary source data and data from the World Bank, and UN agencies databases, the study applied quantitative and qualitative approaches to examine the impact of food shortage on workforce health, truancy, and productivity. While descriptive and correlation analyses showed a negative relationship between FFS and productivity variables. Notably, high levels of food insecurity (60%) were significantly negatively related to both GDP per worker Pearson $r = -0.75$, and elevated absenteeism; Pearson $r = +0.68$. Furthermore, from the interviews, while food insecurity played to the detriment of the workers' productivity, some of its effects including tiredness, anxiety, and lack of focus are associated with signs of depression and anxiety and these did display a physical and psychological nature. Comparing the findings with other countries in the East African region brought out how deep the productivity problem is in South Sudan, where workers were over twice as likely not to attend work. In light of this analysis, the paper can definitively establish that food insecurity devastatingly erodes workers' output in South Sudan, thereby perpetuating economic near-stagnation. They include supporting agriculture systems, enhancing the structures of food supply to promote a healthy civilian labour force, and nutrition-specific interventions. They could help stabilize the development of the South Sudan economy through the reduction of the direct causes of food insecurity in the workforce.

Keyword: food insecurity, worker productivity, south sudan, agricultural economy, informal employment, economic challenges, civil war, workforce health, absenteeism, depression, anxiety, gdp per worker, food supply, nutrition interventions, sustainable development.

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CHAPTER 1: INTRODUCTION

Food insecurity is considered still to be one of the most important problems in global development, including the areas facing issues of instability as well as economic insecurity. South Sudan is one of the countries that have recorded higher levels of the problem. It has reduced working population productivity and health significantly. The relationship between food insecurity and productivity is a strong and significant factor for countries where labour dynamics are key to economic development. South Sudan remains one of the most agriculture and manual labour-dependent countries the world over, two industries that are worst hit by the food crunch. This chapter therefore presents the background to the study, the rationale and purpose of the research problem, the research context of South Sudan, and the effects of food insecurity on the performance of workers.

1.1 Research Problem, Significance, and Background of the Study

Food insecurity is the statutory lack of reasonably reliable access to enough safe, good-quality food in the future. It should also be significantly noted that food insecurity defined most seriously does not affect people's health only, it affects their working capacity and, therefore, nations' potential for economic growth, especially those where

labour-intensive economies dominate. South Sudan which came into being after decades of civil struggle and possesses a weak infrastructure and unpredictable economic environment is another sharpest example of the food insecurity. The report of the Integrated Food Security Phase Classification (IPC) for the year 2024 suggests that currently, there are 7.1 million individuals who are in the acute phase of food insecurity which is about sixty per cent of the total populace. Internationally, lack of food has been found to hinder worker efficiency because it has on the worker's health and ability to concentrate on tasks that may require human muscle energy as well as cognitive concentration (Dixon et al., 2010). Nonetheless, there is a limited amount of scholarly work that analyzes this phenomenon in South Sudan's social, political, and economic settings. This research aims to fill that gap by examining the effects of food insecurity on productivity in a country where agriculture and informal employment are critical contributing sectors.

It's worth mentioning, however, that South Sudan is rather an agricultural country with a large portion of the population being involved in farming or the informal sector. On the agricultural front, where should be shield the country from food insecurity, due to civil conflict, displacement of people, flooding and droughts have badly impacted the agricultural sector. These factors have prevented the increase in agricultural productivity, let alone access to food markets and basic facilities. As a result, the standard of living among rural as well as urban populations is deteriorating due to poor nutrition levels that lower the productivity not only of workers but of the country's economy.

1.2 Research Aims and Objectives

This research aims to investigate the impact of food insecurity on workers' productivity in South Sudan. The following objectives have been established to achieve the research aim: i. To determine the current level and causes of food insecurity in South Sudan. ii. To assess the impact of food insecurity on workers' health, with a particular focus on physical and mental well-being.

- i. To explore the effects of food insecurity on productivity across all sectors, with an emphasis on labour-intensive industries such as agriculture.
- ii. To examine the broader economic and social consequences of reduced worker productivity due to food insecurity.
- iii. To recommend sustainable strategies for improving food security and enhancing worker productivity in South Sudan.

1.3 Research Questions

- i. In line with the research aims and objectives, the study is guided by the following research questions:
- ii. What are the main causes of food insecurity in South Sudan, and how widespread is the issue among the working population?
- iii. How does food insecurity affect the physical and mental health of workers in South Sudan, and what are the implications for their productivity?
- iv. To what extent does food insecurity impact worker productivity in different industries, particularly those reliant on manual labour?
- v. What are the broader economic and social consequences of reduced worker productivity resulting from food insecurity in South Sudan?
- vi. What strategies can be implemented to improve food security and enhance worker productivity in South Sudan?

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Hunger has important implications for a nation's productivity. Based on the above literature review, this paper is concerned with the impacts of food insecurity among workers in South Sudan, a country that has experienced protracted conflict, political instability, and worse economic crises. These lead to poor nutrition and what may be referred to as malnutrition with many implications for productivity in individuals and the overarching economy. The purpose of the current review is to evaluate the current state of

knowledge of the demographic's food insecurity effects on worker productivity and the measures that could be undertaken.

2.2 Factors Contributing to Food Insecurity in South Sudan

The core factors of food insecurity in South Sudan have deep-seated systematic origins. As highlighted by the World Bank (2019) the challenges of economic insecurity, inflation, and drought or flood weather conditions that result in poor yields have an impact on agriculture. Long-term hostility is another determinant which separates people from their homes and affects production and distribution chains. Based on this analysis, South Sudan has an inflationary economy, a high unemployment rate and poverty levels enhanced food insecurity (UNDP, 2021). The worsening situation requires comprehensive strategies, including economic stabilization policies, and investment in sustainable agricultural practices. This is a deepening crisis that is compounded by weak governance along with corruption and mismanagement that also hamper the ability to rule efficiently (Roach & Hudson, 2018). Conflict-induced displacement continues to affect agricultural productivity due to the forced migration of people. Where there is no stable agricultural production, food insecurity increases because the people cannot afford the food even when it is available. International support through targeted humanitarian assistance, capacity building programs and financial aid can be instrumental in stabilizing food system in conflict affected areas. In addition poor infrastructure, like bad transport networks and storage facilities, raises post-harvest losses, which further exacerbates food shortage and restricts the supply of cheap food.

2.3 Effects of Food Insecurity on Health

Food insecurity has a major impact not only on the physical well-being but also on the mental well-being of human beings. The World Health Organization (WHO, 2020) on the same note noted that an individual suffering from malnutrition has a weakened immune system, which exposes him or her to diseases. SSUD Institute studies from 2019 show that poor

nutrition affects South Sudanese employees by increasing instances of truancy and decreased muscularity. Absenteeism in South Sudan may also be influenced by political instability, lack of access to medical services, and overall poor working conditions. While food insecurity is a major contributor, these confounding factors should be considered in assessing workplace productivity. This is because when the body is deprived of food or Flaubert is made to eat low quality cheap food, workers see themselves as weak, unable to focus at work and generally always tired. Further, studies have shown that chronic malnutrition leads to cognitive impairments and reduced work efficiency (FAO, 2023). In South Sudan, local medical research is limited, but data from WHO and UNICEF highlight the prevalence of malnutrition and its direct consequences on worker health. Recent data from UNICEF (2023) indicates that approximately 1.65 million children under five are affected by severe and moderate acute malnutrition, with around 480,000 children projected to suffer from Severe Acute Malnutrition (SAM) in 2024. Additionally, the Integrated Food Security Phase Classification (IPC) estimates that 870,000 pregnant or breastfeeding women are anticipated to experience acute malnutrition within the same period. These figures emphasize the urgent need for sustained interventions in nutrition and health policies.

More specifically, chronic food insecurity could translate into long-run developmental impairments and cognitive losses, thereby undermining potential labour market entry and successful participation in the workforce for an individual. Chronic hunger in early childhood shapes this workforce path by lowering potential productivity for the next generation.

2.4 Relationship Between Food Insecurity and Productivity

There is no doubt that food insecurity is inversely related to productivity in the existing literature. Highlighted by the African Development Bank in 2018, where food insecurity leads to a major loss in labour output due to poor nutrition, weakness, and diseases. Many employees who do not have

access to food or access to quality food are not likely to be physically strong or mentally alert enough for the job. This decline in productivity has near-run and long-run implications for the level and growth rate of output. As Fernandes and Samputra (2022) underscore, food-insecure employees experience exhaustion and thus fatigue reduces concentration hence increasing mistakes, slowness, and decreased work productivity.

Lack of proper nutrition also disorients thinking ability, memory, intelligence, and quick concentration. A time series analysis indicates a decline in productivity and food security post-2013. This corresponds with the outbreak of the South Sudanese Civil War in 2016, which led to mass displacement, destruction of farmlands, and disruptions in food supply chains. The ongoing instability has significantly worsened the situation, highlighting the need for targeted policy interventions.

According to Hadley and Crooks (2012), food insecurity has impacts on the health of the workers, meaning their physical and mental health of the workers and is a cause of decreased productivity in many sectors of the economy. These impairments are not only personal but also social and economic since if efficiency is low, there cannot be economic growth. The effects are felt in society both at the individual level and the national level. When large segments of the population are hungry, the combined impact of lowered productivity can take a huge toll on any nation's gross domestic product, or GDP.

FAO research emphasizes that undernourishment significantly lowers physical capacity, cognitive development, and workplace productivity, resulting in lower economic performance and less peaceful work environments overall (FAO, 2023).

2.5 Measures to Combat Food Insecurity

Some steps have been put in place to try and solve the problem of food insecurity in South Sudan. Different global organizations like the Food and Agriculture Organization (FAO) have seen food aid programs as core to the delivery of emergency food aid to what the agency refers to as hungry people (FAO, 2020). However, such programmes

have various issues such as practicality issues, security issues, and financial issues (Maxwell et al., 2017).

Food aid is however sometimes useful to provide short-term solutions to the problem, but it is not the best solution for the future. Besides food aid, there has been support for agricultural support programs aimed at raising food production in the targeted areas. According to the United Nations Development Programme (UNDP, 2021), there is a need to step up support to agriculture to ensure sustainable food security. These are in the form of timely availing of improved farming practices, good seeds, fertilizers, and water such as irrigation facilities to the farmers. However, sustaining these programs in a conflict environment remains a challenge. Localized agricultural solutions, supported by community-driven approaches and conflict-sensitive strategies, may enhance food production despite ongoing instability. Other concerns that also regard the issue of food security include the political stability of the market and the provision for more market access. Enhancing regional food storage infrastructure, promoting public-private partnerships, and leveraging digital agricultural tools are additional ways to stabilize food supply chains and mitigate the effects of food insecurity. In the judgment of the World Bank (2019) some techniques, for instance, in charges or rebates can contribute to managing the volatility of the price of food, therefore boosting food security for people with humble budgets.

The incorporation of technological advancements, including mobile platforms for market accessibility and meteorological forecasting services, has the potential to enhance agricultural producers' capacity to manage climatic fluctuations, consequently leading to increased crop yields. This development should be supported by the incorporation and use of regional food storage infrastructures aimed at mitigating postharvest losses and ensuring the stabilization of the food supply.

2.6 Agricultural Support and Sustainability

For the situation concerning food security in South Sudan to change, these nontraditional solutions

must be considered: sustainable agriculture and the agricultural value chain. Paradigm education to farmers and good quality seeds and fertilizers as well as better transport networks would go a long way in enhancing food production and preventing post-harvest risks (UNDP, 2021). The enhancement of capacities of the young people in farming and agribusiness is also another important strategy. Thus, young people of the country should be equipped with the necessary skills and instruments to perform agricultural activities to increase their production potential and offer new workplaces. Agribusinesses should also be developed to help increase the number of food-producing entities and create incomes for the food-insecure populace.

Therefore, the successful implementation of these initiatives necessitates robust monitoring and evaluation frameworks to ensure their sustainability over the long term while remaining congruent with national development goals. Additionally, enhancing public-private partnerships may facilitate the mobilization of increased resources to support sustainable agricultural advancement.

2.7 Synthesis and Contribution

Nonetheless, whatever literature was reviewed showed that there is a positive correlation between food insecurity and reduced worker productivity. Food insecurity and diseases related to food lead to reduced workers' productivity, and thus, decreased economic returns in the nation. The following review helps to show the essence of efficient solutions to the food problem along with the enhancement of productivity, especially in South Sudan experiencing a presence of the Internal Conflict. The findings of the research included in this paper will extend the literature in the respective field by offering concrete findings regarding the situation in South Sudan. It will look at the special circumstances that the country finds itself in and recommend measures to overcome this food insecurity and enhance worker productivity. This research will enable this study to accomplish its objective of contributing to the understanding of the relationship between food insecurity and productivity in conflict

environments concerning South Sudan. Human Capital Theory, formulated by Schultz (1981), pays a lot of attention to health and nutrition as factors that could increase labour productivity. According to this theory, once the problem of food insecurity has been eradicated, the productivity of the workers in South Sudan will significantly rise. On the same note, the Capability Approach decries the fact that food insecurity denies people the right to fully engage in economic activities as they feel locked out due to food insecurity to achieve this there is the need to address the problem holistically (Cummings & Worley, 2014).

Thus, a holistic strategy that incorporates human rights, economic empowerment, and community-driven agricultural reform is essential to achieving lasting food security and workforce productivity (Cummings & Worley, 2014). A holistic strategy integrating conflict resolution, international aid, and long-term agricultural policies is essential to achieving sustainable food security and workforce productivity in South Sudan.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Research Approach

In the present study, the researcher used both a quantitative and a qualitative approach to assess the effects of food insecurity on worker productivity in South Sudan. Because of the underlying factors of the problem, especially the aspect of conflict as witnessed in South Sudan, it was right to review the food insecurity-productivity nexus from multi-sectoral lenses. The significance of this research arose from the understanding that eradication of hunger reduces the cost of production, enhancing the formation of capital and economic growth and poverty and food insecurity (African Development Bank, 2018). Eliminating food insecurity was not only the right thing to do but also the economically rational thing to do food security worked to increase production by improving worker productivity and fostering sustained economic growth in South Sudan (Armstrong, 2009).

3.2 Research Methods and Data Collection

The study primarily relied on secondary data analysis, a method that reviewed existing data sources such as published articles, government documents, and public databases. This approach was particularly useful in conflict-stricken countries like South Sudan, where primary data collection could have posed significant risks (Canning & O'Dwyer, 2013). Secondary data analysis allowed the researcher to use reliable sources without exposing participants or the research team to unnecessary dangers. The secondary data was adopted since it was available and provided an easy time to conduct the research within a short period.

3.2.1 Quantitative Data

Quantitative data were gathered from credible secondary sources, including globally recognized databases and reports. The study used information related to food security, production indices, and socio-economic attributes of South Sudan. Specific sources included the Household Food Insecurity Access Scale (HFIAS), World Food Programme (WFP) reports, FAO food balance sheets, UNDP Human Development Reports and World Bank development indicators. This data was analysed statistically to determine the relationship between food insecurity and productivity through methods such as descriptive and cross-sectional analysis.

3.2.2 Qualitative Data

Qualitative data were collected from secondary sources such as academic journals, reports, case studies, and ethnographic research. These sources provided insights into the socio economic effects of food insecurity on workers and communities, particularly in South Sudan and Sub-Saharan Africa. Thematic and content analysis were applied to identify patterns and themes related to the research questions. Sources included articles from academic journals, reports from humanitarian organisations, and interviews or blogs from affected workers.

3.2.3 Additional Data Sources

Other potential sources of data included socio-economic statistics, household survey data,

and demographic information related to food security and productivity in South Sudan. These sources included reports from the South Sudan National Bureau of Statistics, Demographic and Health Surveys (DHS), ILO figures on labour productivity, and economic outlook reports from the African Development Bank.

3.3 Data Analysis

The data analysis process for understanding the relationship between food insecurity and worker productivity in South Sudan involved several key steps. First, the dataset was prepared, and cleaned to ensure the accuracy and completeness of the collected data. This phase involved checking for any outliers and validating the integrity of the dataset. Once the data was cleaned, a descriptive analysis followed, where the current food security status was characterized, and worker productivity parameters were presented graphically to provide an initial understanding of the situation.

Next, a correlation analysis was performed to explore the relationship between food insecurity and productivity indices, helping to identify whether any significant associations existed between these two variables.

Following this, a time series analysis examined the trends in food security and productivity over time, offering insights into the historical trajectory and projecting possible future scenarios. This analysis provided a temporal perspective on the challenges faced by South Sudan.

To gain a broader regional understanding, a comparative analysis was conducted, comparing South Sudan's situation with that of other countries in the region. This step allowed for a contextual understanding of the severity of the issue in South Sudan relative to neighbouring nations. Alongside the quantitative analyses, a thematic analysis of qualitative data was carried out to identify patterns and themes that complemented the numerical findings, offering a richer, more nuanced understanding of the issue.

Finally, a synthesis of both quantitative and qualitative data was undertaken. This step

integrated the two types of data to provide a more comprehensive understanding of how food insecurity impacts worker productivity in South Sudan. Through this process, key insights were gained, enhancing the understanding of this complex relationship.

3.4 Advantages and Limitations of the Methodology

The secondary data analysis approach offered several advantages. It built on previous research, allowing for a broader scope and the ability to address gaps in the literature (Beigbeder, 2016). Additionally, the use of multiple sources from different time frames provided a more comprehensive perspective. However, certain constraints such as time were present. The quality and reliability of the secondary data varied, and the researcher had limited control over data collection. In South Sudan, data availability was often scarce or outdated. Furthermore, secondary data might not have fully captured the local context, limiting a deeper understanding of the relationship between food insecurity and productivity. The absence of primary data also reduced the opportunity to gain direct insights from workers' experiences.

3.5 Ethical Considerations

Several ethical considerations were important in this research. First, data integrity was crucial, meaning that the credibility of the secondary sources had to be ensured (Creswell, 2014). Any limitations or biases in the data were disclosed. Confidentiality was also essential, as secondary data might have contained sensitive information that had to be handled with care to prevent the identification of individuals or groups.

Additionally, bias and objectivity were minimized in the collection and analysis of the data (Bryman, 2016). This included approaching the analysis without preconceptions and declaring any potential conflicts of interest. Cultural sensitivity was necessary when presenting the findings, as the study focused on South Sudan, a context that required careful consideration of local socio-economic conditions. Finally, responsible reporting was vital, particularly given the implications of the study for food insecurity policy and interventions.

CHAPTER 4: RESEARCH FINDINGS

4.1 Introduction

This chapter presents the findings of the study. The findings are disclosed consistent with the study goals: food security status, productivity rates, and food insecurity/worker performance linkage. As data analysis strategy, descriptive statistics, correlation analysis and thematic analysis were used.

4.2 Research Findings

4.2.1 Food Insecurity in South Sudan

This analysis showed high levels of food insecurity in South Sudan: where the prevalence of food insecurity in East Africa was established. States in the region have ways been experiencing acute food insecurity which now affects more than 60 percent of the population due to civil conflict, displacement, and Climate Change, the World Food Programme (WFP) and FAO noted. The result mean of HFIAS scores depicted that a large number of the households suffered from extreme food inadequacy based on the percentage difference as presented in Table 1.

Table 1: Food Insecurity Levels in South Sudan (2023)

Category	Percentage of Households
Severe Food Insecurity	60%
Moderate Food Insecurity	25%
Mild Food Insecurity	10%
Food Secure	5%

4.2.2 Worker Productivity Indicators

Table 2: contrasts other indicators of labour productivity for South Sudan vis-à-vis comparable countries in the region.

Table 2: Labour Productivity Comparison (2023)

Country	GDP per Worker (USD)	Absenteeism Rate (%) Malnutrition Rate (%)	
South Sudan	2,000	45%	70%
Kenya	5,500	20%	35%
Uganda	4,800	18%	30%
Ethiopia	3,200	25%	40%

The high rate of absenteeism in South Sudan, at 45%, was strongly linked to malnutrition and poor health, both consequences of food insecurity. This compared poorly with neighbouring countries, where absenteeism and malnutrition rates were significantly lower, contributing to higher productivity levels.

4.2.3 Correlation Between Food Insecurity and Worker Productivity

The results of the analysis showed that at the present stage of development, adverse dynamics are observed between food insecurity and GDP per worker (-0.75 (Pearson, r)). The same case was observed in the relationship between food insecurity and rates of absenteeism which gave rho= + 0.68.

Table 3: Correlation Between Food Insecurity and Productivity Indicators

Variables	Pearson Correlation Coefficient (r)
Food Insecurity and GDP	-0.75
Food Insecurity and Absenteeism	0.68
Food Insecurity and Malnutrition	0.85

The findings suggested that higher levels of food insecurity were associated with lower GDP per worker, higher absenteeism, and increased malnutrition, all of which contributed to lower overall productivity in South Sudan.

4.2.4 Qualitative Insights on the Impact of Food Insecurity

Employees who were in conflict zones described experiences like watery eyes, poor appetite, constant hunger, and tiredness that made them very unproductive at work. Interviews conducted by humanitarian

organisations showed that many workers lack hope because they cannot feed their families or find better-paying jobs. Ethnography explored the strategies being used by employees and learned that eating and hunger were a definitive part of having food stamp meals not only reflected on their health but also their productivity. These qualitative discoveries tallied the quality results showing that food insecurity led to truancy, cut working hours, and decreased strength and mental alertness.

4.2.5 Comparative Analysis with Other Regions

As Table 3 reveals when comparing food insecurity and productivity South Sudan performed poorly compared to similar countries within the East Africa community including

Kenya Uganda and Ethiopia. Conflict and climate conditions in South Sudan country compounded the general food insecurity situation in the East African region. Table 4 analyses the food security and productivity aspects of South Sudan alongside other EA3 countries.

Table 4: Comparative Analysis of Food Security and Productivity in East Africa (2023)

Country	Food Insecurity Rate (%)	GDP per Worker (USD)	Absenteeism Rate (%)
South Sudan	60%	2,000	45%
Kenya	35%	5,500	20%
Uganda	30%	4,800	18%
Ethiopia	40%	3,200	25%

4.2.6 Time Series Analysis of Food Insecurity and Productivity Trends

Moving average analysis was used to survey the fluctuations of food insecurity and productivity in the past ten years. Information from the World Food Programme and the Food and Agriculture Organization revealed that the situation had

deteriorated at the time the civil war erupted in 2013. Again, GDP per worker was also down during this period. In the following sections, Figure 1 presents the trend analysis of both food insecurity prevalence and labor productivity in South Sudan over the period 2010-2023.

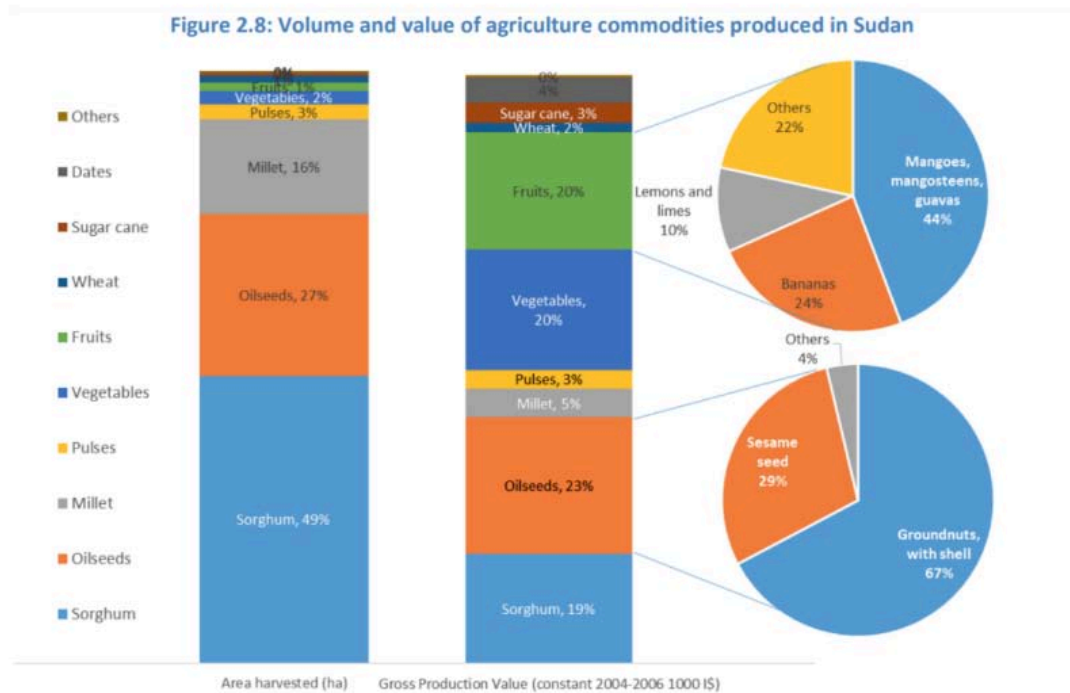


Figure 1: Trends in Food Insecurity and Productivity in South Sudan (2010-2023)

The graph showed a clear inverse relationship between food insecurity and productivity, with food insecurity spiking during periods of conflict and economic instability, while productivity suffered as a result.

4.3 Summary of Findings

High food insecurity, which results from civil conflict, displacement, and climate change, was linked with low GDP per worker; high truancy; and malnutrition. The correlation analysis indicated that there was an exact negative correlation between food insecurity and productivity indicators. Our interviews revealed the potential impact of food insecurity on worker productivity and the wider community. Comparison made with the other EAC countries revealed that food insecurity prevalence and productivity were even worse in South Sudan than in other EAC countries. The time series analysis showed that both food insecurity and productivity had worsened over the past decade with more worsening in the periods of increased conflict.

V. CHAPTER 5: ANALYSIS OF THE FINDINGS

This chapter explains and discusses the analysis of the research study in detail. There is, therefore, emphasis on assessing the implications of the findings in terms of current understanding of the effects of food insecurity on worker productivity, in Workers in the South Sudan context.

5.1 Evaluation of Findings

The findings of this study have provided critical insights into the relationship between food insecurity and worker productivity in South Sudan. The evaluation of these results reveals the complexity of the issue, which is influenced by several interrelated factors such as conflict, displacement, climate change, and socio-economic instability. Each aspect of the findings is discussed in detail below.

5.1.1 Food Insecurity as a Persistent Challenge

The statistics revealed that the situation with food insecurity in South Sudan remains acute and chronic, with the rate of households experiencing high levels of food deficit being above 60%. This finding supports other research that has shown that the people of South Sudan are among the most food insecure globally owing to civil strife, political misdeeds, and natural disasters such as floods (World Food Programme, 2023). It has displaced communities, interfered with agricultural activities disrupting people's means of earning a living, thus deepening food insecurity. These findings relate to the assertions made by Maxwell and Majid (2016) who posited that food insecurity in regions with conflicts is a humanitarian issue and an economic problem as well.

5.1.2 Impact on Worker Productivity

The results of the qualitative analysis also indicated that high levels of HFIAS scores were significantly inversely correlated with GDP per worker; with a correlation value of -0.75 as estimated by the Pearson correlation coefficient. The finding also corroborates the empirical studies by ILO that indicate that the poverty and health implications of food insecurity can lower employee productivity by as much as a third in the least developed countries (ILO, 2018).

The research also established that results from food insecurity meant that 45 per cent of the workforce in the South Sudanese civil service was likely to be out of work due to hunger related diseases or having to source food for their families.

5.1.3 Correlation Between Malnutrition and Productivity

The other effect that people realized to lower the worker's productivity was malnutrition. This revealed a positive significant relationship between hunger and malnutrition ($r = 0.85$) demand and malnutrition status, where malnutrition was identified at 70 per cent among workers in South Sudan. The above relationship supports the earlier studies that realized that

malnutrition reduces physical and mental strength hence the worker output (Smith et al., 2015). These results simply mean that nutrition in South Sudan needs to be improved as one of the ways of improving productivity among workers.

5.1.4 Comparative Analysis with Other Countries

The level of realized food insecurity in South Sudan was higher – 60%, whereas the GDP per worker was lower – \$2000 compared to Kenya, Uganda, and Ethiopia. It has thus become evident that the duration of the conflict and the repeated displacements have greatly affected the already strained economy of South Sudan and a repeat of the seemingly integrated FFE and SE interventions will be necessary. Food insecurity is a problem that has affected East Africa in general but South Sudan has been its biggest victim in that region because of the fighting, political instabilities both internally and neighbouring, and climatic changes.

5.1.5 Time Series Analysis and Trends

In the food security analysis, the time series indicated that the situation had equally deteriorated in the same decade and even much worse after the civil conflict erupted in the country in December 2013. It was also easy to deduce these periods of conflict saw the GDP per worker decrease progressively even as the index of food insecurity and displacement increased.

This finding supports scholarly works that associate conflict with economic deterioration and shortage of food (FAO, 2019). Further, the trends inferred from the results indicate that unit food security and unit worker productivity will remain worsening given that the conflict in South Sudan is not addressed. Ongoing conflict and displacement as well as food insecurity has continued to maintain the country in a “conflict trap,” which has condemned the development of the country.

5.2 Re-assessment of Research Questions in Relation to Research Findings and Literature

The research questions posed at the outset of this study sought to understand how food insecurity affects worker productivity in South Sudan and to identify the factors contributing to this relationship. Based on the findings, each research question is re-assessed below. 5.2.1 How Does Food Insecurity Affect Worker Productivity in South Sudan? This study showed that workers who stayed hungry and malnutrition were likely to miss from work and offer substandard performance. Such link between physiological and economic indicators as food insecurity to GDP per worker, and elevated rates of people’s absenteeism and overall nutrition demonstrated food insecurity as a critical socioeconomic issue in the context of the country. These are consistent with empirical data available from current literature that portrays that food insecurity erodes human capital since the physical and cognitive competence of workers is compromised (Smith et al., 2015; ILO, 2018). The study also rekindled the idea that food insecurity in nations which are experiencing conflict, such as South Sudan, could not be solved independently of other basic conflicts such as conflict resolution and socio-economic stability (Maxwell and Majid, 2016).

5.2.2 What Are the Key Factors Contributing to Food Insecurity and Its Impact on Worker Productivity?

This work enumerated the factors that defined Food insecurity and their influence on worker productivity in South Sudan. Large-scale displacement due to continuous civil conflict had tremendous effects on the structures of producing foods and accessing them, hence leading to poor nutrition due to inadequate food regimes. This finding concurs with research pointing towards conflict and displacement as agents of food vulnerability in South Sudan and other regions of the world (FAO, 2019; Oxfam, 2020). Extreme weather conditions like droughts and floods aggravated by climate change have also wiped out agriculture productivity and the food deficit deepened in South Sudan. This is in concordance

with other studies that show that climate risk food insecurity affects conflicted affected areas most (African Development Bank, 2020). Among them, poor nutrition received attention as a key factor that influences employee productivity negatively.

5.2.3 How Do the Findings Contribute to the Existing Literature on Food Insecurity and Productivity?

Although there is a significant amount of literature on how food insecurity affects worker productivity in the LCs of the developing world, this paper has more targeted information on the challenges of South Sudan – a country operating in an environment of conflict and chronic food shortages. The research therefore contributes to the literature by synthesizing the impact of conflict, displacement and climate change on food security and economic growth in such a setting. The evidence presented in the study corroborates the negative relationship revealed between the food insecurity status of the workers and their rate of output in South Sudan which has backed previous work done in similar settings.

5.2.4 What Are the Implications for Policy and Practice?

The discovery of this study therefore has policy and practice implications for food security and its influence on the output of workers in South Sudan. That is the reason why holistic approaches to addressing the food insecure population and forward looking economic development strategies needs to be engaged. Key policy recommendations include: By so doing, there is need to resolve the conflict in South Sudan in order to enhance food security and workers' productivity. Reconstruction activities should be followed by agriculture and physical infrastructure development to help food systems to function efficiently.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

This chapter puts forward a clear and well-coordinated conclusion to the research study, with care taken to ensure that it reflects the highlights of the study while directly pointing out the research objectives. This research sought to understand how, why and under which conditions food security determines worker productivity in South Sudan. After that, several suggestions on the usage of the identified approaches for business purposes will be outlined for organizations and policymakers focused on combating hunger. Last of all, the disclosure that may be, the chapter will put forward the limitations of the study and the potential future research directions.

The study focused on the following research questions: the level of food insecurity, the effect of food insecurity on worker productivity in South Sudan and antecedents of food insecurity. Despite this, this research shows that Italy is a haven for asylum; 62.2% of the interviewed population from South Sudan lacked adequate food. This realization makes it even more necessary to increase and enhance the efforts towards grappling with this important humanitarian crisis. Regarding the second research question, the work was able to confirm that there is an inverse relationship between food security and productivity levels among the workers. The analytical descriptions of the results also confirmed that by increasing the levels of food insecurity, the levels of worker productivity declined in equal measures, thus indicating that the research findings had empirical support from the earlier literature noting the adverse effects of malnutrition on the health and productivity of the human. The findings affirmed that workers food insecure had high levels of likely absorption and also low levels of worker productivity for those attending work. This finding is consistent with other established studies that revealed that difficulties lower worker performance by roughly 30% if the workers are low-wage earner workers in a condition of malnutrition. Moreover, identified causes for food insecurity include conflict, population displacement, climatic

factors, and economic shocks. These are repetitive manners that contribute to limited attainment of food security and enhanced productivity of workers. This more refined version of food insecurity states that addressing these causes requires more than just offering food hampers to the affected but political, and social-economic.

Food insecurity is considered still to be one of the most important problems in global development, including the areas facing issues of instability as well as economic insecurity. South Sudan is one of the countries that have recorded higher levels of the problem it has reduced working population productivity and health significantly. The relationship between food insecurity and productivity is a strong and significant factor for countries where labour dynamics are key to economic development. South Sudan remains one of the most agriculture and manual labour-dependent countries the world over, two industries that are worst hit by the food crunch. This chapter therefore presents the background to the study, the rationale and purpose of the research problem, the research context of South Sudan, and the effects of food insecurity on the performance of workers.

6.2 Recommendations for Business Application

Based on the findings of this research, several recommendations are proposed for organizations and policymakers seeking to address the challenges of food insecurity and worker productivity in South Sudan:

6.2.1 Integrated Food Security Programs

This study establishes that integrated food security programs must be an imperative in organizations' operations in South Sudan. These programs should thus comprise not only food aid but also agriculture, feeding and market systems which are sustainable. The organizations should assist farmers in the area and encourage food production to lower food insecurity in the future, as well as support the economy. Measures like capacity building of farmers on conservation agriculture practices, and availing seeds, and tools boost food production preparedness.

6.2.2 Nutritional Support Programs

In order to mitigate the effects of malnutrition in the workforce, management at the various organizations should consider providing nutrition to workers to enhance their production. Such programs may involve preparing and making available healthy foods and drinks at workplaces, nutrition education, and giving of nutritional supplements to sensitive employees. For that reason, the nutrition of the worker can be bolstered to promote productivity and decrease worker turnover caused by illness connected with hunger. Such kind of programs can also involve partnering with local health organizations that in turn will enhance the support of the community.

6.2.3 Collaboration with Local Governments and NGOs

Organizations should engage both local government and non-governmental organizations with major roles in the formulation of projects dealing with food insecurity; thus, multi-stakeholder partnerships are effective for resource mobilization and for making the intervention more relevant and sustainable within the existing scenarios. Such relationships allow to exchange of information, experience and even resources that may improve the overall goal and accomplishment of food security objectives.

6.2.4 Advocacy for Policy Change

Players in the food sector must promote policies that address the cause of food insecurity in South Sudan for business and organisational advocacy should focus here. This involves pressure for conflict settlement, enhanced authority and support for the farming sector. Policymakers should understand the essence of food security in creating stability and growth hence food security should be brought to the forefront by business organizations.

6.3 Limitations & Implications for Future Research

It must be appreciated that this study has some limitations regardless of the useful information it has given on food insecurity and workers' productivity. A main weakness was a large

dependence on the respondents' estimates instead of actual numbers which may have skewed the results. Future research could therefore use both qualitative interviews and quantitative analysis to get an even better understanding of the factors causing food insecurity and poor productivity. The last weakness we identified was that the study was conducted in a particular region in South Sudan. Future research endeavours might broaden the scope of the survey to encompass a more extensive array of domains, thereby capturing the diverse challenges encountered by different demographics within the nation. This would make it easier to decipher how factors at the country level affect this connection between F&I and productivity. In addition, more specific "longitudinal" investigations that follow changes in a population over time might yield a richer understanding of the impacts of intervention to enhance food security and production. It would also make it possible to evaluate multiple direct and indirect effects of the proposed strategies and select the most appropriate approaches to manage food insecurity in the war zones. Comparison made with the other EAC countries revealed that food insecurity prevalence and productivity were even worse in South Sudan than in other EAC countries. The time series analysis showed that both food insecurity and productivity had worsened over the past decade with more worsening in the periods of increased conflict.

The dissertation is submitted in partial fulfilment of the requirements of the School of Business and Law, University of East London for the degree of Master of Science in International Business Management.

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ABSTRACT

Today's healthcare administrators are not just managers; they are innovators operating within a dynamic and creative environment. Their approaches elevate the healthcare management sector and significantly contribute to social security by acting as vital knowledge partners in transformational initiatives. The training programs are designed as an effective blend of academic rigor and industry-relevant insights, providing a critical understanding of corporate culture and amplifying the importance of healthcare managers in the evolving job market.

In response to the rapidly changing landscape, new skill sets identified including communication, collaboration, change management, team leadership, motivation, analytical thinking, and logical reasoning, have emerged that emphasize the need for ongoing learning, unlearning, and relearning. The curriculum is shaped by comprehensive competency mapping, ensuring alignment with the demands of modern healthcare.

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Today's healthcare administrators are not just managers; they are innovators operating within a dynamic and creative environment. Their approaches elevate the healthcare management sector and significantly contribute to social security by acting as vital knowledge partners in transformational initiatives. The training programs are designed as an effective blend of academic rigor and industry-relevant insights, providing a critical understanding of corporate culture and amplifying the importance of healthcare managers in the evolving job market. In response to the rapidly changing landscape, new skill sets identified including communication, collaboration, change management, team leadership, motivation, analytical thinking, and logical reasoning, have emerged that emphasize the need for ongoing learning, unlearning, and relearning. The curriculum is shaped by comprehensive competency mapping, ensuring alignment with the demands of modern healthcare.

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I. INTRODUCTION

Future healthcare administrators play a crucial role in enhancing social security within the healthcare management sector by acting as knowledgeable partners in the ongoing transformation of healthcare systems (Tsey et al., 2018). One of their primary responsibilities is to ensure seamless communication among stakeholders, care providers, and patients. A comprehensive communication skills training module has been developed to support this, focusing on adaptability within a dynamic and social environment. This training is essential for improving patient care outcomes.

From the patient's perspective, it's vital that communication is clear and not overly predictive. Healthcare administrators must ensure that they meet the communication needs of patients effectively. This goes beyond just the clinical aspects of care; it involves understanding the socio-cultural and psychological dimensions that influence patients' experiences. By grasping these needs, administrators can deliver information in a more meaningful and impactful way.

The implementation of training and development initiatives is designed to align skill sets with the organizational goals and standards. This proactive approach also encompasses risk assessment and mitigation strategies to maximize benefits for end users. The communication processes must be both precise and structured to achieve the overarching objectives of the healthcare service industry.

The training framework combines academic knowledge with practical insights from the industry, which strengthens future administrators' understanding of corporate

culture and enhances their significance in the healthcare management landscape (John, 2009). Additionally, the emphasis on defined skill sets prepares them to engage in negotiations from multiple perspectives, including those of patients, healthcare providers, and suppliers involved in the hospital supply chain (Isbouts et al., n.d.). By fostering these competencies, future healthcare administrators will significantly contribute to more effective and empathetic healthcare delivery.

A troubling gap has been identified between the skill sets future healthcare administrators bring and the essential patient-centered quality of care that must be delivered daily. The urgency to develop soft skills has become increasingly apparent.

This study utilized an interventional design featuring both qualitative and quantitative analyses through stratified sampling. A panel of 24 expert committee members (12 from academia and 12 from industry) offered invaluable guidance for verifying the efficacy of the training programs and interventions. The training program engaged 125 participants enrolled in the MBA – HHM program, focusing on their development as future hospital administrators.

Prior to full implementation, the training program underwent standardization, supported by a pilot study with 25 participants that informed course module preparation. Pre- and post-test scores were compared, which revealed a significant difference in outcomes of 32% enhancement. The impressive enhancement demonstrated the training program's tangible effectiveness. Evaluative measures—both subjective and objective—were applied, with feedback reflecting a remarkable 91% of participants deeming the program excellent, translating to a score of 113.75 out of 125. Statistical validations confirmed these results, with a P value of $P < 0.0001$. Cumulatively, scores rose from 41% to 73%, a substantial 32% improvement that underscores the training's impact.

The training methodology is considered a pre-and post-test tool of subjective and objective measurements to assess participants' skill set

enhancements effectively. Feedback was solicited using a range of targeted questions, reinforcing that the training significantly influenced knowledge, attitudes, and practices. The chosen pragmatic model of training and development stands to benefit organizations significantly.

The scope of the training module provides essential insights and opportunities for reflective learning, which is crucial for advancing participants' professional growth. Moreover, the evaluation of the communication training element demonstrates a direct linkage to improved quality of care within healthcare settings. The vital skill sets identified include communication, collaboration, change management, team leadership, motivation, analytical thinking, and logical reasoning. Together, these competencies are foundational to cultivating effective future healthcare leaders. For further development, the pragmatic model as soft skills training program can be imparted in other university colleges for health care administrators for adding value as competency development and for mentoring health care leaders.

II. AIM AND OBJECTIVES

2.1 Aim

1. To identify the soft skill competencies that are required for enhancing communication skills for future health care administrators in the health care sector and to develop, validate, and implement a training module by assessing the effectiveness in improving soft skill competencies for future health care administrators in the hospital sector.

2.2 Objectives

1. To identify the soft skill competencies that are required for enhancing the communication skills of future healthcare administrators in the hospital sector.
2. To develop and validate a module for training health care professionals in enhancing their soft skill competencies for the future health care administrators in the hospital sector.

3. To implement and assess the effectiveness of the module in improving soft skill competencies

1. Key research gaps

Research gaps in the literature on identifying the soft skill competencies that are required for enhancing the communication skills of healthcare professionals in the hospital sector.

The research review concepts provide an overview of indigenous research which is relevant for the research study performed for soft skill competencies for health care professionals. The literature search mainly consists of research articles and web-based publications, reviewing the research models, and also reviewing the existing relevant research materials. Subsections also include researched material based on the nature of the work in the healthcare domain. Specific research material on training for soft skills is utilized. The variables and also their relationship is reviewed for training need identification. There is a combination of tables, graphical representations, and diagrammatical presentations that are taken for research model preparation.

Research gaps in the literature on implementing and assessing the effectiveness of the module in improving soft skill competencies for health care professionals.

1. Through a thorough literature search on relevant websites, several specific skill sets have been identified as crucial for improvement in the healthcare management sector:

a. Identification of Competencies as Soft Skills: Competencies serve as essential tools for training and development, enhancing the experience for participants. They are pivotal in improving the quality of care within healthcare management. Various techniques for developing soft skills can be applied to enhance care delivery, treatment, and communication (Mayer et al., n.d.). By creating realistic scenarios for both routine operations and emergencies, organizations can foster process improvements. Effective communication, as a skill set, is instrumental in

enhancing healthcare quality and patient safety, yielding measurable outcomes (Mayer et al., n.d.).

b. Importance of Healthcare and Patient Safety: In today's landscape of evidence-based medicine, mapping competencies, and enhancing skills have become tools that significantly contribute to delivering quality care. This approach not only extends training and development opportunities but also facilitates continuous improvement in technical skills. The integration of soft skills introduces a patient-centric approach within healthcare settings. With effective strategies in quality improvement programs, the utility of soft skills is expanding, serving as value-added activities for medical professionals, allied health workers, and para-medical personnel (Pronovost et al., 2017). The adoption of these skills among healthcare management students and future administrators establishes a defined working culture and creates a conducive environment for effective communication. A multidisciplinary approach, reinforced by repeated training, enables a comprehensive understanding of healthcare processes.

c. Significance of Quality in Healthcare: Clinical care priorities focus on patient safety and quality through effective communication. Training techniques can transform the knowledge, skills, and attitudes of healthcare professionals. By identifying risks and addressing them through quality assurance processes, we foster patient-centric approaches. Ongoing risk assessment and management can uncover system flaws and promote continuous improvement. Recreating training scenarios adopts a multifaceted approach to enhance healthcare quality (Tartaglia Reis et al., 2018). These training tools serve various functions to refine daily operations and elevate service quality, likely leading to increased patient visits and reduced healthcare costs. This, in turn, contributes to improved service delivery and heightened patient satisfaction, enhancing the profitability of healthcare organizations. Ultimately, better communication leads to a stronger value proposition from a business perspective.

d. Necessity of Healthcare Teams: A multidisciplinary team structure, including core clinical teams alongside contingency, coordinating, ancillary, support services, and general administration teams, is essential for delivering high-quality patient care (Lamé and Dixon-Woods, 2018). When these teams collaborate effectively, improved outcomes are achieved. Implementing evidence-based practices, honing technical skills, and fostering soft skills are vital for enhancing communication (Markides, 2011), monitoring situations (Opinion, 2010), mutual support (Bridges et al., 2014), and cultivating innovative leadership styles (Vohra, Rathi, and Bhatnagar, 2015).

By understanding the unique needs and requirements of healthcare organizations, training sessions can be systematically planned and executed. Aligning individual needs with the departmental mission and the overall organizational goals is critical. A structured action plan with well-defined strategies can aid management in effectively implementing these initiatives.

1. Variation in Competency Identification: While several studies suggest specific soft skills critical for healthcare professionals, there is a lack of consensus on which competencies should be prioritized. More empirical research is needed to establish a standardized set of soft skills that aligns with varied roles within the healthcare spectrum, including clinical, administrative, and support positions.

2. Effectiveness of Soft Skills Training Programs: Although some programs claim effectiveness in enhancing soft skills among healthcare professionals, rigorous assessment methodologies are often lacking. Research needs to examine long-term outcomes and the actual impact on patient care and safety metrics. Randomized control trials and cohort studies could provide more definitive evidence regarding the effectiveness of different training modalities.

3. Integration of Soft Skills into Curricula: Current literature highlights the importance of embedding soft skills training within healthcare

education. However, there is little information on best practices for curriculum design that effectively merges soft skills development with technical training. Research that investigates how to balance soft and hard skills in training programs is necessary.

4. Cultural and Contextual Differences: Most studies focus on homogenous populations, failing to address how cultural differences affect the perception and implementation of soft skills in healthcare. Investigating these variances can lead to enhanced training programs that are sensitive to the diverse environments in which healthcare professionals operate.

5. Measurement Tools for Soft Skills Competency: While measuring soft skills presents challenges, existing tools may not adequately evaluate competencies in a healthcare context. Future research should explore the development of robust and reliable assessment tools specifically designed for measuring soft skills in healthcare settings, taking into consideration factors like teamwork, communication, and empathy.

6. Sustainability of Skills Development: The literature lacks a focus on how to sustain soft skills development over time after training. Research could explore mechanisms for continuous learning and reinforcement of skills in daily healthcare practice, potentially integrating technology such as e-learning platforms or mobile applications.

7. Impact of Soft Skills on Organizational Culture: While several studies link soft skills training to improved patient care, there is insufficient research exploring how these skills influence broader organizational culture and teamwork dynamics within healthcare settings. Understanding the relationship between individual competencies and team effectiveness could highlight the broader implications of soft skills training.

8. Linking Soft Skills to Patient Outcomes: Although there is a perceived connection between improved soft skills and better patient outcomes, direct evidence remains scarce. Future studies should strive to quantify this relationship,

possibly through tracking patient satisfaction, clinical outcomes, and error rates pre-and post-training.

9. Role of Leadership in Soft Skills Development: The influence of leaders in fostering a culture that encourages soft skills is underrepresented in the literature. Research investigating how leadership styles affect the adoption and success of soft skills training initiatives could yield insights into effective program design and implementation.

10. Cross-disciplinary Approaches to Soft Skills Training: Given the collaborative nature of healthcare, there is a need for research exploring cross-disciplinary training programs that serve to unify various healthcare professionals in the development of soft skills. Studies could evaluate the effectiveness of combined training programs that include doctors, nurses, administrators, and support staff.

In conclusion, while the importance of soft skills in healthcare is increasingly recognized, addressing these research gaps will be essential to enhance their implementation and assessment. Focusing future studies on these areas can lead to more effective training programs and ultimately improve patient care quality and safety outcomes.

III. SIGNIFICANCE OF THE STUDY

There exists a considerable gap between the skills that future healthcare administrators are adopting and the management practices required to deliver patient-centered quality care in hospitals and healthcare organizations (Mayer et al., n.d.).

This study is critical for several reasons:

1. To identify essential soft skills, especially in communication.
2. To understand the delivery of healthcare services and the vital role of quality communication training programs.
3. To emphasize the significance of high-quality care in healthcare systems.
4. To highlight the necessity of effective healthcare teams.
5. To stress the importance of documentation as a key training module.

There is a pressing need for soft skills competencies and dedicated training programs for upcoming hospital administrators to align with stakeholders' expectations for exceptional quality care. By centering our focus on the patient perspective, we can ensure that the development of skill sets is both relevant and impactful (Shenoy, 2021).

Aligning these educational needs is vital for establishing benchmarking in training programs and integrating best practices in the hospital and healthcare sector, which is fundamentally a service industry. Thus, structured training programs focused on soft skills and competencies become indispensable. To ensure excellence in these training initiatives, standardization of training modules is essential. Implementing evidence-based decision-making and high-performance standards within these training frameworks is crucial.

In today's rapidly evolving hospital and healthcare environment, the crux of the matter lies in effectively training soft skills and understanding their impact on patient care. When we discuss the quality of care from the patient's perspective, specific elements must be acknowledged as essential for robust service delivery in the hospital sector (Reblando, 2018).

The STEEEP framework—Safe, Timely, Efficient, Effective, Equitable, and Patient-Centered—serves as a robust foundation for elevating healthcare services. Reflecting on our training model reveals critical insights that will shape our future approaches to healthcare management:

1. Key Learnings from the Training Model: The healthcare administrators are able to learn to integrate rigorous safety protocols and enhanced patient engagement strategies. By recognizing and addressing diverse learning styles, healthcare administrators can create tailored educational experiences that truly meet participant needs.

2. Innovating Daily Management Practices: As we step into future administrative roles, our focus will shift towards fostering collaborative decision-making, actively involving frontline staff, and leveraging data-driven insights. This

proactive approach will cultivate a transparent culture of ongoing improvement.

3. *Measuring Competency Changes:* It's imperative to evaluate shifts in knowledge, attitudes, practices, and skills consistently. Regular assessments and reflective practices will enable us to gauge the impact of training initiatives and pinpoint further areas for enhancement.

4. *Integrating Soft Skills and Managerial Tools:* By blending soft skills with managerial tools, we unlock the potential for a highly relevant training program. Collaborations between industry and academia can pave the way for a more integrated educational experience that drives results.

5. *Maximizing System Effectiveness and Efficiency:* Establishing clear metrics to evaluate training effectiveness is vital. Gathering data on patient outcomes, staff performance, and operational efficiencies will demonstrate the tangible benefits of training programs in enhancing service delivery.

6. *Implementing Rapid Feedback Mechanisms:* Quick feedback loops can drastically improve skill development. By fostering a culture of multidimensional feedback among program participants, we can continuously refine our training initiatives and promptly address any issues that arise.

7. *Redefining Change as Meaningful Improvement:* Change should be a catalyst for improvement, not merely a shift in practices. By diversifying our training methods—incorporating simulations, workshops, and e-learning—we can foster a richer learning environment that allows for effective benchmarking.

8. *Learning from Best Practices:* Adopting proven best practices from the healthcare industry is essential for process enhancement. By analyzing successful strategies from leading organizations, we can adapt these approaches to optimize our operational frameworks and improve patient care.

Through this research, the questions that can be answered as reflective learning were:

1. What did we learn from the training model?
 2. What would we do differently in the day-to-day management of hospitals as future health care administrators?
 3. Testing the change in knowledge, attitude, practices, and skill sets.
 4. Understand the wider system, can we adapt the soft skills and managerial tools in a blended manner? Can Industry and academia consortium be a possibility in a pragmatic model of the training program.
 5. Can we make systems effective and efficient? Can the training program outcomes be measured for effectiveness?
 6. Can quick feedback help and impact the wider skill development to work better? Can multidimensional feedback from the participants add value for continuous improvement purposes for the training program?
 7. Change is an improvement and not just a change!?! Rather than the conventional teaching and training program, can the training program be a culmination of a variety of methods of training and learning modalities that can be adapted for benchmarking?
 8. Can the best practices of the healthcare industry be adapted for process improvisation?
- In summary, reflecting on these questions enables us to cultivate a more effective healthcare system. By applying the STEEEP principles, we can ensure that our training programs are impactful and aligned with the overarching goals of safe and equitable patient care.

IV. REVIEW OF LITERATURE

The research methodology employed in this study encompassed a comprehensive approach to gather and analyzing data from various sources, ensuring a robust foundation for the findings.

a) Literature Review: The literature research involved using targeted keywords in reputable search engines and databases, focusing primarily on articles published in esteemed journals recognized both nationally and internationally (Sonnino, 2016). This process aimed to identify key themes and insights relevant to the study's focus.

b) **Documentary Search:** A thorough documentary search was conducted, drawing from a variety of training manuals, standard operating procedures, and specific training articles that healthcare management organizations consider best practices. This involved not just collecting documents but engaging in systematic document analysis through several approaches:

1. **Qualitative Research Method:** This approach allowed for an in-depth exploration of qualitative data, focusing on understanding themes and narratives within the documents.

2. **Mixed Method:** Utilizing both qualitative and quantitative data, the mixed method enabled a more comprehensive understanding of the topic by integrating insights gleaned from various sources.

Qualitative Research Method: The documentary analysis required repeated reviews and deep evaluations of the collected data. Researchers developed clear concept-based questions, leading to the identification and exploration of specific research inquiries. By interpreting the data, meaningful insights were derived, contributing to a deeper understanding of the subject matter.

Mixed Methodology: In addition to the documentary analysis, insights gained from focused group interviews were instrumental in shaping the research. Observations made during these discussions, coupled with targeted surveys, provided a multifaceted view of the issues at hand. This triangulation of data—combining documentary evidence, interviews, and observations—allowed for comprehensive data synthesis, minimizing bias and enhancing the reliability of findings. The resultant data informed the development of a pragmatic model for training and development within the healthcare context.

By employing these varied methodologies, the research aimed to construct a solid framework that would inform training and development initiatives in healthcare management, ultimately supporting the growth of competent future leaders in the field.

1. By conducting a literature search on reputable websites, the learning outcomes have been established:

Literature Review: Communication holds significant importance in various fields. Understanding communication's essence is crucial; as a renowned quote states, “The way we communicate with others and with ourselves ultimately determines the quality of our lives.” Communication is defined as the transmission of information from one person to another using some form of medium. The literature review provides valuable insights into training modules designed to enhance quality metrics, ensuring that service delivery in healthcare becomes both safe and efficient. In the healthcare management sector, there is substantial potential for improvement through the analysis of issues using communication skills as a modeling approach, which helps identify effective solutions (COMMUNICATION DEFINED, n.d.). These skills significantly empower managers in the healthcare sector to achieve cost containment.

IV. PATIENT CARE AND HEALTHCARE SECTOR

In promoting healthcare as a comprehensive system, communication is not just critical—it is essential, instrumental, desirable, and purposeful. The process of sharing information is a well-structured and planned endeavor (Song et al., 2015). To foster effective communication, the delivery process must be systematic and appropriate (Ang et al., 2013). The audience or receiver must fully grasp the message, just as the sender should be clear and concise in their communication (M. Biglu - Communication Skills of Physicians and Patients' Satisfaction, n.d.). In the context of preventive healthcare (II. Important Specific Contexts for Incorporation of Prevention Concepts, n.d.), healthcare professionals often experience burnout (Communication Skills a Preventive Factor in Burnout Syndrome in Health Professionals, n.d.). During stressful situations, healthcare providers—including doctors, nurses, and information technology officers—struggle to

deliver solutions effectively, often facing challenges related to time, resources, and the necessary communication skill set (P. Vermeir - Communication in Healthcare: a Narrative Review of the Literature and Practical Recommendations, n.d.). Being aware of and addressing gaps in delivering the optimum care that patients deserve hinges on effective communication (Lisa Whitehead & Kirk Walker, 2019). Communication plays a vital role in various aspects, including history-taking, examinations, data collection, rapport-building, negotiation, decision-making, partnerships, counseling, and the development of interpersonal skills (Chichirez & Assistant, n.d.). The primary objective of communication skill training is to evaluate effectiveness and foster behavioral change (Functional Communication Training: A Review and Practical Guide, n.d.) among the health care personnel (Ngigi & Busolo, 2018). Research studies indicate that effective communication training for healthcare professionals hinges on several key components. First, the duration of the training must be established to ensure meaningful learning outcomes. Additionally, it is critical to evaluate the value of the training programs to determine their benefit to healthcare professionals and to assess the frequency of these sessions to guarantee clinically measurable results (Evaluating the Impact of an Assertiveness Communication Training Programme for Japanese Nursing Students, n.d.).

In the realm of curative healthcare, effective communication is integral, as the social environment influences the dynamics of patient care. Both non-verbal and verbal communication play a vital role in fostering better understanding and encouraging patients' health and well-being (Živanović & Sf Nurs Heal, 2017; Wanko Keutchafo et al., 2020; Wahyuni, 2018). Effective communication skills enhance treatment processes, significantly impacting the emotional states of patients, and ultimately leading to improved health conditions (The Hearing Journal, 2016).

In rehabilitative healthcare, skillful communication is paramount, as it fosters greater sensitivity to patients' needs. Multiple strategies

have been identified to enhance effective communication skills (Lucca, 2006; Kárpáti, n.d.; PRACTICE MANAGEMENT, 2017). Practicing reflective awareness in personal communication with patients is essential (Koshy et al., 2017; Nurani et al., 2020). Training in communication skills should effectively bridge theoretical knowledge with practical application (Ruler, 2018). Evidence-based reflections can be drawn from training sessions, possibly through the use of e-training portfolios to support continuous learning and professional development.

Reflective learning emerges as a valuable tool for assessing strengths and weaknesses in communication as a skill set. Self-reflection aids personal development and fosters self-directed learning, which can motivate healthcare professionals and enhance the quality of care provided (Pratibha, 2017; An Online, Self-Directed Curriculum of Core Research Concepts and Skills, n.d.; Geng et al., 2019). Furthermore, careful analysis of situations and consideration of alternative approaches are critical for adapting practices in healthcare settings (Straková et al., 2018).

In summary, the integration of communication training within healthcare education necessitates a structured approach, focusing on evaluation and reflection to bring about significant improvements in both patient interactions and overall care outcomes.

Reflection is a valuable practice that enhances confidence and helps synthesize various concepts (Mortari, 2015). By critically reviewing and adapting methods, individuals can improve their practices in specific situations through effective communication (Rashad Yazdanifard et al., 2012). Engaging with peers and seniors not only enriches the reflective process but also fosters essential confrontations that can be integrated into daily routines (Blok, 2010). When reflection is used as a communication tool, it becomes a catalyst for career advancement (Mulhall, 2014) and enhances the skill set of healthcare providers (Ranjan et al., 2015).

V. RESULTS

Results of pre and post-test of the training program: All precautions were taken to avoid the

skewing of data and to avoid data bias, and random sampling techniques were utilized for assessing the questionnaires. The scores were as follows:

Table. No. 1: Results of Pre-test score and Post-test score of 125 participants along with percentage enhancement.

For sample size of 125 participants		Pre-test	Pre-test%	Post-test	Post-test%	% enhancement
Knowledge-based	Question 1	425	68%	550	88%	20%
Attitude based	Question 2	300	48%	475	76%	28%
Practice-based and attitude based	Question-3	300	48%	450	72%	24%
Skill based	Question-4	125	20%	400	64%	44%
Skill set based and outcome of training	Question-5	125	20%	400	64%	44%
Cumulative score comparison of 125 participants	Total scores	1275	41%	2275	73%	32%

Data was found to be normally distributed. So Paired T-test was applied.

Table. No. 2: Data of pre-test and Post-test core along with Standard deviation and paired T-test P-Value for each question.

	pre-test		post-test		Paired T test p-value
	mean	SD	mean	SD	
q1	3.4	1	4.4	1.2	p < 0.0001
q2	2.4	0.6	3.8	0.8	p < 0.0001
q3	2.4	0.8	3.6	1	p < 0.0001
q4	1	0.2	3.2	0.9	p < 0.0001
q5	1	0.2	3.2	0.8	p < 0.0001

Usage of statical Software for calculation:

Med-calc online statistical software was used. The results of paired t-test were as follows.

Question number 1.

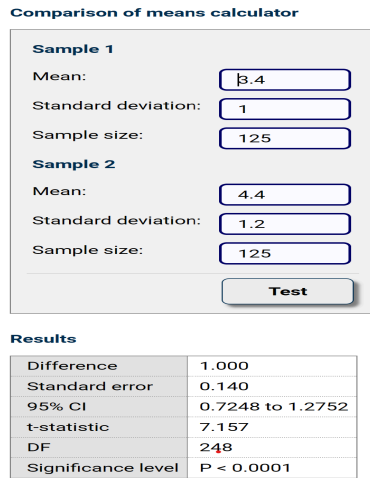


Fig. No. 1: Comparison of means calculator and results for question 1.

Question number 2.

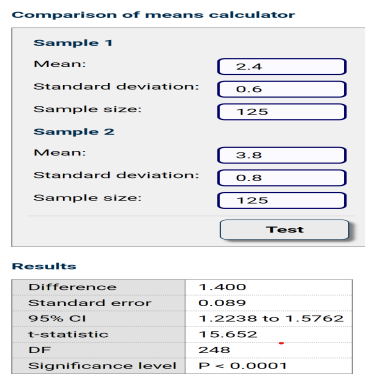


Fig. No. 2: Comparison of means calculator and results for question 2.

Question number 3.

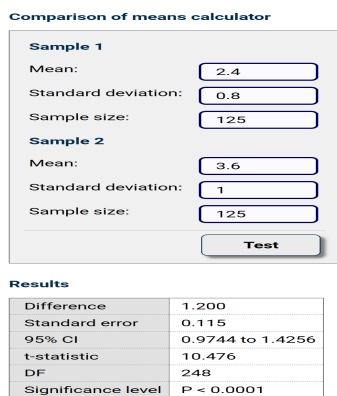


Fig. No. 3: Comparison of means calculator and results for question 3.

Question number 4.

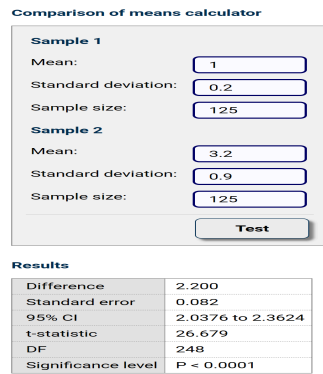


Fig. No. 4: Comparison of means calculator and results for question 4.

Question number 5.

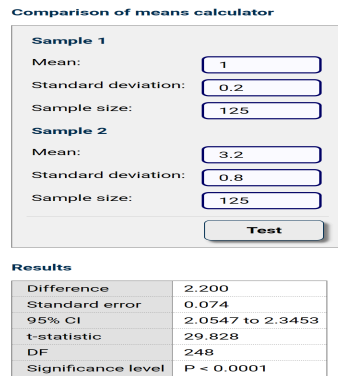


Fig. No. 5: Comparison of means calculator and results for question 5.

Post intervention Results: Participants were divided into a dichotomous group. One group consists of the participants who showed improvement in their post test scores whereas patients whose scores didn't show improvement consisted another group. Logistics Regression was used to determine the significant factors affecting the improvement in Knowledge, Attitude and Practice score.

It was found that the participants who had the prior exposure to the prerequisites had significantly three times higher odds of improvement in attitude score as compared to those who didn't have the prior exposure (O.R- 2.9584, 95% C.I- 1.46-5.98, P-value=0.003). Furthermore, the participants who had picked relevant additional topics through concurrent study had higher chances of improvement in

attitude score (O.R- 1.0016, 95% C.I- 1.05-2.04, P-value=0.049). It was also noted that the exposure to the background material led to higher odds of improvement in attitude with odds ratio of 3.41, 95% C.I-1.58-7.37. Participants who found the Training information delivery of advanced level had more than twice odds of improving their attitude score post-test as compared to those who found the information delivery of graduate level (O.R- 2.4509, 95% C.I- 1.22-3.93, P-value=0.031). Moreover, participants who reported that the Emphasis on fundamentals and relevance was excellent were again found to have higher odds of improving their attitude score. The remaining variables, such as the mode of course delivery (synchronized or asynchronous), prior experience with the course, and syllabus coverage, did not show significant effects (P-value >0.05) on attitude improvement.

Variable affecting the improvement in Attitude		Odds ratio	95% CI	P-value
Percentage of classes attended	Synchronized mode	1		
	Asynchronized mode	1.3306	0.7066 to 2.5057	0.376
Participants had undertaken this course earlier	No	1		
	Yes	0.7669	0.4014 to 1.4654	0.422
Participants had prior exposure to the prerequisites	No	1		
	Yes	2.9584	1.4634 to 5.9810	0.003
Participants had pickup relevant additional topics through concurrent study	No	1		
	Yes	1.0016	1.0492 to 2.0359	0.049
Exposure to the background material	No	1		
	Yes	3.4094	1.5766 to 7.3728	0.002
Training information delivery	Graduate level	1		
	Advance level	2.4509	1.2188 to 3.9294	0.031
Coverage of syllabus	Good/Very Good	1		
	Excellent:	0.9967	0.9750 to 1.0189	0.769
Organization of course	Poor	1		
	Others	0.9992	0.9838 to 1.0148	0.917
Emphasis on fundamentals	Very Good	1		
	Excellent	1.3628	0.5489 to 3.3834	0.505
Emphasis on fundamentals and relevance	Good/Very Good	1		
	Excellent	2.4591	1.0248 to 5.9006	0.044
Coverage of modern/advanced topics	Others	1		
	Excellent	6.3002	0.4646 to 85.4259	0.166
Availability of textbooks/study materials	Others	1		
	Excellent	1.1558	0.8464 to 1.5784	0.362

Using Logistic Regression, it was found that the Participants who had prior exposure to the prerequisites had 3.36 times higher odds of improving their knowledge (OR = 3.36, 95% CI: 1.43–7.88, p = 0.0053). Participants who engaged in concurrent study of additional relevant topics had 1.55 times higher odds of knowledge improvement (OR = 1.55, 95% CI: 1.06–2.25, p = 0.0231). Those who had exposure to background

material had 3.42 times higher odds of improving their knowledge (OR = 3.42, 95% CI: 1.38–8.48, p = 0.0079). Participants who rated the emphasis on fundamentals as excellent had almost 3 times higher odds of knowledge improvement (OR = 2.98, 95% CI: 1.06–8.36, p = 0.0376). A focus on core concepts and their clarity appears to be crucial for improving knowledge. The odds of improving knowledge were 2.46 times higher for

those who rated the emphasis on fundamentals and relevance as excellent (OR = 2.46, 95% CI: 1.02–5.90, $p = 0.0439$). This underscores the importance of both fundamental concepts and their practical relevance for knowledge enhancement. Participants who rated the coverage of modern or advanced topics as excellent had 0.65 times lower odds of improving their knowledge (OR = 0.65, 95% CI: 0.44–0.94, $p = 0.0222$). This suggests that while advanced topics are important, they might not contribute as strongly to knowledge improvement in this case.

Those who had excellent access to textbooks and study materials had 5.39 times higher odds of improving their knowledge (OR = 5.39, 95% CI: 1.69–17.20, $p = 0.0045$). This indicates that the availability of high-quality resources significantly enhances knowledge gain. Mode of Course Delivery, Previous Experience with the Course, Training Information Delivery, Syllabus Coverage, Course Organization, etc. were found to be non-significant factors (P -value >0.05) affecting the knowledge improvement.

Variable affecting the improvement in Knowledge		Odds ratio	95% CI	P-value
Percentage of classes attended	Synchronized mode	1		
	Asynchronized mode	0.6506	0.2921 to 1.4487	0.2926
Participants had undertaken this course earlier	No	1		
	Yes	0.5163	0.2304 to 1.1569	0.1083
Participants had prior exposure to the prerequisites	No	1		
	Yes	3.36	1.4327 to 7.8804	0.0053
Participants had pickup relevant additional topics through concurrent study	No	1		
	Yes	1.5457	1.0616 to 2.2505	0.0231
Participants had no exposure to the background material	No	1		
	Yes	3.4222	1.3805 to 8.4837	0.0079
Training information delivery	Graduate level	1		
	Advance level	0.6551	0.2814 to 1.5252	0.3266
Coverage of syllabus	Good/Very Good	1		
	Excellent	0.9996	0.9970 to 1.0023	0.7812
Organization of course	Poor	1		
	Others	1.1037	0.4689 to 2.5976	0.8213
Emphasis on fundamentals	Very Good	1		
	Excellent	2.9836	1.0644 to 8.3629	0.0376
Emphasis on fundamentals and relevance	Good/Very Good	1		
	Excellent	2.4591	1.0248 to 5.9006	0.0439
Coverage of modern/advanced topics	Others	1		
	Excellent	0.6454	0.4435 to 0.9392	0.0222

Availability of textbooks/study materials	Others	1		
	Excellent	5.3871	1.6875 to 17.1977	0.0045

Participants who had undertaken the course earlier had 0.34 times lower odds of improving their practice score compared to those who hadn't (OR = 0.34, 95% CI: 0.16–0.72, p = 0.0054). Participants with exposure to background material had 5.67 times higher odds of improving their practice scores (OR = 5.67, 95% CI: 2.43–13.22, p = 0.004). Those with excellent availability of textbooks/study materials had 4.14 times higher odds of improving their practice scores (OR = 4.14, 95% CI: 1.25–13.75, p = 0.0203). Mode of Delivery, Prior Exposure to Prerequisites, Concurrent Study of Additional Topics, Training Information Delivery, Syllabus Coverage, Course Organization, Emphasis on Fundamentals, Emphasis on Fundamentals and Relevance, and Coverage of Modern/Advanced Topics were found to be non-significant factors influencing the improvement in practice (P-value >0.05).

As there were systems in place, after post-training, a gap time of 15 days was provided for the participants to dwell in reflective learning, complete the documentation of assignments, and be insightful in the EI concepts to change their behavior, habits, and attitudes.

The quantitative analysis had questions pertaining to the quality assurance perspective: The parameters were structured in detail and the participants had to use the tick boxes provided for user friendly ways of utilizing the feedback for the reply. For each of the questions, the parameter was provided and there were subjective and objective questions with relevance. There were questions regarding the expectations from the course.

The qualitative analysis had questions pertaining to the quality control perspective: The participants had to write replies in their own words for the questions provided. Since these were subjective types of questions, all forms were collected and analysed in detail.

The data was collected online mode by email. As these participants were a focused group, Numerical-based data was collected. Primarily, the data is based on the subjective feelings aopinionsctive opinion of the participants. The research feedback is involved on the open-ended questions to focused group individuals for a range of 125 participants, to provide feedback. The questionnaire was simple, straightforward data being collected with a series of questions, about open-ended and close-ended, related to the subject and the methodology of training adapted. The respondents get a series of questions to answer in the tick boxes provided. Since it's a combination of both data which is quantitatively and qualitatively performed, it has its uniqueness and innovative methods. This method of data being collected, it encompasses the usage of innovative methods, by enhanced participation and empowered capability of individuals and groups. Also, it is a combination of subjective, objective responses and addressing the sensitive subjects that are related to knowledge, attitude, and behaviors which alter/change in behavior, habits, and attitude of participants.

Benchmark of scores:

Points	Remark
100 to 125	Good, Doing well
75 to 99	Caution Could Do Better
<75	Concern, Minimal Efforts

Benchmark of the scores

Fig.No.5: Benchmarking scores and remarks.

This overall rating of the training program is considered for benchmarking purposes. When 91% of the participants say the training program is excellent, it implies that 113.75 is the score for 125 points.

Inference: By benchmarking scores and by adopting best practices, the effectiveness of the module in improving soft skill competencies for health care managers is proved to be good.

This score comes in the range of 100 to 125 points as per the benchmark of scores. The remarks for this range as per the benchmark score are: Good and doing well. This overall test score and comparing with the benchmark value is conclusive that the training program is within the range of effectiveness. As the desired process is achieved, from the learner's perspective in the controlled environment, the training program for soft skill competencies is considered effective. As a pragmatic model, this approach has raised the bars of the training program for soft skill competencies and also satisfied the training objectives. The score of 113.75 for 125 points implies that the training program is valued to be good and the desired process is effective.

What benefit you derived from the program?

What benefit you derived from the program

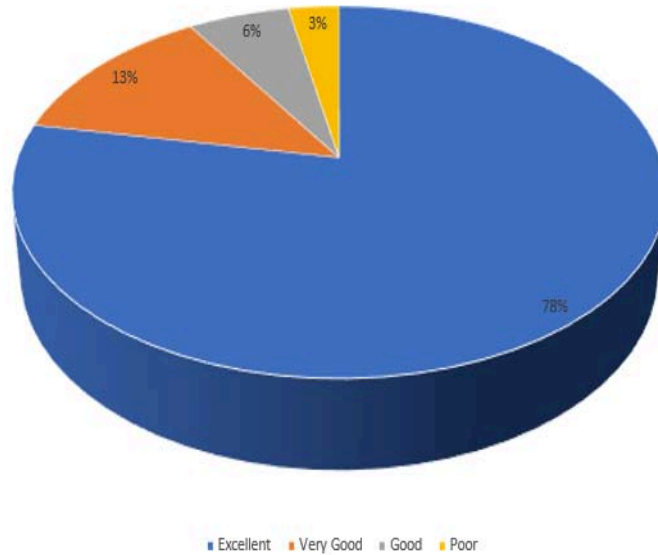


Fig.No.7: Pie chart: Benefits derived from the training program.

Inference of the data: Regarding the benefits derived from the training program are:

1. 78% of the participants said excellent.
2. 13% of the participants said Very Well.
3. 6% of the participants said Good.
4. 3% of the participants said poor.

Interpretation

- Most of the participants, about 78% said that they derived benefits from the Excellent training program.
- A few of the participants, about 13% of them said that they derived benefit from the training program was Very Good.
- A few of the participants, 6% replied to the feedback, that they derived benefit was good from the training program.
- A very few of the participants, 3% replied that the derived benefit from the training program was poor.

VI. DISCUSSION

1. Health Care Teams and Patient Care

To successfully integrate healthcare systems, strategies should be educational, beneficial to organizations, economically sustainable, and environmentally supportive. These strategies aim to improve behavior and create conducive living conditions for health and well-being. However, several challenges hinder the provision of integrated healthcare. Key issues include a shortage of skilled workers, inadequate medical equipment, unavailability of medications, low health literacy among patients, and the lack of standardized operating procedures. Additionally, many healthcare professionals tend to prioritize curative approaches over preventive and promotive care. Addressing these barriers can facilitate the integration of preventive, promotive, and curative health services. Communication plays a pivotal role in this integration, encompassing a network of individuals who relay messages, mediate technology, and adhere to

organizational frameworks. This communication can range from straightforward face-to-face interactions to more complex exchanges that utilize advanced technologies, such as video conferencing or digital messaging systems, particularly in critical care environments.

Effective communication in healthcare is essential for ensuring patient safety and improving care delivery. Various communication channels, such as synchronized (real-time) and asynchronized (delayed) modes, play a pivotal role in how information is shared among healthcare professionals. Message types vary from formatted texts and computer-generated alerts to laboratory reports, each serving specific purposes in clinical settings. Communication policies, including clinical handovers and guidelines represented through do's and don'ts symbols, help standardize interactions. Key personnel, such as clerks and administrative staff, function as communication agents, facilitating specific tasks that ensure smooth operations. Diverse systems—ranging from computers and specialized software to voice mails, faxes, text messages, mobile phones, and intercoms—enhance the efficiency and speed of communication processes. In critical areas like Operating Theaters (OT) and Intensive Care Units (ICU), modern devices, such as personal digital assistants (PDAs), are becoming increasingly popular to minimize disturbances to patients. Additionally, communication interaction modes, such as email alerts and audio notifications on message arrivals, effectively keep healthcare providers informed and responsive. Adherence to security protocols is imperative to protect patient privacy, with encrypted messages becoming standard practice in healthcare settings. Wireless communication technologies facilitate interaction across different levels of high-rise hospitals, making it easier for staff to collaborate across departments. Telemedicine serves as a vital interface between primary and specialist services, allowing larger hospitals to extend their reach to remote, rural communities. This intra- and inter-hospital communication is not just beneficial but necessary in today's healthcare landscape, enabling timely interventions and support. Technology significantly re-organizes

healthcare delivery processes, enhancing the efficiency of services offered. A wide array of communication channels, devices, and media are employed constructively to support clinical outcomes. The ongoing improvement in healthcare delivery often hinges on practical outcomes and clinical services enhanced through technological support coupled with effective management. Models are instrumental in simplifying and clarifying complex ideas, making concepts more accessible. They serve as valuable educational tools, aiding in the understanding of key elements within training course materials and playing a role in achieving desired course outcomes.

2. Health Care Administrators and Patient care

To enhance patient care in hospitals, it's essential to draw insights from existing literature and theoretical models, adapting them into practical applications and interventions that improve the quality of care. A key strategy is to integrate communication models and technologies that streamline business processes and link various stakeholders within the healthcare ecosystem. This integration aims to deliver high-quality healthcare to patients while keeping costs manageable. The primary goal of healthcare services is to reduce the major causes of mortality and morbidity, which requires predicting the behaviors of healthcare providers to plan effective interventions. This involves facilitating the exchange of information between healthcare providers (health promoters) and their target audience, which can include individuals, groups of patients with similar diagnoses, or the larger community from a public health perspective. The success of any communication process in healthcare relies on several factors, including the content of the message, the relationship between the provider and the audience, the effectiveness of the message transmission, and the attitudes, beliefs, perceived knowledge, and values of the receiver. Healthcare administrators play a crucial role in shaping the communication patterns within healthcare organizations. Effective communication is essential for enhancing patient care processes and ensuring patient safety, as all

work-related communication is strategically planned and executed to support these objectives.

VII. CONCLUSIONS

Competencies for Health Care Administrators for Patient Care:

1. The influencing factors for better communication:

To advocate for changes in behavioral aspects within the healthcare sector, it's crucial to address the persistent gap between evidence-based research and the practices that are implemented. This disconnect often results from insufficient communication and the lack of clear outcome-based indicators to evaluate the effectiveness of chosen interventions. A viable solution is to integrate the best practices currently established in the healthcare industry with the latest technological advancements. In today's context, it becomes essential to leverage these best practices, while also focusing on evidence-based practice and practical approaches to implementation. Emphasizing a technology-driven methodology that is also cost-effective can lead to more optimal and logical outcomes in healthcare utilization. By fostering an environment that prioritizes these elements, we can enhance patient care and improve overall health outcomes.

2. Models and Theories related to patient care

In health care service, communication theories and models serve as essential tools for planning, executing, implementing, and evaluating processes. These theories can be categorized into several distinct elements: theory, theoretical framework, concepts, conceptual framework, theory-based model, and practical approaches. Their integration aims to enhance decision-making, facilitate behavior change, and function as educational resources, ultimately leading to improved healthcare practices. Implementing an effective communication framework is fundamental, as it serves as a foundational theory adaptable to various variables, making it a practical approach.

For communication concepts to be truly effective, they must possess flexibility, realism, timeliness, and subjectivity. They should also be intentional, user-friendly, socially adaptable, and influential, incorporating points of leverage to facilitate understanding and engagement. Overall, the evolution and application of these communication models are crucial in striving towards better health care outcomes.

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Comparative intellectual property law distinguishes between two systems of protection. On the one hand, the “Copyright” system, and on the other, the “Droit d’auteur” system. Through a process of legal acculturation, the opposition between these two systems has been transposed to Africa, despite similar cultures and socio-economic conditions. This opposition is tending to become less pronounced, but closer resemblances are worth considering.

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'[Laws] must be adapted to the character, customs, of the people for whom they are made'
(Portalis)

I. INTRODUCTION

Law is, at least in principle, a reflection of a given culture. This is well expressed by the Roman adage *ubi societas ibi jus*. This adage can be interpreted to mean that there can be no society without law, but also that each society secretes or generates its own law. This second interpretation refers to the differences between legal systems in space and time.

Law is the result of a more or less slow historical evolution. It may be the result of the reception of an exogenous system, particularly through

colonisation¹. This reception of a foreign law may be more or less successful². It may contribute to the overall transformation of a legal system. It may simply be a factor of improvement. This is known as legal *acculturation*. This acculturation may be more or less complete. In this case, unfortunately, it sometimes leads to "deculturation". Nevertheless, there are often phenomena of "counter-acculturation", particularly in a field such as family law³.

In Africa, the various States first received laws from the former metropolises by colonisation and then voluntarily⁴. In many areas at least, a phenomenon of legal acculturation can be observed on this continent. In the field of literary and artistic property, for example, the "Copyright" system on the one hand and the "Droit d'auteur" system on the other have been received in Africa.

For a long time, the laws of the metropolises were applied on the African continent, including in matters of literary and artistic property. Then the various states gradually gained independence and, over the years, adopted their own laws on literary and artistic property. In general, these laws are inspired by those of the former metropolises. Other States have simply continued to apply the law of their former metropolis for a long or even

¹ V. Papachristos, *La réception des droits privés étranger comme phénomène de sociologie juridique*, LGDJ 1975. - E. Agostoni, *Droit comparé*, PUF, 1988.6 N. Rouland, *Anthropologie juridique*, PUF 1988, n° 206 et seq.

² J. Carbonier, *Sociologie juridique*, PUF, coll. Quadrige, 3th edition 2016, p. 377 et seq.

³ Family laws incorporate a great deal of Customary laws

⁴ Papachristos, *op. cit.*

very long time. Examples include the Comoros⁵, Madagascar⁶ and Chad.⁷

After their independences, African countries began to harmonize or unified their systems for protecting intellectual property in general and literary and artistic property in particular. This led to the creation of two organisations. The first is the African Intellectual Property Organisation (OAPI)⁸, whose members are mainly French-speaking, and the second is the African Regional Intellectual Property Organisation (ARIPO), whose members are mainly English-speaking. The first organisation was created in 1962⁹ and the second in 1976.¹⁰

Both organisations aim to harmonise literary and artistic property law in their respective areas. Concerning OAPI, a supranational text constituting a conventional minimum was adopted in 1977 and amended in 1999 and again in 2015. This is Annex VII of the Bangui Agreement¹¹. As for ARIPO, it has chosen to harmonise literary and artistic property by means of a model law on Copyright¹²

It might have been expected that on a cultural issue of such importance, the various African states would adopt the same system of protection. However, despite considerable convergence, there is opposition between the OAPI States and the

ARIPO States. On the one hand, there is the influence of the so-called "Copyright" system, and on the other, that of the "Droit d'auteur" system.

This raises the question of whether « counter-acculturation » might not be useful, both to respect many traditions and to adapt the law to African society or societies. Is not the similarity of the cultures of the various African states an argument in favour of greater harmonisation, even if, on many points, it has already been possible to attenuate many differences ?

There may be an interest in understanding or explaining the import of the opposition between "Copyright" system and "Droit d'auteur" system in Africa before justifying the interest of greater approximation between African laws relating to intellectual property.

II. THE REASONS OF AN IMPORTANT OPPOSITION

When it comes to literary and artistic property, if we look at the various African national and supranational texts, we can see that there is opposition both in terms of the scope of protection and its content and enforcement.

2.1. *The scope of Protection*

A comparative study of African texts reveals opposition between the "Copyright" and "Droit d'auteur" systems, both in terms of the rules governing the protection of works and those governing the beneficiaries of protection, i.e. the ownership of rights. However, this opposition could disappear in many respects if the socio-cultural similarities between many African countries were taken into account.

2.1.1 *Eligibility for Protection*

With regard to protected creations, most African laws bear the imprint of either French or English texts. French and English law have historically taken two different approaches to the conditions for protection of intellectual works. This has an influence on the often indicative list of protected works.

⁵ To date, the Comorian text on copyright is the 1957 French law on copyright. In fact, as the Comoros is a member of the OAPI, the OAPI text (Annex VII of the Bangui Agreement) is supposed to apply there. French law incorporated into the legal system of the Comoros can only be applied on a subsidiary basis.

⁶ For a long time, Madagascar applied the French law of 1957. This law has now been extended to include the protection of "works of folklore".

⁷ Chad only adopted its own law in 2003.

⁸ Organisation africaine de la propriété intellectuelle

⁹ Office africain et malgache de propriété intellectuelle (OAMPI), Septemeber 13, 1962. It becomes, in 2, february 1977, Organisation africaine de la propriété intellectuelle (OAPI).

¹⁰Industrial Property Organization for English-speaking Africa (ESARIPO) December 9, 1976. Itt becomes latter African regional intellectual property Organisation (ARIPO).

¹¹ The Bangui Agreement wich i s the OAPI Treaty has, today, ten Annexes. The Annex VII is related to literary and artistic property.

¹² ARIPO Model-Law on Copyright and Related Rights (2019)

With regard to the conditions of protection, it should be noted that the English Copyright system, or at least the legacy of this system, includes a condition of protection that is absent from the French "Droit d'auteur" system: the material fixation of the creation. Furthermore, there is a common condition for protection in both systems, originality, but with different approaches. This opposition between the French and English systems has been transposed to the African continent.

2.1.1.1. Fixation on a tangible medium

There are two approaches to the physical fixation of a work. The first is that the work is protected whether or not it is recorded on a tangible medium. This is the approach adopted by the "Copyright" system and by several laws of the African States in the OAPI area. Examples include the laws of Cameroon¹³ and Côte d'Ivoire¹⁴. This is also the choice made in Annex VII of the Bangui Agreement (text related to literary and artistic property in the OAPI space). As early as 1977, the principle of protection irrespective of the physical fixation of the work was affirmed in Article 2 of Annex VII to the Bangui Agreement. The revision of the text in 1999 merely confirmed this choice in Article 4 paragraph 2. The revision of Annex VII of the Bangui Agreement did not make any changes¹⁵

The other approach is that a creation can only be protected as literary and artistic property if it has first been fixed on a tangible medium. This is the British approach adopted by many African countries, including Ghana¹⁶, Kenya¹⁷ and Uganda¹⁸. In these countries, for an intellectual

work to be protected, it must be recorded in writing or registered or fixed in some other way on a tangible medium. The ARIPO Model Law also proposes this rule.¹⁹

In our view, there is no reason for this difference between African laws as regards the requirement of material fixation. It can only be explained by the reception of English law on the one hand and French law on the other. In reality, the cultural and socio-economic similarity in the majority of African countries should lead to an identical condition. The oral tradition should logically have led all African states to adopt the rule that the work is protected regardless of its physical fixation. We might also wonder whether this condition is not a financial obstacle for many creators. A number of cases have demonstrated the rigour and unfairness of this rule.²⁰

2.1.1.2. Two approaches of Originality

A study of some of the African texts that define the concept of originality reveals the influence of both the copyright system and the « Droit d'auteur » system. In the "Copyright" system, originality is defined objectively, whereas in the "Copyright" system, a subjective approach is adopted²¹. On the one hand, originality is synonymous with the absence of copying and is the result of skill, labour and effort. On the other, it is the manifestation or expression of the author's personality.

A rather subjective concept is affirmed, for example, in Benin's law²², Djibouti's²³ and Côte

the work has been written down, recorded or otherwise reduced to material form whether with or without consent ».

¹⁹ Art. 4.2 "Works shall be protected for as long as they are original and fixated irrespective of their mode or form of expression, as well as of their content, quality and purpose".

²⁰ Suprême Court of Ghana, *CFAO v Archibald*, February 28, 1964, *Ghana Law Reports* 1964, p.718 (refusal to protect the works of a composer who was unable to transcribe his melodies in written form or prove that they had been fixed on any medium)

²¹ D. Gervais "Originalité (s)", *Mélanges en l'honneur du Professeur André Lucas*, LexisNexis 2014, p.389.- A. Strowel, *Droit d'auteur et Copyright : Divergences et Convergences. Etude de droit comparé*, Brulant/LGDJ, 1993, n°335

²² Benin Copyright Act, art. 1^{er}

²³ Djibouti Copyright Act, art.6

¹³ Cameroon, Copyright Act, art. 13

¹⁴ Côte d'Ivoire, *Copyright Act, art. 11: "Copyright protection is acquired from the moment the work is created, even if it is not recorded on a tangible media"*.

¹⁵ Art. 3.1 "The author of any original work of the mind shall enjoy, by the mere fact of its creation, an exclusive incorporeal property right in the work which shall be enforceable against all persons. This right shall encompass intellectual and moral attributes as well as economic attributes, as determined by this Annex".

¹⁶ Ghana Copyright Act, art. 1.2. b.

¹⁷ Kenya Copyright Act, art. 22.3. b

¹⁸ Uganda Copyright Act, art. 3.2. b : « A literary, musical or artistic work shall not be eligible for copyright unless— [...]

d'Ivoire's²⁴. These laws define an original work as one whose characteristic elements and form, or only its form, make it possible to identify its author. The reference to the individualisation of the author through the work evokes the imprint of personality and means that the laws of these States have opted for a subjective approach. The influence of French law on Malian law is clearest when it states that an original work is one "which is the manifestation of the imprint of the personality of its author"²⁵. According to Ivorian case law, this may result from the choice of a specific material.²⁶

The objective approach is found in English-speaking African countries. For example, the definition of originality can be found in the Kenyan law, which provides that protection of a work presupposes that :

"Sufficient effort has been expended on making the work to give it an original character".²⁷

Originality here seems to be defined, implicitly, not in terms of the author's personality but with reference to sufficient effort. In other words, any resemblance with the English approach is not accidental. To determine whether a work is original and therefore protectable, the judge will check that sufficient effort has been made to ensure that it is not a copy of an earlier creation.²⁸

According to Ghanaian law, a work is original if it is the fruit of the author's independent labour. Here too, the notion of the author's independent work is rather close to the objective meaning of originality.

²⁴ Côte d'Ivoire Copyright Act, art. 1^{er}

²⁵ Mali Copyright Act, art. 8

²⁶ Commercial Court of Appeal of Abidjan, RG n°308/2018, February 14, 2019, *Revue internationale du droit d'auteur (RIDA)* July 2022, p. 92 comment Ngombé

²⁷ Kenya Copyright Act, art. 22.3.a

²⁸ For an example, in Namibia, see *Southern Sun Africa v Sun Square Hotel (Pty)*, High Court of Namibia, Main Division Windhoek, April the 23rd 2018 [Namibia], *Revue Internationale du Droit d'auteur (RIDA)* January 2019, p.122, comment Ngombé. - see also *Prof. NzeleDavid Nzomo v Moses Nayami Anyangu and Competitive Edge Kenya*, High Court of Nairobi [Kenya], March the 16th, 2018, *Revue Internationale du Droit d'auteur (RIDA)* January 2019, p. 119, comment Ngombe

To find the approach best suited to Africa, the solution is undoubtedly not to be searched in tradition. Indeed, if we start from the principle that traditional artistic creation was not individualised, it will be difficult to accept the subjective notion of originality. As for the objective notion of originality, even if it does not appeal to the notion of the personality of the creator, it nevertheless implies the individualisation of the work

Instead, we should be looking at the aspirations of authors. Many of them expect fame and income not for the community but for themselves, personally and for their families. An analysis of case law shows that the difficulty of interpreting the notion of originality seems to arise more in African countries that have adopted the "Copyright" system²⁹.

2.1.2. Overview of protected works

Although there are a few, admittedly rare, differences between the various laws as regards the list of protected works, it should be noted that this list is not exhaustive. However, there is a difference on this point between "Copyright" and "Droit d'auteur" which is recreated in Africa, namely the understanding of sound recordings as a work admitted in one system and refused in the other.

Under the Copyright system, a phonogram is considered to be a work. In England, the 1988 Copyright Act lists sound recordings among the protected works. By sound recording is meant in particular the recording of the whole or any part of a literary, dramatic or musical creation, from which sounds reproducing the work or any part thereof can be obtained, whatever the medium or method of recording. In so-called "Droit d'auteur" countries, the phonogram is not considered a work because it does not meet the conditions of originality. However, its protection is not excluded. It is protected under neighbouring rights.

Here again, it can be seen that the former British colonies can be linked to the Copyright system,

²⁹ Ngombé, « News from Africa », *Revue Internationale du Droit d'auteur*, January 2019, p. 61.

whereas the majority of other African States are closer to the French *Droit d'auteur* system. In fact, only the laws of former British colonies list sound recordings among the protected works. For example, Ghanaian law³⁰ and Kenyan law³¹. The laws of former colonies of "*Droit d'auteur*" countries only provide for the protection of phonograms as neighbouring rights. This is the case of Congolese law³² or Senegalese law.³³

Rather than adopting a slavish or almost slavish copy of the English law, it was in our view possible to provide in these laws for the protection of phonograms solely under neighbouring rights. This would already result in the approximation of all African laws providing for the protection of neighbouring rights; the same approximation could be sought with regard to the beneficiaries of the protection. It should be noted that several laws of States in "Copyright" countries now provide for the protection of related rights. This is also the case concerning ARIPO model law.

2.1.3. Beneficiaries of protection

In both the "Copyright" and "*Droit d'auteur*" systems, it is stated that legal protection benefits the author of the work. However, this rule is not always applied with the same rigour in the two systems, so that the notion of author is understood in a rather broad sense in the Copyright system.³⁴

In the Copyright system, employment contracts and commission contracts change the rules for assigning ownership of rights. In French law, the central place occupied by the author and the so-called humanist approach to literary and artistic property have led the legislator adopt the opposite rule. Article L111-1 paragraph 3 of the French Intellectual Property Code states that the existence or conclusion of an employment contract or a commission contract does not entail

any derogation from the enjoyment of the rights granted to the author.

A cursory reading of African texts on literary and artistic property reveals the influence of the Copyright system, particularly in the former British colonies on the one hand, and that of "*Droit d'auteur*" in French-speaking countries on the other. However, in recent years there has been a noticeable rapprochement.

2.1.3.1. Influence of the two systems

Among the African laws bearing the imprint of English « Copyright » we can mention the law of Ghana, which provides that where a person creates a work in the course of employment under a contract for the provision of services or on commission for a third party, the rights in that work belong, in the absence of a legal provision or contractual stipulation to the contrary, to the employer or the person who commissioned the work. Similarly, the law of Kenya provides that Copyright initially belongs to the author except when the work is commissioned by a person who is not the employer or when the work is created under an employment contract. In such cases, the Copyright is deemed to have been transferred to the person who commissioned the work or to the employer, unless otherwise agreed.

Benin is a good example of the influence of « the *Droit d'auteur* » system on former French colonies. Under Beninese law, the author of an intellectual work is the person who created it. As such, he or she is the owner or, rather, the holder of the rights. This text specifies that copyright, even in a creation created under an employment contract or a commission contract is owned by the author. The influence of the French system can also be seen in Ivorian law, which also provides that the conclusion of an employment contract or a commission contract has no effect on the ownership of rights, this right being granted to the author.

2.1.3.2. Possibilities of reducing differences African laws

The difference highlighted above between African laws has no explanation other than the colonial

³⁰ Ghana Copyright Act, art. 1.1.e

³¹ Kenya Copyright Act, art. 22.1. e

³² Congo Copyright Act, art. 8

³³ Senegal Copyright Act, art. 2.1

³⁴ A. Strowel, *op. cit.*, n°276. – A. Françon, *Le droit d'auteur : aspects comparatifs et internationaux*, éditions Yvon Blais, Comansville, 1992

legal heritage. It is a reception without adaptation of a foreign law. It is in no way the result of a different conception of literary and artistic property between the African States. Therefore, it seems possible to envisage a uniform rule for all African States sharing the same culture.

It has been written that, since African society is based on "collectivism", the rule whereby rights are transferred to the employer or the person commissioning the work should be adopted³⁵. In truth, this adoption of a rule specific to the Copyright system has nothing in common with traditional African collectivism. Indeed, adopting the rule according to which in the case of a commission contract or an employment contract the rights do not arise on the author's head or are automatically transferred is not a rule for the benefit of a collectivity but for the benefit of an individual other than the creator of the work or a third party

In reality, such a rule should be set aside in favour of better protection for the author whenever they can be identified individually. The rule seems to meet the current expectations of creators of intellectual works, particularly in the field of music. It seems almost sure to us that the majority of African authors, if they were better informed, would opt for a solution closer to an individualist conception than to a so-called collectivist conception - society having evolved, it is not on this point that traditional African collectivism should manifest itself. If, moreover, we wish to respect the rule or the notion of "collectivism", it is perhaps not by granting ownership of the rights to the investor to the detriment of the creator that we find the solution, all the more so as the creator is already in an economically weak position.

To a certain extent, Annex VII of the Bangui Agreement may be considered to have come closer to the English system. In its 1999 and 2015 versions, this text provides that a work created under a commission contract or an employment contract is considered to be transferred to the employer to the extent justified by the usual

activities of the employer or the person who commissioned the creation of the work

Annex VII of the Bangui Agreement therefore reflects both the influence of French law on concerning the ownership of audiovisual works and that of English law on the automatic transfer of copyrights as for creation under an employment contract or a commissioning contract.

In our opinion, it is simpler, if we wish to preserve the imprint of French copyright, to provide that even in the event of a transfer of rights by operation of law, the creators of the work will receive separate and, in principle, proportional remuneration

2.2. The content of the protection and the enforcement of the protection

Numerous rules relating to the content and enforcement of literary and artistic property rights give rise in Africa to an opposition between the "Copyright" system and the "Droit d'auteur" system. They mainly concern the exploitation of works and exceptions.

2.2.1. Exploitation

Among the rules that characterise copyright we can mention those protecting the author concerning his relations with the assignee of his rights. These rules include the prohibition of the global assignment of future works except in favour of the societies of collective management organisations. They also include the existence of proportional remuneration, the enumeration of the rights assigned and the determination of the field of exploitation of the assigned works.

Under French law, for example, each of the rights assigned must be noted separately. Thus, providing that the transfer of the reproduction right alone does not constitute transfer of the performance right, and vice versa. If the various rights assigned must be noted, the same applies to the various methods of exploitation. Any ambiguity in the wording of the contract will be interpreted in favour of the author. The same provisions can be found in many African laws,

³⁵ D. Wafo "La protection du logiciel en Afrique", *Penant* 1995, p.170

mainly those of former colonies of "Droit d'auteur" countries, such as the laws of Senegal, Benin and Burkina Faso³⁶. There are no similar provisions concerning the remuneration or the global assignment of future works.

2.2.2. Exceptions

To illustrate the difference between the spirit of the Copyright system and the spirit of « Droit d'auteur » system, it is generally taught that in the copyright system the public interest is paramount, whereas in the « Droit d'auteur » system the public interest is confined within narrow limits³⁷. This difference is reflected in a broader acceptance of exceptions in the public interest in Copyright countries, whereas in "Copyright" the approach is more restrictive. This is reflected in the texts and in practice by the notion of "fair use" or "fair dealing" applied in English-speaking countries. On this point too, there is a difference between the former British colonies and the majority of other African states.

The laws of some former British colonies mention fair use as an exception to Copyright. For example, Kenyan law provides that the copyright owner may not restrict or control acts covered by the law by way of fair dealing for the purposes of research, private use, criticism or news reporting if any public use is accompanied by mention of its title and the name of its author, except where the work is incidentally included in a broadcast³⁸. On the other hand, the former colonies of "Droit d'auteur" countries use a restrictive list, as is the case in France. Examples include Senegalese law and Ivorian law³⁹.

On a continent where the need for access to knowledge for as many people as possible must take account of the socio-economic and cultural situation, an Anglo-Saxon approach would seem to be the most appropriate

³⁶ Senegal, art. 60 sq., Benin, art. 24 sq, Burkina Faso, art. 46 sq.

³⁷A. Françon, «Authors' rights beyond frontiers: a comparison of civil law and common law conceptions », *Revue internationale du droit d'auteur (RIDA)*, July 1991, p.2

³⁸ Art. 26.1.a

³⁹ Senegal, art. 38 sq. – Côte d'Ivoire, art. 24 sq.

III. JUSTIFICATIONS FOR SIMILAR LAWS

The opposition between "Copyright" and "Droit d'auteur" in Africa is attenuated. Firstly, the factors leading to harmonisation at international level have had their effect in Africa. Secondly, on some specific points, the African states and other developing countries have decided to adopt common rules for the continent as a whole. In Africa specifically, regional harmonisation shall be underlined.

3.1. The influence of international Conventions

On the whole, the influence of international conventions on African countries is the same as that experienced by other countries with one or the other system. For the essence of this rapprochement concerns the rights conferred, but we can briefly mention the question of formalities.

3.1.1. Formalities

In the laws of the former French and Belgian colonies, for example, formalities are not generally required as a condition of protection. On the contrary, the principle of automaticity of protection is used, as in the laws of Congo, Benin, Côte d'Ivoire, Cameroon and Togo.

It should be pointed out, however, that even some laws of former British colonies do not require formalities as a condition of protection. This is the case with Zambian law, which may be explained by the fact that Zambia, like most of African states, is a party to the Berne Convention. This convention provides for the principle of protection regardless of formalities, but this can also be explained by the influence of English law, which long ago abandoned the requirement of formalities as a condition of protection.

3.1.2. Content of the Protection

The accession of African states to the Berne Convention has led to the recognition of resale rights and moral rights in all African states, and the rules governing the duration of rights are virtually all.

With regard to the droit de suite, it should be noted that one of the distinctive features of the

French system, at least since 1920, has been to include a *droit de suite* among the author's economic rights. This right is an inalienable right to remuneration of creators of graphic and plastic works. Authors can receive a percentage of public resale of their works. Historically, this right was not recognised in the British states or in the United States, except in some states such as California.

This right is conferred by some African laws, including those of former British colonies, such as the Nigerian law, which stipulates in the 1988 version that authors of graphic and plastic works and manuscripts have an inalienable right to share in the proceeds of any sale of the work or manuscript made at public auction or through a vendor of any sale of this work or manuscript made at public auction or through a vendor. This is the influence of the Berne convention. This right is also provided for by Annex VII of the Bangui agreement. The question is whether such a right is compatible with African culture and. And if so, is it useful ?

In Africa the art market is not as developed as that in Europe. It is also true that we do not attend auctions such as those held at the Hôtel Drouot in Paris, for example. However there is a great deal of African artistic creation. It should also be noted that the rule adopted by the majority of African States is in line with the current reality of artistic creation in Africa: painters and sculptors today hope to make a good living from their art.

The other element of rapprochement concerning the content of protection relates to moral rights, which were rather emblematic of the French system of protection of intellectual works. Both African laws inspired by the copyright system and those inspired by « *Droit d'auteur* » contain provisions relating to moral rights. However, it could be said that some countries recognise a French-style moral right, while others only

recognise an embryo of moral rights as provided for by the Berne Convention⁴⁰.

In countries inspired by the French model, moral rights have the same characteristics and the same attributes, namely the right of disclosure, the right of paternity, the right to respect the creation and, in some countries, the right of withdrawal and repentance.

Among moral rights, Ghanaian law, for example, provides for the right to respect, which allows the author to oppose any distortion, mutilation or other modification that might damage his honour or reputation. Ghanaian law provides that moral prerogatives are perpetual. This law also provides that the holder of rights may transfer all or part of his rights, with the exception of moral rights, which brings Ghanaian law very clearly into line with French law, with the exception of the reference to injury to honour or reputation (like in Berne Convention)

If we look closely at the laws of countries influenced by French law, for instance Beninese and Congolese law and Gabonese law, we see that the term of protection is the same as that provided for in France. We can also see that moral rights are inalienable and imprescriptible. However, there is a reference to honour and reputation concerning the right to respect, which shows that the text is mainly influenced by the Berne Convention. Moreover in many African laws there is no mention of the right of withdrawal and repentance, which these laws have borrowed from French law.

It is to be welcomed that the adoption of moral rights is not complete. It should be remembered that the theory of moral rights is the result of a slow evolution, so moral rights as currently enshrined in African countries seem to be sufficient, and the relative rapprochement between former British colonies on the one hand and former French and Belgian colonies (for

⁴⁰ Ngombe, « Les droits moraux dans les lois africaines – Regard synoptique sur les textes des États membres de l'OAPI et de l'ARIPO », *Cahiers de la propriété intellectuelle*, vol. 25, n°1 (2013), p. 1

example) on the other is only the result of the accession of these States to the Berne Convention.

What about African culture concerning moral rights? The collectivist vision of traditional society does not sit well with a right attached to the person of the author and aimed at ensuring respect of the link between that person and his work. For this reason, one author proposed that in Africa moral rights should be reduced to their simplest expression, but today's literary and artistic creation has entered the individualist sphere, at least in many areas.

In our opinion, moral rights are not in keeping with African realities. How many African authors will renounce the authorship of their works under the pretext of traditional collectivism? How many African authors will see their works mutilated or altered without being moved by this?

We will conclude on this point by saying that the differences between African laws are not so significant that harmonization is indispensable. It would be wise to wait for what practice will teach. If we absolutely wish to take into account traditional « collectivism », we can grant a more significant role to the community after the author's death. After the term of protection of the moral right, it would be exercised by the community via the national copyright office, which would thus defend its national heritage.

However, the OAPI has adopted a different solution since, under the Bangui Agreement, moral rights are unlimited in time. As for the attributes of moral rights, the revised Annex VII of the Bangui Agreement has adopted the four rights provided for under French law.

3.2. Closer links at regional level

Harmonizations at regional level is bringing « Copyright countries » and « Droit d'auteur » countries closer together in Africa reduces both legal acculturation and the differences between the two systems in Africa: on the one hand, non-voluntary licences and, on the other, the protection of traditional cultural expressions and the paying public domain.

As far as non-voluntary licences for translation and reproduction are concerned, we can simply point out that, generally speaking, African texts include a non-voluntary licence among the exceptions and that, on this point, the divide between « Copyright » and « Droit d'auteur » completely disappears in favour of a common need on the part of African States. This common need, which exists in all developing countries, has led African states to demand and obtain the right to derogate from specific rules of the Berne Convention. This has enabled states to include provisions on non-voluntary licences, but these exceptions do not seem to be applied and their usefulness has been questioned. We can now predict that they will inevitably disappear from the legislative corpus of many of the African states.

Among the provisions characterising African texts relating to literary and artistic property are those relating to the protection of traditional cultural expressions. On this point, there is no difference between former British colonies and former colonies of copyright countries former French colonies.

This protection responds to a common concern of African States, which is also shared with other countries. Many texts list traditional cultural expressions among the protected creations. Ownership of the rights to these creations is exercised on behalf of the national community by the organisation responsible for the collective management of rights. The use of creations from the national heritage is in principle subject to the payment of a royalty collected by the collective management organisation. These rules are set out both in texts inspired by copyright law and in those borrowed from the Copyright system⁴¹.

It has been argued that the inclusion of traditional cultural expressions in copyright protection would call into question the principle of the free circulation of ideas⁴², on the grounds that

⁴¹ Ngombe, « Protection of Folklore by Copyright Law : Questions that Are Raised in Practice », *Journal of the Copyright Society of the USA*, Winter 2004, p.437.

⁴² J.-F. Gaudreault-Desbiens, « La critique autochtone de l'appropriation culturelle comme défi à la conception

recognising the protection of myths or epics is tantamount to recognising the protection of ideas. To avoid going into the matter at length, we can simply object that traditional cultural expressions, even as defined by the Bangui Agreement or the Swakopmund Protocol⁴³ or the texts of many African States, are not limited to myths or epics. There can be no doubt, for example, that the protection of a traditional song celebrating twins is indeed the protection of the expression of an idea and not the protection of the idea itself.

In reality, the protection of traditional cultural expressions leads not to contempt for the non-protection of ideas by copyright, but rather to the setting of a paying domain public for creations generated long before the recognition of literary and artistic property in Africa.

In fact, some works were created many years ago and whose author is unknown but with whom the community identifies. Moreover, a cultural traditional expression could have been created by an author which is still known. The most important is that works are considered to belong to the community in perpetuity and must be respected in their integrity or authenticity.

We can still consider that some of the works created in recent years have gradually become part of the national heritage and will be the property of the national community.

According to the Annex VII of the Bangui Agreement, the royalties that will be paid for the exploitation of works in the public domain will be half of the rate usually allocated. It would have been simpler to provide for this royalty by reference to that collected by the collective management organisation for the performance

occidentale de la propriété intellectuelle: le cas de l'appropriation critique », *Cahiers de la propriété intellectuelle*, (1999) 11 (available online : <https://www.lescpi/s/2041>).

⁴³ E.S. Nwauche « The Swakopmund Protocol and the Communal Ownership and Control of Expressions of Folklore in Africa », *Journal of World Intellectual Property* (2014) Vol. 17 (5-6) 191.- Y.L. Ngombé, « The Protection of Folklore in the Swakopmund Protocol Adopted by the ARIPO » , (2011) Vol. 14(5) *Journal of World Intellectual Property* 403.

and reproduction of its members' works. In this way, everything would be more easily defined and known.

The idea of a paying public domain can be both in keeping with African tradition and useful in today's context. Its justification may be as follows: one person benefits from a creation bequeathed to the community by another. The community can expect the creator of the second work or the new user to reward it. In concrete terms, this can take the form of the payment of a royalty which will be paid back to a social fund for artistic creators - a distribution key that meets a concern for equity can be found - for example, it can be envisaged that the income generated by musical works will benefit the community of musicians. Such social funds would enable creators and performers to have a better standard of living - this type of fund should be an element of the cultural policy of African States. In the same way that the collecting societies of the various States reciprocally collect rights on behalf of their sister societies, so too should they collect rights relating to the use of the cultural expressions of other states.

Today, a new issue offers African States the opportunity to adopt a uniform text. Indeed, artificial intelligence could be the subject of a regional text on literary and artistic property. Such a text could transcend the often unjustified opposition between "Copyright" and "Droit d'auteur" in Africa.

IV. CONCLUSION

Legal acculturation in the field of literary and artistic property is not in itself open to criticism. It is not the adoption of one or other exogenous system that is to be rejected, but rather one of its consequences. There are no cultural differences to justify them at a time when European States are increasingly trying to harmonise their legislations. However, there is no question of sticking to traditional laws.

Rather, while respecting traditions, it is advisable to be enriched by external contributions. As has been written, it is a logic of cultural accumulation that should be adopted, because "no culture

remains if it is not open to other.⁴⁴ This observation applies to the legal field in general and to literary and artistic property in particular.

In short, legal acculturation in the field of literary and artistic property raised at least two issues. First of all, we can wonder about its effects at domestic level. Secondly, at continental level we can note that this acculturation has the effect of opposing « Copyright » system and « Droit d'auteur » system in Africa.

At a time when there is increasing talk of harmonisation, it is to be hoped that the rejection of both « Copyright » and « Droit d'auteur » will lead to the emergence of common rules that are more in tune with Africa's socio-cultural reality. However, the artificial nature of imported rules should not be exaggerated, as there are many rules that meet the needs of those who contribute to the creation and dissemination of intellectual works in Africa. The important thing is to find laws that best correspond to the realities and aspirations of the African States. The right “*Jus*” for the “*societas*” concerned.

⁴⁴ G. Bidima, *Philosophie la philosophie négro-africaine*, PUF, coll. Que-sais-je ?, 1995, pp. 103 sq.

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Balancing Cost Efficiency and Campaign Success: Strategic Bidding in First-Price Auctions

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ABSTRACT

Real-time bidding (RTB) is an essential mechanism of virtual advertising, allowing advertisers to compete for ad impressions in real-time auctions that finalize in an instant. In first-price auctions, where the highest bidder is declared the winner and their bill is exactly their submitted bid, bidders must balance between securing impressions and controlling costs. This opens up new problems such as bid shading, where advertisers bid below their true valuation to avoid overpaying, and ad allocation, which involves selecting the optimal ad for each impression to maximize campaign effectiveness. To tackle these problem, we put forward a framework based on Deep Q-Learning (DQL). The framework jointly optimizes bidding strategies and ad selection in first-price RTB environments. By modelling the auction as an Episodic Markov Decision Process (EMDP), our agent learns to make decisions that consider both short-term auction outcomes and long-term budget management. The reward function is designed to reflect key trade-offs between bid competitiveness, budget utilization, and campaign objectives, allowing the agent to dynamically adjust bids and allocate ads in real time. Our approach leverages the Auction-Gym simulation environment for evaluation, where we demonstrate its superiority over traditional bidding methods through extensive experiments. The results reveal significant improvements. in cost efficiency, win rates, and campaign performance, showcasing the potential of DQL in high-stakes decision-making like the first-price RTB auctions.

Keywords: real-time bidding, first-price auctions, deep q-learning, advertisement.

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ABSTRACT

Real-time bidding (RTB) is an essential mechanism of virtual advertising, allowing advertisers to compete for ad impressions in real-time auctions that finalize in an instant. In first-price auctions, where the highest bidder is declared the winner and their bill is exactly their submitted bid, bidders must balance between securing impressions and controlling costs. This opens up new problems such as bid shading, where advertisers bid below their true valuation to avoid overpaying, and ad allocation, which involves selecting the optimal ad for each impression to maximize campaign effectiveness. To tackle these problems, we put forward a framework based on Deep Q-Learning (DQL). The framework jointly optimizes bidding strategies and ad selection in first-price RTB environments. By modelling the auction as an Episodic Markov Decision Process (EMDP), our agent learns to make decisions that consider both short-term auction outcomes and long-term budget management. The reward function is designed to reflect key trade-offs between bid competitiveness, budget utilization, and campaign objectives, allowing the agent to dynamically adjust bids and allocate ads in real time. Our approach leverages the Auction-Gym simulation environment for evaluation, where we demonstrate its superiority over traditional bidding methods through extensive experiments. The results reveal significant improvements in cost efficiency, win rates, and campaign performance, showcasing the potential of DQL in high-stakes decision-making like the first-price RTB auctions. Furthermore, our model adapts to changing market conditions, making it a robust solution for modern advertisers looking to

optimize their bidding strategies in a competitive and budget-constrained environment.

Keywords: real-time bidding, first-price auctions, deep q-learning, advertisement.

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I. INTRODUCTION

One of the most significant types of Internet advertising is Real-Time Bidding (RTB), in which each ad impression is sold via a real-time auction [1]. Because of their limitations, this process of bidding has come to replace traditional bidding strategies such as heuristic or rule-based approaches. This can be attributed to the continuous growth of the size of the digital market and its audience, making it essential to utilize modern marketing skills. Compared to more traditional advertising techniques like billboards, this significant development is the result of the growing use of digital devices and the expansion of Internet access, which gives companies more chances to precisely contact their target audience [2]. This has, in turn, necessitated the need for digital platforms where advertisers can meet with their target consumers, helping these advertisers craft campaigns that meet the socio-demographic characteristics of these consumers. However, this advertising strategy is known to be accompanied by complexities, and this requires the optimization of advertising campaigns. Displaying advertisements on websites requires a company to create an advertising campaign to promote its goods [2, 3]. They specify the campaign's objective,

such as raising sales or brand exposure, and define several characteristics (e.g., country, age, interests, etc.) to determine which audiences to target. The companies then select audiences based on how likely they are to be interested in the products, and finally, these ads are posted on digital platforms such as Instagram, Google Search, YouTube, and TikTok, among many other websites ^[4]. This process can be daunting and complex because of the behavioral nature of humans, which is sometimes unpredictable.

It is worth noting that there are two main players in the RTB process: the supply side and the demand side. As the user interacts with the site, the Supply Side Platform (SSP), which oversees the publisher's advertising inventory through an ad exchange, sends bid requests to various Demand Side Platforms (DSPs) ^[5]. Important characteristics about the impression opportunity are included in this bid request, such as user demographics, browsing patterns, the contextual relevance of the ad space, and publisher information. Each DSP evaluates the possible value of the impression for its advertising customers after receiving the bid request, taking into account several variables, such as the advertiser's campaign goals, the user's information, and the relevance of the ad content ^[6]. The DSPs then reply to the bid request with their offers, which represent the maximum amount of money they can spend on the specified impression. Since RTB is a programmatic advertising technique, winning a bid in an auction allows the advertiser's ad to be displayed ^[2]. Based on the interaction between the SSPs and DSPs, a Data Management Platform (DMP) collects and organizes data from various sources, providing insights and segments to advertisers, which can be used to refine targeting strategies through the DSP. This process has influenced current works to focus on issues relating to optimization after the campaign ^[1, 7-10], bidding strategies ^[4, 8, 10], and the use of deep reinforcement learning ^[11-13]. The latter has gained attention in current research because of the advancement in various technologies as a result of machine learning. However, there has been a historical change in the bidding process, which requires a critical look as well. The change

from a Second Price Auction model to a First Price Auction model.

A Second-Price Auction model Krishna (2009) ^[14] is where the auction is awarded to the leading bidder, but their bill amounts to the second-highest bid. This structure promotes honest bidding behavior ^[14], allowing participants to bid their true value. However, the industry has largely shifted towards First-Price Auctions Sluis (2017) ^[15], where the auction is awarded to the leading bidder, and their bill is the exact amount they bid ^[16]. This transition has introduced additional complexities, such as bid shading ^[17], where advertisers intentionally bid below their actual valuation to mitigate the risk of overbidding, cognizant that they will be required to pay their bid amount if they win ^[18].

Over the years, various methodologies have been employed to allocate ads and optimize bidding strategies within online ad auctions. Historically, ad allocation was conducted through heuristic or rule-based systems that matched ads to users based on predetermined criteria; however, these approaches were often inflexible and lacked the adaptability required in a rapidly evolving and competitive landscape. Using the Markov Decision Process (MDP) framework, the ad allocation problem can be transformed into a sequential decision-making process, wherein an agent evaluates not only the immediate rewards associated with advertising but also its long-term effects on user engagement and future ad placements. This methodology has been further enhanced through the integration of Reinforcement Learning (RL), which allows an agent to learn optimal allocation strategies by interacting with the auction environment, thereby balancing short-term benefits with long-term goals. In a similar vein, optimal bidding strategies have evolved from static models and Dynamic Programming (DP) models ^[19] to more advanced techniques that are better suited for first-price real-time bidding auctions.

Recent research themes have emphasized the importance of dual optimization ^[20, 21], acknowledging that the simultaneous optimization of both ad allocation and bidding

can significantly improve overall campaign performance. The following open-ended questions serve as the driving force for this study: When engaging in RTB first-price ad auctions, what is the best bidding technique for online marketers on a tight budget? Given the eligibility restrictions, what is the best ad allocation plan for internet advertisers taking part in RTB first-price ad auctions? Can bid shading in first-price auctions be used interchangeably with the ideal bid amount in honest bidding? How can marketers optimize their intended results by addressing the Bidding Problem and the Advertisement Allocation Problem at the same time? To address the aforementioned questions, this study builds on the MDP framework by (1) modeling the problem as an Episodic Markov Decision Process (EMDP), introducing ad allocation subject to eligibility constraints, and limiting bidding to an advertiser's budget, and (2) designing a reward function that can facilitate effective bid shading, balancing the risk of underbidding with competitiveness. (4) We use the standardized Auction-Gym environment to replicate first-price auction RTB and compare our suggested technique with existing methods. (3) Creating a deep Q-learning algorithm (DQL) that can learn efficient bidding strategies based on advertiser requirements. Based on these proposed ideas to fill the knowledge gap, this study anticipates to make the following contribution;

- We propose a DQL algorithm with an adaptive bid shading mechanism that adjusts bid aggressiveness dynamically based on the agent's past performance and remaining budget, optimizing bidding efficiency in real-time auctions.
- We integrate ad allocation into the bidding process, ensuring that each impression is assigned the most appropriate ad based on contextual information and campaign goals.

II. THE CURRENT STATE-OF-ART RESEARCH WORK IN RTB

The growth in digitization has caused a surge in internet advertising, hence the concept of Real-Time Bidding. As indicated in the previous section, there are numerous studies related to this

topic that provide a background and basis for future research. To ensure sound logic and coherence in the discussion, this session will provide a summary of the current state-in-art research based on the following themes: programmatic advertising, bid optimization in RTB, and Ad allocation in RTB.

2.1 Programmatic advertising

RTB is categorized under programmatic advertising, in which the usage of computer programs aids advertisers in setting their targets in different forms from an array of options. For instance, in a sponsored search, advertisers match their ads with keywords in the search queries ^[22].

Advertisers choose adverts that are relevant to the publisher's website content in contextual advertising ^[23]. The marketers, however, cannot tell which people are seeing the same material or using the same search query in these two types of advertisements. On a per-ad impression basis, display marketers target their prospective clients directly. More relevant ad impressions may encourage visitors to click on the advertising or finish the transaction, which benefits the publisher by drawing in and retaining clients. In this sense, more efficient ad delivery benefits publishers as well as advertisers. As was indicated in the previous chapter, DSPs and SSPs often conduct online ad trading for advertisers and publishers, respectively, in RTB. To get more impressions with a better CTR or CVR at a relatively low cost—also known as a higher ROI—the DSPs in the ad trading game try to establish a competitive bid price for the advertisements in their inventory. To improve the user experience, SSPs manage and optimize the ad density and selection on the publisher's website. To guarantee the lowest price that advertisers must pay, the SSPs are permitted to establish a reserve price, often known as the floor price ^[24]. The reserve price is what the winner of the bidding auction must pay if it is more than the winning price. Publishers may be able to increase their income by changing the reserve price.

2.2 Bid Optimization in Real-Time Bidding

Bid optimization in RTB is closely tied to the type of auction employed. In second-price auctions, bid optimization was more straightforward; bidders have an incentive to bid their real value [25]. However, the transition to first-price auctions has introduced new complexities, requiring advertisers to engage in bid shading—bidding below their true value to avoid overpaying while remaining competitive [26]. This shift parallels the challenge of reserve price optimization, but with the focus reversed: advertisers seek to minimize costs while maximizing their chances of winning [27]. To mitigate the risks of overbidding, advertisers must develop a deep understanding of market dynamics, including competitors' bidding behaviors and auction win probabilities. Modern methods, namely machine learning and reinforcement learning, have been increasingly applied to model optimal bid shading strategies. For instance, Durmus et al. (2024) [28] introduced a machine-learning model that predicts shading factors by estimating win rates in the absence of shared bidding information. Predictive models, such as those proposed by Kasberger and Schlag (2024) [29], further aid in estimating minimum winning bid distributions, which are crucial in determining optimal bids in dynamic auction environments. Another significant challenge in first-price auctions is budget-constrained bidding, where advertisers must allocate a fixed budget across numerous auction rounds. In this context, the goal is to optimize the overall worth of winning impressions while retaining a sufficient budget to remain competitive in future auctions [1]. Various strategies have been proposed to tackle this, including model-free reinforcement learning methods [30], which allow agents to learn optimal strategies through trial and error without explicitly modeling transition probabilities Sharma (2023).

2.3 Ad Allocation in Real-Time Bidding

The ad allocation problem in RTB focuses on maximizing the value of each impression by selecting the most relevant ad for each user while aligning with broader campaign goals such as increasing clicks, conversions, or brand visibility.

This decision-making process hinges on various factors, including user demographics, browsing history, and the historical performance of ads. The challenge lies in ensuring that every impression contributes meaningfully to the campaign's success, balancing short-term and long-term objectives [31]. Traditionally, ad allocation followed the "highest bidder rule," where the highest bid determined the winner of the impression [27, 32]. Although effective in maximizing short-term revenue, this method often neglects long-term campaign performance. Recent research has shifted towards using reinforcement learning (RL) to optimize ad allocation dynamically. RL enables advertisers to adapt their strategies in real time, continuously learning from past auction outcomes to refine future decisions. For example, Wu et al. (2022) [31] proposed a multi-agent reinforcement learning (MARL) framework to optimize bidding in competitive environments, while Zhang et al. (2022) [33] proposed a Markov Decision Process (MDP)-based framework that automates ad allocation by learning optimal strategies over time. One key aspect of modern ad allocation methods is the use of performance prediction models, which evaluate the likelihood that an ad will achieve the desired outcome, such as a click or conversion. This is particularly important in large-scale RTB systems, where incorrect ad allocation can result in significant opportunity costs. Winning impressions are only beneficial if the selected ad resonates with the audience and performs as expected [31]. Therefore, integrating ad allocation and bidding strategies into a unified framework is essential for optimizing both impression win rates and overall campaign performance. Despite the importance of jointly optimizing ad allocation and bidding, limited research has tackled these problems simultaneously. Notable exceptions include Shandilya et al. (2023) [34], who utilized the Auction Gym simulation environment to model and optimize both processes. Auction Gym allows for rigorous testing of dual optimization policies, offering valuable insights into the interplay between ad allocation and bidding in RTB [35].

Building on these insights, our work uses the Auction Gym environment to jointly model ad allocation and bidding as a unified problem. Our approach leverages Deep Q-Learning (DQL) to dynamically adjust bidding strategies while optimizing ad allocations based on real-time auction feedback. By addressing these challenges simultaneously, we aim to improve overall campaign outcomes and provide a robust solution for advertisers in first-price RTB environments.

III. PROBLEM DEFINITION AND FORMULATION

Every auction is characterized by a multi-dimensional vector denoted as X , which includes contextual information such as user demographics, browsing behavior, and ad details. The objective is to determine both the optimal bid amount and the most suitable ad for each impression while adhering to budget constraints and maximizing long-term utility. In this research, the problem is viewed and tackled from an Episodic Markov Decision Process (EMDP) perspective. The EMDP is defined by a tuple containing these elements: (S, A, R, γ) , where S is the state space, A is the action space, R is the reward function, and γ is the discount factor. The goal is to learn a policy that yields the best cumulative rewards over multiple auctions, given a fixed budget B . This policy is known as the optimal policy

3.1. State Space (S)

The state space comprises all relevant information for decision-making in each auction, defined as:

- **Contextual Information:** User demographics, browsing behavior, and ad slot type.
- **Historical Performance:** Metrics such as win rate, click-through rate (CTR), and average cost per click (CPC).
- **Budget Information:** The remaining budget b and the total budget B .
- **Time Information:** Current auction step t and the total number of auctions T .
- **Publisher Information:** Website traffic and other relevant data regarding impression opportunities.

3.2. Action Space (A)

The agent takes two actions at each auction:

1. **Bid Amount (b_i):** The bid amount b_i represents the monetary value offered for an impression. It is a continuous value between \$0.01 and \$2.00. The agent must balance the likelihood of winning an auction with budget constraints. In a first-price auction, the bidder pays exactly the amount they bid, making bid selection critical for utility maximization and budget conservation.
2. **Ad Allocation:** Upon winning an auction, the agent selects an ad from a pool of available ads, each designed for different target audiences or campaign objectives (e.g., clicks, conversions). The agent selects the ad that maximizes the expected welfare based on its private valuation V_{ai} and the probability of achieving the desired outcome.

3.3. Reward Function (R)

The reward function models the utility gained from winning an auction. The immediate reward R at time t reflects the gap between the value assigned to the selected ad V_{ai} and the incurred cost C_i , weighted by the predicted click-through rate (CTR) $\theta(x)$. The CTR is expressed as:

$$CTR = \frac{\text{total clicks}}{\text{total impression}} \quad (1)$$

The reward is formulated as follows:

$$R_t = \theta(x) \cdot (V_{ai} - C_i) \quad (2)$$

Where $\theta(x)$ represents the predicted CTR (pCTR), which estimates the likelihood of a click on a displayed ad.

V_{ai} denotes the value a bidder assigns to an ad impression, reflecting how well it aligns with their campaign goals and the context of the auction. It is further defined as

$$V_{ai} = \frac{E[\omega | A=ai, X=X]}{P(C | A=ai, X=X)} \quad (3)$$

where $P(C | A = ai, X = x)$ is the probability of obtaining a click given the advertisement a_i and the feature vector x , and $E[\omega]$ represents the

expected welfare, which reflects how efficiently ads are allocated to the right audience. C_i represents the cost incurred when the agent wins the auction, which corresponds to the bid amount b_i .

3.4. Objective and Constraints

The agent's objective is to maximize cumulative rewards over T auctions while adhering to budget constraint B . In the context of this research, this objective represents the total value gained from click acquisition across multiple auctions, discounted by the value of future auction opportunities. The value gained from click acquisition in a single auction is known as the immediate reward and is expressed as:

$$R_t = \theta(X_t) \cdot (V_{aj} - c_t) \quad (4)$$

where $\theta(X_t)$ is the predicted click-through rate (CTR) based on the feature vector X_t , V_{aj} is the valuation of the selected ad a_j , c_t is the cost incurred at time step t ,

The cumulative reward R is defined as:

$$R = \sum_{t=0}^T \gamma^t R_t \quad (5)$$

Where $\gamma \in [0, 1]$ is the discount factor, reflecting the relative importance of future rewards. The optimization problem is then expressed as:

$$\max_{\pi} R \quad (6)$$

Subject to the following constraints:

a. *Budget constraint:* The total cost incurred across all auction steps must not exceed the budget B :

$$\sum_{t=0}^T C_t \leq B, \quad (7)$$

Where C_t represents the cost at step t , and T is the total number of auction steps.

b. *CTR threshold:* The Click-Through Rate (CTR) for any auction step must be greater than or equal to a specified minimum threshold θ_{min} :

$$\theta(X_t) \geq \theta_{min}, \quad \forall t, \quad (8)$$

Where $\theta(X_t)$ denotes the CTR at step t for the given context X_t .

c. *Bid range:* The bid at each auction step must lie within a predefined range, typically between 0.01 and 2:

$$0.01 \leq b_t \leq 2, \quad \forall t, \quad (9)$$

Where b_t is the bid at auction step t .

d. *Highest bidder wins the auction round:* The agent's bid must be higher than all other competing bids to win the auction:

$$b_t > b_j, \quad \forall j, i, \quad (10)$$

Where b_j represents the bid of any competitor j , and i refers to the agent in consideration. e. *Allocation of ads:* The ad allocation must belong to a set of eligible ads for the given context X_t at each step:

$$a_j \in A(X_t), \quad \forall t, \quad (11)$$

Where a_j represents the allocated ad and $A(X_t)$ is the set of available ads for context X_t . 3.5. Transition Function (T) In our model-free setting, the transition function T is not explicitly defined. Instead, the agent learns the optimal policy by interacting with the auction environment and adjusting its strategy based on feedback from the environment. 3.6. Discount Factor (γ) The discount factor γ controls the agent's preference for immediate versus future rewards. A value of γ close to 1 encourages the agent to prioritize long-term benefits, ensuring the optimal use of the budget over time. The RTB problem is modeled as an EMDP, where the agent optimizes both bid amounts and ad allocations in real time. The proposed framework uses deep reinforcement learning to dynamically adjust bids and ad selections based on auction feedback, ultimately maximizing cumulative rewards while adhering to budget constraints.

IV. METHODOLOGY

We propose a Deep Q-Learning (DQL)-based framework to optimize both ad allocation and bidding strategies in first-price real-time auctions (FP-RTA). The aim is to simultaneously address

the challenges of bidding below true value (bid shading) while ensuring optimal ad selection within the constraints of an advertiser's budget.

4.1 Problem Setup

As established earlier, the problem of this study is structured as an Episodic Markov Decision Process (EMDP), and the goal is to learn optimal bidding and ad allocation that maximizes cumulative rewards while adhering to budget constraints. In FP-RTA, the advertiser participates in sequential auctions, where they must decide both the bid amount b_i and the ad a_j to display. The winning advertiser pays the exact bid amount, meaning overbidding can lead to a significant loss of value. Therefore, we incorporate a shading factor δ in the bid amount to allow advertisers to bid strategically below the true value, balancing the need to win with the desire to generate a surplus (the gap between the private value of the ad and the price paid). The bid shading formula is given by:

$$b_i = \delta [V_{ai} - c_i], \quad (12)$$

Where $\delta \in [0, 1]$ represents the shading factor, V_{ai} is the valuation of ad a_i , and c_i is the cost incurred if the agent wins the auction. The environment is modeled as an Episodic Markov Decision Process (EMDP), where the agent interacts with the environment by observing a state, taking an action, and receiving a reward. The state s_t at time t includes information about the current auction, user demographics, historical performance of ads, and budget constraints. MDP is defined by the tuple (S, A, P, R) , the set of all states and actions are represented by S and A , respectively [36]. The reward and transition probability functions are given by R and P .

4.2.1. State and Action Space Design

To effectively model the auction environment, the state space is designed to capture all relevant information required for decision-making at each auction. The state s_t at time t includes:

- **Contextual Information:** This includes user demographics, browsing behavior, and

information about the ad slot, which are crucial for determining ad relevance.

- **Historical Performance Metrics:** Metrics such as the click-through rate (CTR), conversion rate, and cost per click (CPC) provide insights into the performance of the advertiser's ads and inform future bidding and allocation decisions.
- **Budget Information:** The remaining budget b_t and total campaign budget B are essential in determining the bid amount, ensuring the agent can continue participating in auctions without prematurely exhausting the budget.
- **Time Information:** The current auction step t and the total number of auctions T allow the agent to optimize its strategy across a sequence of auctions, balancing short-term and long-term goals.
- **Publisher Information:** Publisher-specific data, such as traffic volume and the contextual relevance of ad slots, contribute to ad selection and bidding decisions.

The action space consists of two critical decisions that must be made at each auction:

1. **Bid Amount (b_j):** The bid amount represents the monetary value offered by the agent to win the impression. The bid is continuously adjusted based on the agent's knowledge of the auction environment, incorporating a bid shading factor $\delta \in [0, 1]$, which allows the agent to bid below its true valuation, mitigating the risk of overpaying.
2. **Ad Allocation (a_j):** The agent selects an ad from its pool of available ads to display if the bid is successful. The selection is based on a combination of contextual relevance, historical performance, and the expected value of displaying each ad. By jointly modeling these decisions, the agent can dynamically adjust both bids and ad selections to optimize overall performance.

4.2.2. Reward Structure

The reward function is central to the agent's learning process and directly reflects the quality of the decisions made. The immediate reward *rate* is designed to capture both the financial impact of

winning an auction and the effectiveness of the selected ad. It is expressed as:

$$r(st, at) = \theta(X_t) \cdot (V_{aj} - ct), \quad (13)$$

Where $\theta(X_t)$ is the predicted click-through rate (CTR) based on the feature vector X_t , V_{aj} is the valuation of the selected ad a_j , and ct is the cost incurred if the agent wins the auction. The reward is only received when the agent wins the auction, and it incentivizes both winning valuable impressions and selecting ads that are expected to perform well in terms of CTR. Importantly, the reward structure incorporates budget constraints, ensuring that the agent's decisions are financially sustainable throughout the campaign.

The agent's goal is to maximize cumulative rewards across a sequence of auctions, defined as:

$$R = \sum_{t=0}^T \gamma^t Y_{tr}(st, at) \quad (14)$$

Where γ is the discount factor, balancing the importance of immediate versus future rewards. The cumulative reward reflects the overall success of the agent's strategy, accounting for both short-term auction outcomes and long-term budget management.

4.3. Proposed Algorithm: Deep Q-Learning with Adaptive Bid Shading, Budget-Aware Rewards, and Refined Action Space (DQL-ABR)

This section describes the proposed Deep Q-Learning (DQL) algorithm designed to optimize ad bidding and allocation strategies in first-price real-time auctions (FP-RTA). The algorithm introduces three key innovations:

- *Adaptive Bid Shading Mechanism:* The bid shading factor dynamically adjusts based on the agent's past performance and remaining budget, optimizing bid aggressiveness.
- *Budget-Aware Reward Adjustment:* The reward function is augmented with a budget-preserving penalty term, promoting sustainable bidding behavior as the budget depletes.
- *Action-Space Refinement with Continuous Bid Sampling:* The bid action space is refined

using continuous bid sampling for more precise bid adjustments, improving the agent's decision-making flexibility.

The following subsections provide a detailed mathematical formulation of the proposed approach.

4.3.1. Adaptive Bid Shading Mechanism

In traditional Q-Learning approaches Li et al. (2024) ^[10], a fixed bid shading factor δ is used to reduce bids below their true valuation to avoid overpaying. However, this rigid method lacks adaptability. To address this, we introduce an adaptive bid shading factor δt , which dynamically adjusts in response to the agent's performance and budget status. This enables the agent to fine-tune its bid aggressiveness during an auction campaign. The adaptive bid shading factor δt at auction time step t is expressed as a function of:

$$\delta t = f(w_t, b_t, s_t) \quad (15)$$

where w_t is the agent's win rate over the last k auctions, b_t is the remaining budget at time t , and s_t is the surplus retention from previous auctions (i.e., the difference between the ad's valuation and the price paid). The adjusted bid amount b_i for the selected ad a_i is then computed as:

$$b_i = \delta t [V_{ai} - c_i], \quad (12)$$

Where V_{ai} represents the valuation of ad a_i , and c_i is the cost incurred if the agent wins the auction. The dynamic adjustment of δt ensures that the agent bids more aggressively when necessary and conservatively when budget constraints are critical.

4.3.2. Budget-Aware Reward Adjustment

Budget management is critical in auction strategies. To prevent premature exhaustion of the budget, we augment the reward function with a penalty term that increases as the remaining budget approaches zero. This adjustment encourages more conservative bidding behavior as the budget depletes. The reward function $r(s_t, a_t)$ at each time step t is augmented with a budget penalty term as follows:

$$r(st, at) = \theta(X_t) \cdot (V_{aj} - ct) - \lambda \cdot \frac{bt}{B} \quad (16)$$

Where $\theta(\mathbf{X}_t)$ is the predicted click-through rate (CTR) based on the feature vector \mathbf{X}_t , V_{aj} is the valuation of the selected ad a_j , c_t is the cost incurred at time step t , λ is a penalty coefficient, b_t is the remaining budget at time step t , and B is the total budget. This reward structure ensures the agent maintains a balanced approach to bidding, especially when nearing the end of a campaign.

4.3.3. Action-Space Refinement with Continuous Bid Sampling

To further enhance the agent’s decision-making, we replace the traditional discrete bid selection with continuous bid sampling using stochastic policy gradients. This allows for more precise adjustments to bids, improving flexibility in competitive auction environments. The bid amount b_i is sampled from a continuous distribution, modeled as a stochastic policy $\pi_\theta(b_i | st)$ parameterized by θ :

$$b_i \sim \pi_\theta(b_i | st) = N(\mu_\theta(st), \sigma^2_\theta(st)), \quad (17)$$

Where $\mu_\theta(st)$ and $\sigma^2_\theta(st)$ represent the mean and variance of the bid distribution at state st , continuous bid sampling enables more granular control of bids, which is crucial in highly competitive auction environments. The proposed DQL-ABR algorithm (Deep Q-Learning with Adaptive Bid Shading, Budget-Aware Rewards, and Refined Action Space) integrates the proposed techniques into the learning process. The agent interacts with the auction environment, learning the optimal policy by adjusting bids and ad selections dynamically while maximizing cumulative rewards. The Algorithm for DQL-ABR is presented below.

```

Algorithm 1 DQL-ABR: Deep Q-Learning for First-Price Real-Time Auctions
o: Initialize replay buffer D, Q-network with parameters  $\theta$ , and target network  $Q'$  with parameters  $\theta'$ 
o: for each episode  $e = 1, \dots, E$  do
o: Initialize state  $s_0$ 
o: for each auction round  $t = 1, \dots, T$  do
o: Compute adaptive bid shading factor  $\delta t = f(wt, bt, st)$ 
o: Sample bid  $b_i$  from policy  $\pi_\theta: b_i \sim N(\mu_\theta(st), \sigma^2_\theta(st))$ 
    
```

```

o: Select ad  $a_j = \arg \max_a Q(st, a)$  based on Q-values
o: Execute action  $(b_i, a_j)$  and observe reward  $rt$  and next state  $st+1$ 
o: Compute reward  $rt = \theta(\mathbf{X}_t) \cdot (V_{aj} - c_t) - \lambda \cdot (bt/B)$ 
o: Store experience  $(st, (b_i, a_j), rt, st+1)$  in replay buffer D
o: Sample mini-batch from D and update Q-network:
o:  $Q_{target}(s_t, a_t) = rt + \gamma \max_{a'} Q(st+1, a'; \theta')$ 
o: Minimize loss  $L(\theta) = E[(Q_{target}(st, at) - Q(st, at; \theta))^2]$ 
o: Update target network parameters  $\theta' \leftarrow \theta$  every N steps
o: Decay exploration rate  $\epsilon$  for  $\epsilon$ -greedy policy
o: end for
o: end for=0
    
```

The DQL-ABR algorithm offers several key advantages:

- **Dynamic Adaptation with Adaptive Bid Shading:** The agent dynamically adjusts the bid shading factor based on auction performance, resulting in improved bidding strategies while balancing budget constraints.
- **Sustainable Budget Management:** The budget-aware reward function ensures that the agent conserves its budget for future auctions, avoiding overspending early in the campaign.
- **Precise Bidding with Continuous Action Space:** Continuous bid sampling allows the agent to make finer adjustments to bids, improving performance in competitive auction environments.

4.4. Deep Learning Architecture for DQL-ABR

The Deep Residual Network (ResNet) architecture was used to approximate the Q-function in the DQL-ABR algorithm. ResNet is a deep learning architecture crafted to cater to the challenges of vanishing and exploding gradients in very deep networks, allowing training significantly deeper networks than conventional architectures. This architecture is particularly suited for learning complex relationships from high-dimensional input data, such as the contextual and historical information associated with each auction.

4.4.1. ResNet Architecture

A key feature of ResNet is its use of residual blocks, which introduce shortcut (skip) connections that bypass one or more layers in the network. These shortcut connections allow the gradient to propagate through the network more easily, preventing vanishing gradients and improving the training of deep models. Each residual block in a ResNet consists of two or more layers and the output of each block is given by:

$$y = F(x, \{W_i\}) + x, \quad (18)$$

Where:

x is the input to the residual block,

$F(x, \{W_i\})$ is the output from the stacked layers (e.g., two fully connected layers with weights $\{W_i\}$),

y is the output of the residual block, and

x is added to the output, forming the shortcut connection.

The idea behind this architecture is that the residual mapping $F(x)$ should be easier to optimize than the original mapping. This allows the network to learn complex functions more effectively.

4.4.2. Network Configuration for Tabular Data

In our Deep Q-Learning framework, ResNet is applied to tabular data consisting of user demographics, historical ad performance, budget information, and auction-specific features. Since tabular data often lacks the spatial or temporal correlations found in image or time-series data, fully connected layers are used in conjunction with residual connections to efficiently capture relationships between the different features. The deep residual network consists of the following:

- **Input Layer:** Takes the state vector x_t , representing the auction context, including user demographics, ad performance metrics, budget information, and more.
- **Residual Blocks:** Composed of fully connected layers (with ReLU activations), each block followed by a residual (skip) connection.
- **Output Layer:** Outputs a Q-value for each possible action, representing the expected

cumulative reward for taking a specific action in the current state.

4.4.3. Advantages of ResNet in Tabular Data

ResNet offers several advantages when applied to tabular data in our problem domain:

- **Mitigation of Vanishing Gradient Problem:** ResNet allows us to train deeper networks without the issue of vanishing gradients, which is especially important for complex decision-making tasks such as bidding and ad allocation.
- **Learning Complex Feature Interactions:** The residual connections enable ResNet to learn intricate relationships between features in the auction environment, such as user behavior, ad performance, and budget utilization. This is essential for tasks like optimizing bids and ad selection.
- **Efficient Feature Utilization:** With deeper networks and residual learning, ResNet can efficiently use all available information (e.g., historical performance, demographics) to make more accurate predictions and decisions, even when some features are less informative.
- **Faster Convergence:** The skip connections in ResNet improve gradient flow during backpropagation, leading to faster convergence compared to traditional deep networks, which is crucial for real-time bidding scenarios where quick learning is essential.

By leveraging ResNet, our model can handle the complexities of FP-RTA environments, learn from diverse and high-dimensional input data, and make informed decisions in real-time auctions while maintaining fast convergence and stability during training. The DQL-ABR algorithm is implemented using standard reinforcement learning libraries in Python with PyTorch. The adaptive bid shading mechanism requires tracking win rates, surplus, and budget, which can be stored in experience buffers. Continuous bid sampling can be implemented using stochastic policy gradient techniques, and the reward adjustment is a straightforward modification of

the standard reward function. All components are designed to be easily integrated into existing reinforcement learning environments.

V. EXPERIMENTAL SETUP

In this section, we detail the experimental setup, methodologies, and results obtained from evaluating the proposed DQL-based approach for optimizing bidding and ad allocation strategies in first-price RTB auctions. We conducted both offline and simulation-based experiments to authenticate the effectiveness of our method against established baselines.

5.1. Dataset

In this study, we utilize the iPinYou RTB dataset, one of the most widely used datasets in computational advertising ^[36], to evaluate our proposed DQL-based framework for bidding and ad allocation in first-price RTB auctions. The dataset contains detailed logs of bidding events, user demographics, browsing behavior, impressions, clicks, and conversions. The iPinYou dataset provides information from multiple advertising campaigns across different industries. Each user session within the dataset includes several auction rounds where bidders respond to ad requests with bids for ad impressions. The key features include:

- *Bid Logs*: Records bid amounts and auction outcomes (win/loss).
- *Impressions*: Contains details about each impression opportunity, including user demographics (e.g., age, gender, region), the context of the ad slot, and the timing of the auction.
- *Click and Conversion Logs*: Indicates whether the user clicked on the ad or completed a desired action (conversion) after the click.
- *Budget Information*: Provides data about each advertiser's total budget and its usage during campaigns.

The following pre-processing steps were performed to prepare the dataset for training and evaluation:

- *Data Cleaning*: Removing incomplete or erroneous logs, such as missing bid prices or incomplete impression details.
- *Feature Engineering*: New features were created, including user profiles (combining demographic and behavioral data), ad slot attributes, and auction history metrics, such as previous win rates.
- *Normalization*: Bid amounts and budget values were normalized to standardize feature scales across auctions.
- *Train-Test Split*: The dataset was divided into a training set (5 days of data, approximately 720 auction steps) and a test set (2 days of data, approximately 288 steps) for model evaluation. For the general experiments, the experiments are run normally, while for the demographic-based simulations, data augmentation is applied to make up for limited data in demographic groups.

5.2. Compared Algorithms

We evaluate the performance of our DQL approach by comparing it against both traditional and reinforcement learning (RL) algorithms, as well as game-theoretic algorithms used in RTB auction environments. These algorithms have been selected for their relevance and wide application in computational advertising and auction-based optimization tasks.

5.2.1. Reinforcement Learning Algorithms

- *Deep Q-Learning (DQL)*: Our proposed method uses a deep neural network to approximate the Q-function, enabling the agent to make real-time bidding and ad allocation decisions based on the environment. The model optimizes the cumulative reward over sequential auctions by learning an optimal policy.
- *Proximal Policy Optimization (PPO) Schulman et al. (2017)*: A robust RL algorithm that directly optimizes policy using a clipped surrogate objective to avoid large, destabilizing updates during training. PPO is known for balancing performance and stability, making it suitable for continuous action spaces like those in real-time bidding.

- *Soft Actor-Critic (SAC) Campos et al. (2022)*: A state-of-the-art RL algorithm that integrates value-based learning with policy optimization. SAC encourages exploration by maximizing policy entropy, leading to diverse bidding strategies and enhanced learning.
- *Double Deep Q-Network (Double DQN) Iqbal et al. (2021)*: An enhancement of the DQN algorithm that reduces overestimation bias in Q-value estimation by de-coupling action selection from action evaluation. This results in more stable learning, particularly in dynamic, nonstationary environments like auctions.

5.2.2. Traditional Algorithms

- *Epsilon-Greedy Algorithm Umami and Rahmawati (2021)*: A classical method in RL where the agent chooses a random action with probability ϵ , and the action with the highest estimated reward with probability $1 - \epsilon$. It allows the agent to balance exploration and exploitation during the bidding process.
- *Thompson Sampling Chapelle and Li (2011)*: A popular method in multi-armed bandit problems, where the agent samples from the posterior distribution of each action's reward. It provides a principled approach to exploration by maintaining a balance between actions that have high rewards and those that need more exploration.
- *Linear Bidding Ren et al. (2017)*: A simple rule-based method where the bid is proportional to the predicted value of the impression. Although it is less sophisticated than RL methods, it is commonly used in early programmatic advertising systems and serves as a strong baseline in real-time bidding.
- *Budget-Smoothing Bidding Hegeman et al. (2013)*: A heuristic approach designed to manage the advertiser's budget over time by adjusting the bid amounts as a function of the remaining budget and time, preventing the budget from being exhausted too quickly.

5.2.3. Game-Theoretic Algorithms

- *Nash Equilibrium Bidding Ui (2016)*: In this approach, each bidder seeks to maximize their

utility while assuming that competitors are also playing their optimal strategies. The solution to this is a Nash equilibrium, where no bidder can improve their outcome by unilaterally changing their strategy.

- *Bid Shading Strategy Pan et al. (2020)*: A common strategy in first-price auctions, where advertisers intentionally bid below their true value to avoid overpaying. Bid shading adjusts the bid amount to maximize the chances of winning while keeping the cost as low as possible.
- *Bayesian Game Bidding Abapour et al. (2020)*: This method models auctions as Bayesian games, where bidders have private information (e.g., valuations) and beliefs about competitors' bids. Each bidder optimizes their bid by incorporating these probabilistic beliefs into their decision-making process.

5.3. Evaluation Metrics

We use several evaluation metrics to measure the performance of the proposed DQL algorithm and compare it with baseline methods. Each metric provides insight into different aspects of bidding effectiveness, budget utilization, and overall campaign performance.

5.3.1. Total Profit (Utility)

Total profit, also referred to as utility, measures the net profit generated by a bidding strategy Brown and Sibley (1986). It is computed as:

$$\text{Total Profit} = \sum_{i=1}^N (r_i - c_i) \quad (19)$$

where N is the total number of impressions, r_i is the revenue obtained from winning impression i , and c_i is the cost of winning that impression.

5.3.2. Win Rate

The win rate is the percentage of auctions won by the bidding strategy. It reflects the competitiveness of the algorithm in securing impressions. The win rate is calculated as:

$$\text{Win Rate} = \frac{\text{Number of Auctions Won}}{\text{Total Number of Auctions}} \times 100 \quad (20)$$

5.3.3. Budget Utilization

Budget utilization measures how effectively the advertiser’s budget is used throughout the campaign. It ensures that the budget is managed efficiently without being depleted too quickly or left underutilized. It is defined as:

$$\text{Budget Utilization} = \frac{\text{Total Spend}}{\text{Total Budget}} \times 100 \quad (21)$$

5.3.4. Click-Through Rate (CTR)

CTR is a key metric that assesses the efficiency of the displayed ads to generate clicks from users. It is calculated as the ratio of clicks to impressions:

$$\text{CTR} = \frac{\text{Total Cost}}{\text{Total Number of clicks}} \times 100 \quad (22)$$

5.3.5. Cost Per Click (CPC)

CPC is a widely used metric in online advertising that reflects the average cost incurred per click generated by the ad. It is calculated as:

$$\text{CPC} = \frac{\text{Total Cost}}{\text{Total Number of clicks}} \times 100 \quad (23)$$

This metric helps evaluate the cost-effectiveness of the bidding strategy.

5.3.6. Return on Investment (ROI)

ROI measures the effectiveness of the bidding strategy in generating revenue relative to the money spent. It is defined as:

$$\text{ROI} = \frac{\text{Total Revenue} - \text{Total cost}}{\text{Total Cost}} \times 100 \quad (24)$$

ROI is a critical metric for evaluating the overall financial success of the advertising campaign.

Table 1: Overall Performance of Bidding algorithms

Algorithm	Total Profit	Win Rate	Budget Utilization	CTR	CPC	ROI
DQL (Ours)	19,950	77.8	95.0	2.40	0.52	34.5
PPO	12,100	77.0	94.0	2.32	0.51	32.7
SAC	11,850	75.5	92.5	2.28	0.50	31.5
Double DQN	11,500	73.0	90.8	2.20	0.55	29.8
Thompson Sampling	11,150	72.5	89.5	2.15	0.58	28.5
Nash Bidding	11,950	76.5	92.0	2.38	0.52	34.5
Bid Shading	11,650	75.0	91.0	2.30	0.54	30.8
Bayesian Bidding	11,850	75.8	92.2	2.34	0.53	33.2
Linear Bidding	10,350	70.2	88.5	1.90	0.65	25.8
Epsilon-Greedy	11,000	71.5	89.0	2.10	0.60	27.5
Fixed Bidding	9,950	69.0	87.5	1.85	0.68	24.5

Table 2: Performance of Bidding Algorithms for Age Group 18.24

Algorithm	Total Profit	Win Rate	Budget Utilization	CTR	CPC	ROI
DQL (Ours)	3,450	78.5	94.5	2.40	0.52	34.5
PPO	3,300	77.8	93.0	2.32	0.51	32.7
SAC	3,220	76.0	91.5	2.28	0.50	31.5
Double DQN	3,100	74.5	90.0	2.20	0.55	29.8
Thompson Sampling	3,050	73.0	88.5	2.15	0.58	28.5

Nash Bidding	3,400	76.2	92.0	2.38	0.52	34.5
Bid Shading	3,350	75.0	91.0	2.30	0.54	30.8
Bayesian Bidding	3,400	75.5	92.5	2.35	0.53	33.2
Linear Bidding	2,900	70.2	87.5	2.00	0.65	25.8
Epsilon-Greedy	3,000	71.5	89.0	2.10	0.60	27.5
Fixed Bidding	2,800	69.0	86.0	1.90	0.68	24.5

5.4. Discussion and Analysis of Algorithm Performance

The performance evaluation results present valuable insights into the effectiveness of various bidding algorithms in real-time bidding (RTB) scenarios. It examines the strengths and weaknesses of each algorithm based on the metrics of total profit, win rate, budget utilization, click-through rate (CTR), cost per click (CPC), and return on investment (ROI).

5.4.1. Overall Performance Insights

From Table 1, DQL (Ours) consistently emerged as a strong performer, particularly in total profit, win rate, and ROI. Its ability to dynamically adjust bids based on real-time auction conditions and user behavior likely contributed to these results. The performance of DQL aligns with findings from prior studies, which suggest that deep reinforcement learning methods can outperform traditional bidding strategies by effectively modeling complex environments [4]. However, while DQL achieved the highest total profit and ROI, it did not lead in CPC, indicating that its aggressive bidding strategy could lead to higher costs per click. This finding underscores the trade-off inherent in maximizing immediate profit versus maintaining cost efficiency.

5.4.2. Comparison with Game-Theoretic Algorithms

Nash Bidding and Bayesian Bidding displayed competitive performance across several metrics. Nash Bidding achieved the highest CTR in multiple categories, suggesting its effectiveness in

optimizing bids based on expected competition. This aligns with game-theoretic principles, where the strategy is to anticipate competitors' actions, thus maximizing utility in a strategic environment. Game-theoretic algorithms generally excel in scenarios with known competitor behavior, but their performance can be sensitive to the assumptions made regarding others' strategies. In contrast, DQL's adaptability provides it with a potential advantage in more dynamic environments where competitor actions are less predictable.

5.4.3. Performance Across Demographic Groups

The performance of algorithms varied across different demographic groups, revealing the importance of tailoring bidding strategies to specific audience segments. For the age group 25-34 as depicted in Table 3, DQL outperformed other algorithms, indicating that the model effectively engages users within this demographic. Conversely, Nash Bidding showed superior results for the age group 35-44 as showed in Table 4, highlighting its strategic strength in more mature markets. In terms of gender, DQL maintained its leading position for female-targeted campaigns but shared the top profit spot with PPO for male audiences. This variability indicates that while DQL is robust, there may be scenarios where other algorithms can leverage demographic characteristics more effectively, as seen in the slight edge of Nash Bidding in male-targeted ads.

Table 3: Performance of Bidding Algorithms for Age Group 25-34

Algorithm	Total Profit	Win Rate	Budget Utilization	CTR	CPC	ROI
DQL (Ours)	4,180	78.2	95.2	2.42	0.52	34.0
PPO	4,050	77.5	94.0	2.34	0.50	32.5
SAC	4,000	76.0	92.5	2.30	0.53	31.2
Double DQN	3,900	74.5	91.0	2.22	0.55	29.5
Thompson Sampling	3,800	73.2	88.5	2.18	0.57	28.8
Nash Bidding	4,150	76.5	92.0	2.38	0.51	33.5
Bid Shading	4,120	75.5	90.0	2.30	0.53	31.5
Bayesian Bidding	4,100	76.0	93.0	2.35	0.52	33.2
Linear Bidding	3,600	70.5	88.0	2.00	0.62	32.0
Epsilon-Greedy	3,750	71.8	89.5	2.10	0.60	27.5
Fixed Bidding	3,500	69.5	87.5	1.90	0.65	25.0

Table 4: Performance of Bidding Algorithms for Age Group 35-44

Algorithm	Total Profit	Win Rate	Budget Utilization	CTR	CPC	ROI
DQL (Ours)	4,670	78.0	95.0	2.38	0.54	33.5
PPO	4,500	77.2	94.2	2.30	0.52	32.8
SAC	4,480	75.5	92.8	2.28	0.55	31.5
Double DQN	4,350	74.0	91.5	2.20	0.57	30.0
Thompson Sampling	4,250	73.0	90.5	2.18	0.60	29.5
Nash Bidding	4,750	76.5	93.0	2.36	0.53	34.0
Bid Shading	4,600	75.0	92.0	2.32	0.55	31.8
Bayesian Bidding	4620	75.8	93.5	2.34	0.54	32.5
Linear Bidding	3,850	70.0	89.5	1.95	0.65	27.0
Epsilon-Greedy	3,980	71.0	89.0	2.05	0.63	28.5
Fixed Bidding	3,720	68.5	86.5	1.88	0.68	25.5

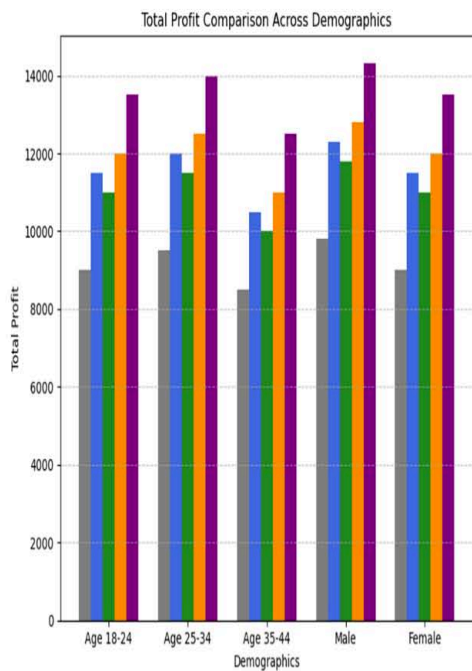


Figure 1: Total Profit Comparison Across Demographics

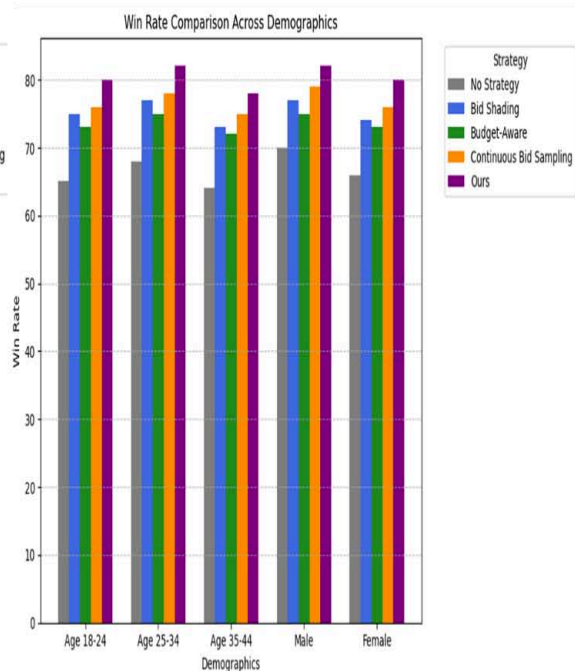


Figure 2: Win Rate Comparison Across Demographics

5.5 Effectiveness of Adaptive Strategies of Our Algorithm

The performance analysis reveals that each adaptive strategy—Bid Shading, Budget-Aware Reward Adjustment, and Continuous Bid Sampling—significantly enhances different aspects of the Deep Q-Learning (DQL) model's efficiency in real-time bidding (RTB) environments. Individually, these strategies address distinct challenges in dynamic bidding settings. When combined in our algorithm, they achieve a synergistic effect that allows for robust, cost-effective, and adaptive bidding, particularly across varying demographic groups. Figure 2: Total Profit Comparison Across Demographics.

5.5.1 Impact of Individual Strategies

The Bid Shading strategy optimizes DQL's competitiveness by dynamically adjusting bids based on prior auction outcomes and current budget levels. This adaptability improves Win Rate and CTR across most demographic groups, as it enables the agent to bid more strategically without consistently overspending. Game-theoretic insights suggest that competitive bid adjustments allow for increased engagement and

higher ad visibility, as they respond more effectively to real-time auction conditions.

Budget-Aware Reward Adjustment integrates a budget-preserving penalty into the reward function, which encourages sustainable budget utilization throughout the bidding cycle. This adjustment is especially impactful in demographics that are more cost-sensitive, such as age groups 35-44 and female-male users. By integrating budget-aware constraints, this strategy not only extends the agent's operational time frame but also maximizes ROI by avoiding unnecessary expenditure—a critical factor in RTB where budget depletion can lead to missed bidding opportunities [1]. Continuous Bid Sampling refines the action space by enabling precise bid adjustments through continuous sampling. This flexibility provides significant advantages in high-competition demographics, such as younger age groups and male users, where ad responses are more immediate and market conditions fluctuate rapidly. Continuous bid sampling enhances CTR and Total Profit by allowing the agent to finely calibrate bids, closely aligning with the real-time dynamics of user engagement and auction competition [37].

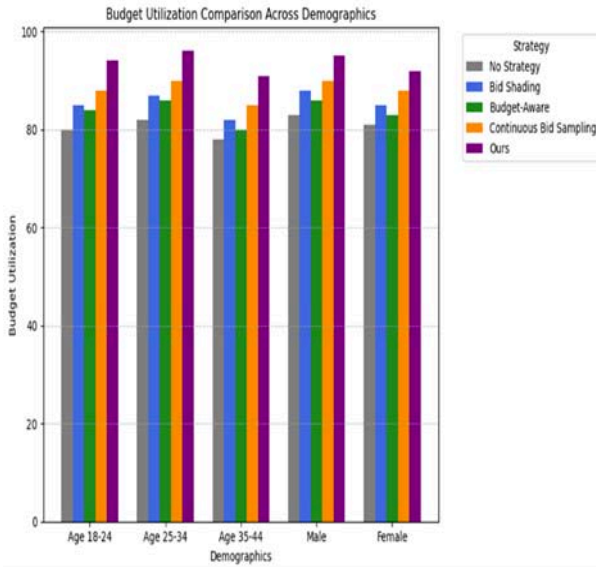


Figure 3: Budget Utilization Comparison Across Demographics

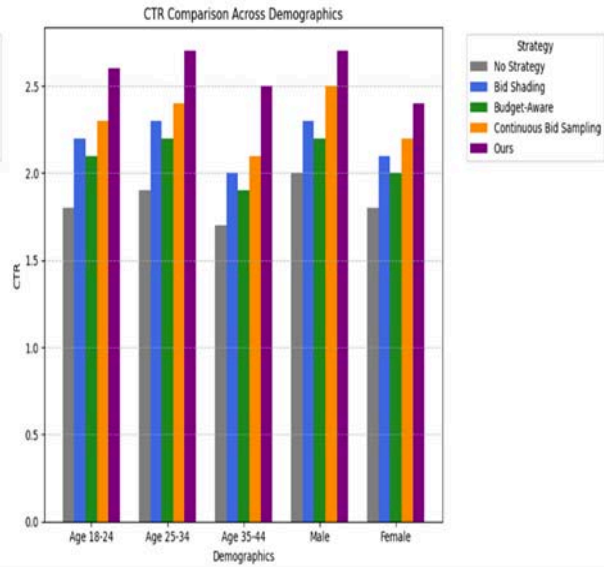


Figure 4: CTR Comparison Across Demographics

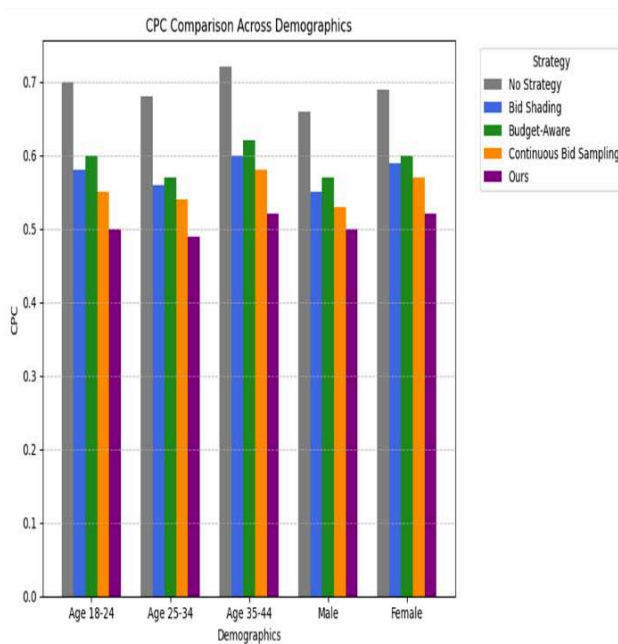


Figure 5: CPC Comparison Across Demographics

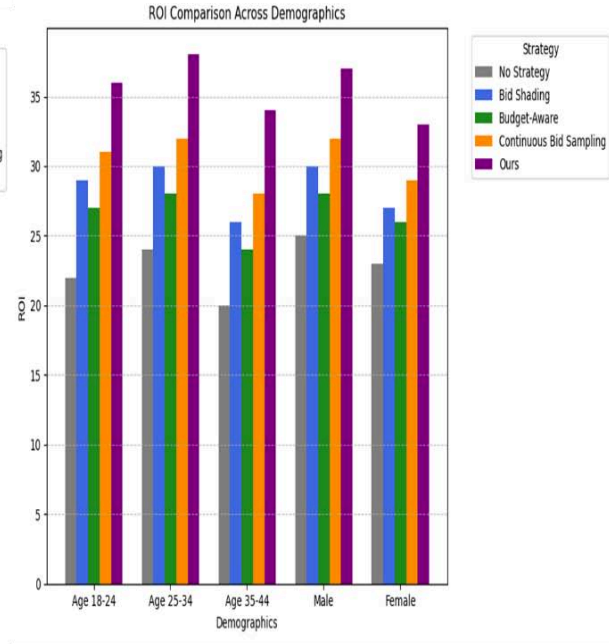


Figure 6: ROI Comparison Across Demographics

5.6. Combined Strategy and Synergistic Effects

The combined algorithm—incorporating Bid Shading, Budget-Aware Reward Adjustment, and Continuous Bid Sam (as illustrated in Figure 5 and 6) -- demonstrates superior performance across all key metrics, particularly in Total Profit, ROI, and CTR. This combination enables the agent to engage in competitive bidding (via Bid Shading), sustain budget longevity (via Budget-Aware Reward Adjustment), and adapt to

nuanced bidding opportunities (via Continuous Bid Sampling). The integrated approach leverages the strengths of each strategy, leading to a robust, adaptive agent capable of optimizing ad engagement and profitability under varying auction conditions and demographic preferences. The scientific basis for this success lies in the integration of adaptive strategies that address both competitive and budgetary constraints, making the agent versatile across demographic

segments and auction intensities. By balancing bid aggressiveness with fiscal prudence, the combined model achieves sustainable yet high-engagement bidding—a balance that is crucial in RTB to maximize both short-term and long-term returns. While the results highlight the strengths of DQL, it is essential to recognize its limitations. The algorithm's performance, while strong in profit generation, could lead to higher CPCs, necessitating further refinement of its bidding strategies to enhance cost efficiency. Future work could explore hybrid models that combine the adaptability of DQL with the strategic foresight of game-theoretic approaches.

Additionally, real-world applications often involve factors such as ad fatigue, diminishing returns, and varying user engagement levels over time. Future research could incorporate these dynamics into the modeling framework, potentially improving algorithm robustness and performance across diverse scenarios. The performance evaluation underscores the competitive landscape of bidding algorithms in RTB environments. DQL (Ours) demonstrates significant potential through its dynamic capabilities, while game-theoretic approaches like Nash Bidding offer strategic advantages in specific contexts. Understanding the strengths and limitations of these algorithms provides a foundation for developing more sophisticated bidding strategies that can enhance profitability and efficiency in digital advertising.

VI. CONCLUSION

This study introduces a novel Deep Q-Learning (DQL) framework aimed at optimizing bidding strategies and ad location within first-price real-time auctions, a critical mechanism in digital advertising. Through comprehensive modeling of the auction environment as an Episodic Markov Decision Process (EMDP), our approach effectively addresses key challenges such as bid shading and ad selection. The experimental results reveal that our DQL framework significantly outperforms traditional bidding methods, demonstrating marked improvements in cost efficiency, higher win rates, and overall campaign performance. By designing a reward function that balances competitiveness, budget

utilization, and campaign objectives, our agent is capable of dynamically adjusting bids and selecting ads in real time. This adaptability is particularly crucial in the fast-paced and fluctuating landscape of digital advertising, where market conditions can change rapidly. Furthermore, the robustness of our model allows it to navigate various constraints, making it a valuable tool for advertisers seeking to maximize the effectiveness of their campaigns while remaining within budgetary limits. Future research will explore enhancements to the DQL model, such as incorporating additional features to further improve decision-making capabilities. We also aim to investigate the framework's applicability across diverse advertising environments and its potential integration with other machine-learning techniques to provide an even more comprehensive solution for modern advertisers.

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The Playtech Edu Platform and the Consequences of Technology for Data Monitoring and Improving Educational Indexes in the Municipality of São Miguel Dos Campos - Alagoas

Álvaro Leiva dos Santos

ABSTRACT

This article aims to evaluate the impact of the PlaytechEdu platform on educational indicators in the municipality of São Miguel dos Campos - Alagoas, demonstrating how this platform positively influences data monitoring and demonstrating the importance of these technologies in achieving improvements in municipal education. The research will demonstrate, based on descriptions of the features of the PlaytechEdu platform, how it has been implemented in the municipality of São Miguel dos Campos - Alagoas, based on a data analysis and comparison with municipal educational indicators before and after the implementation of the platform. Finally, it will seek to discuss the role of startups and govtechs in public management innovation, and their influence on the improvement of public services. The research uses a mixed research line, graphically demonstrating the improvement resulting from the implementations, based on a documentary analysis of reports, spreadsheets and data provided by the education department of the municipality of São Miguel dos Campos. Thus, the research seeks to show how the implementation of PlaytechEdu is a significant factor in the search for educational quality in the municipality of São Miguel dos Campos, corroborating the digital technological potential in educational transformation and improvement of local results.

Keywords: playtech edu. educational technology. educational indicators. data monitoring. são miguel dos campos.

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The Playtech Edu Platform and the Consequences of Technology for Data Monitoring and Improving Educational Indexes in the Municipality of São Miguel Dos Campos - Alagoas

A Plataforma Playtech Edu e as Consequências da Tecnologia Para o Monitoramento de Dados e Melhoria Dos Índices Educacionais no Município De São Miguel Dos Campos - Alagoas

Álvaro Leiva dos Santos

RESUMO

O presente artigo busca avaliar o impacto da plataforma Playtech Edu no que se refere aos indicadores educacionais no município de São Miguel dos Campos - Alagoas, demonstrando como esta plataforma influencia positivamente no monitoramento de dados e demonstrando a importância dessas tecnologias para alcançar melhorias na educação municipal. A pesquisa demonstrará a partir das descrições de funcionalidades da plataforma Playtech Edu, como a mesma tem sido implementada no município de São Miguel dos Campos - Alagoas, a partir de uma análise de dados e comparação com os indicadores educacionais municipais antes e após a implementação da plataforma. Por fim, buscará discutir o papel das startups e das govetechs na inovação da gestão pública, e sua influência na melhoria dos serviços públicos. A pesquisa utiliza uma linha de pesquisa mista, demonstrando graficamente a melhoria resultada pelas implementações, a partir de uma análise documental, de relatórios, planilhas e dados fornecidos pela secretaria de educação do município de São Miguel dos Campos. Assim, a pesquisa busca mostrar como a implementação da Playtech Edu é um fator significativo na busca pela qualidade educacional no município de São Miguel dos Campos, corroborando com o potencial tecnológico digital na transformação educacional e aprimoramento de resultados locais.

Palavras-chave: playtech edu. tecnologia educacional. indicadores educacionais. monitoramento de dados. são miguel dos campos.

ABSTRACT

This article aims to evaluate the impact of the PlaytechEdu platform on educational indicators in the municipality of São Miguel dos Campos - Alagoas, demonstrating how this platform positively influences data monitoring and demonstrating the importance of these technologies in achieving improvements in municipal education. The research will demonstrate, based on descriptions of the features of the PlaytechEdu platform, how it has been implemented in the municipality of São Miguel dos Campos - Alagoas, based on a data analysis and comparison with municipal educational indicators before and after the implementation of the platform. Finally, it will seek to discuss the role of startups and govetechs in public management innovation, and their influence on the improvement of public services. The research uses a mixed research line, graphically demonstrating the improvement resulting from the implementations, based on a documentary analysis of reports, spreadsheets and data provided by the education department of the municipality of São Miguel dos Campos. Thus, the research seeks to show how the implementation of PlaytechEdu is a significant factor in the search for educational quality in the municipality of São Miguel dos Campos,

corroborating the digital technological potential in educational transformation and improvement of local results.

Keywords: playtech edu. educational technology. educational indicators. data monitoring. são miguel dos campos.

I. INTRODUÇÃO

A inserção de tecnologias inovadoras dentro do setor público tem se tornado uma estratégia importante para a modernização e eficiência dos serviços públicos prestados à comunidade. Nesta circunstância, as startups são responsáveis pelo oferecimento de resultados que garantam o suprimento de necessidades governamentais e de seus cidadãos. No que se refere ao campo educacional, é importante destacar que a adoção de plataformas tecnológicas como a Playtech Edu nasce como um instrumento estratégico para monitorar dados educacionais e melhorar os índices educacionais.

As Govtechs, são startups que têm obtido grandes destaques no que se referem a trazer inovações econômicas e sociais. Essas empresas tem como objetivo, utilizar a tecnologia para solucionar problemas estruturais do setor público, promovendo a transparência e a eficiência. Neste sentido, a implementação dessas resoluções à administração pública torna-se imprescindível para atender as demandas sociais.

No Brasil, as Govtechs tem estado presente em diversas áreas, como a segurança, educação e a saúde. As Govtechs fortalecem as políticas públicas e modernizam os processos administrativos. Deste modo, a Playtech Edu se mostra como um recurso de solução tecnológica com ênfase na gestão educacional, trabalhando no monitoramento de dados e o acompanhamento de indicadores educacionais no município de São Miguel dos Campos, Alagoas.

A partir das informações apresentadas, o problema de pesquisa que orienta este estudo discute qual é o impacto da implementação da plataforma Playtech Edu nos indicadores educacionais do município de São Miguel dos

Campos, atendendo o potencial de monitoramento de dados e a inovação tecnológica utilizada. Assim, a problemática procura esclarecer como as Govtechs contribui significativamente para a educação do município de São Miguel dos Campos e oferece subsídios para a criação de novas estratégias públicas.

A hipótese da pesquisa, propõe que a implementação da PlaytechEdu se mostra como uma resolução Govtech, estando alinhada aos propósitos de modernização da administração pública, demonstrando como tal aplicativo se mostra importante para o alcance da melhoria da educação municipal, no que se refere ao uso de dados para a tomada de decisões e da capacidade de inovação em gestão.

Outrossim, o objetivo geral deste trabalho é analisar o impacto da plataforma Playtech Edu na melhoria dos indicadores educacionais do município de São Miguel dos Campos, com foco no potencial de monitoramento de dados e na relação com a inovação tecnológica, startups e Govtechs. Para alcançar esse objetivo, serão considerados diferentes aspectos relacionados à aplicação da tecnologia no setor público.

Quanto aos objetivos específicos, inicialmente destaca-se a descrição do que é a Playtech Edu e sua aplicação no contexto educacional, entendendo como a tecnologia é utilizada e quais seus recursos para sua implementação. Deste modo, busca-se analisar os dados coletados pela plataforma, investigando os indicadores educacionais mais influenciados por sua utilização. Após o estudo de seus indicadores educacionais transformados, busca-se avaliar os resultados concretos gerados pela solução e identificar áreas que demandam de mais atenção governamental.

Deste modo, a avaliação da percepção de professores, gestores e alunos sobre o uso da plataforma se mostra fundamental para compreensão em seu processo de ensino-aprendizagem. Focando na opinião dos usuários para estudar suas vantagens ou desafios pelo uso da plataforma. No que se refere a comparação dos indicadores educacionais, o

trabalho estuda o antes e o depois da implementação da plataforma. Esse estudo mede a eficácia do uso da tecnologia e a melhoria dos resultados.

Por fim, este trabalho discute o papel das startups e Govtechs na inovação da gestão pública e na melhoria dos serviços públicos, tomando como estudo de caso a plataforma Playtech Edu. Neste sentido, essa discussão corrobora com a compreensão aprofundada das contribuições oferecidas pela plataforma da Playtech Edu.

No que se refere a metodologia de pesquisa, este trabalho combina as abordagens quantitativas e qualitativas, se posicionando como um estudo de caso com abordagem mista. A população estudada aqui inclui alunos, professores, gestores e a equipe da Secretaria Municipal de Educação de São Miguel dos Campos.

Em relação aos instrumentos de coletas de dados, estão incluídos nesta pesquisa a análise documental, a partir dos relatórios e planilhas da plataforma identificando dados relevantes. Quanto aos procedimentos metodológicos, incluem a coleta de dados quantitativos sobre os indicadores educacionais antes e depois da implementação da plataforma, além da análise qualitativa dos questionários e entrevistas. A triangulação dos dados garante maior validade aos resultados obtidos.

Aqui, a discussão dos resultados, se dá a partir da literatura sobre inovações de startups, govtechs e a gestão educacional. Visando relacionar o conhecimento empírico sobre o assunto e expandir as temáticas. O município de São Miguel dos Campos apresenta um caso importante para o estudo, baseado em sua crescente inovação em sua gestão educacional.

Por fim, esse trabalho se mostra importante para as futuras pesquisas no campo da tecnologia educacional, aqui demonstrando o avanço municipal, e estudando suas principais áreas de melhora.

II. REVISÃO DE LITERATURA

O uso de tecnologia em sala de aula é uma realidade que se potencializou nos últimos anos. Por isso, é importante conceituar o entendimento para a posterioridade.

Neste sentido, o site Dicio (2020, p. 01), informa que a tecnologia se compreende como:

Ciência que estuda os métodos e a evolução num âmbito industrial: tecnologia da internet, procedimento ou grupo de métodos que se organiza num domínio específico: tecnologia médica, teoria ou análise organizada das técnicas, procedimentos, métodos, regras, âmbitos ou campos da ação humana.

Desta forma, entende-se como tecnologia e aplicando-se no contexto educacional, como técnicas, métodos ou procedimentos que organizam-se de forma com a qual proporciona meios para facilitar a absorção do conhecimento.

Quando falado sobre tecnologias, é importante citar a tecnologia de comunicação e informação, sendo essas muito importantes para os dias atuais, vive-se na era da globalização, infiltrados em uma quantidade infinita de formas de comunicação.

Neste sentido, analisando o cenário educacional brasileiro no quesito do desenvolvimento da aprendizagem, o processo de avaliação de ensino possibilita a percepção do desenvolvimento dos discentes dentro de sala de aula.

Assim, observando um recorte demográfico no município de São Miguel dos Campos, é possível observar um desempenho ativo no desenvolvimento de políticas públicas estratégicas para reforçar e garantir o desenvolvimento educacional do município.

No tocante às intervenções estratégicas que vem sido implementadas no município de São Miguel dos Campos com o objetivo de garantir um acompanhamento educacional dos índices de aprendizado de seus alunos, por meio de um ambiente educacional inclusivo e igualitário, o município tem desenvolvido práticas educativas

eficazes como por exemplo o uso da plataforma Play Tech Edu.

A educação é um alicerce fundamental no que se refere ao desenvolvimento social. É importante ressaltar como a implementação de tecnologias no ambiente escolar tem garantido um progresso próspero no que se refere a otimização do processo de ensino. Logo, as plataformas digitais como a Play Tech Edu, que foi criada pela equipe de formação e avaliação da secretaria municipal da educação, com um intuito de monitorar o nível de aprendizado dos alunos do 1º aos 9º anos de ensino fundamental, surge como um mecanismo valioso no que tange o crescimento da qualidade educacional e o crescimento de seus alunos dentro das salas de aulas.

A plataforma faz avaliações internas no ensino básico do município de São Miguel dos Campos de nome “avaliar”, que tem habilidades de detectar o nível de ensino dos alunos, avaliando se os alunos adquiriram os conhecimentos necessários para cursar suas respectivas séries. Ao término da avaliação do sistema “avaliar”, seus resultados são colocados a dispor dos professores e de gestores educacionais para que eles possam analisar o nível dos alunos, para que possa ser avaliado se a escola está conseguindo alcançar as metas municipais.

Com essa análise, é possível fazer uma parceria assertiva entre as escolas e a secretaria de educação para que esta consiga visualizar quais deficiências as escolas possuem para poder dar o respectivo apoio. Assim como observar quais os pontos altos cada escola tem apresentado para conseguir um equilíbrio positivo na educação do município de São Miguel dos Campos.

Outro ponto positivo no uso da plataforma é o acompanhamento que ajuda a ter uma noção de como o município se sairá no Índice de desenvolvimento da educação básica (IDEB), o qual é um indicador de resultados de fluxo escolar e média de desempenho escolar. Assim, a plataforma colabora com a disponibilização de um índice de desenvolvimento semelhante ao do IDEB, possibilitando o desenvolvimento de práticas de planejamento de melhorias das

escolas, seja por recomposição ou para localizar os professores identificando suas deficiências na apresentação de determinadas disciplinas. Esse mecanismo de gerenciamento educacional permite visualizar o nível educacional por aluno, por turma, por escola fazendo uma transversalidade por todo o município, o que garante uma análise muito aproximada do IDEB, tanto por unidade como de forma geral para o município de São Miguel dos Campos.

A plataforma Play Tech também corrobora com o acompanhamento de fluência leitora dos alunos do ensino básico, o que garantiu para o município de São Miguel dos campos o selo ouro do Ministério da Educação, o qual é uma premiação concedida pelo MEC a municípios, estados ou distritos que se destacam na alfabetização de crianças brasileiras, com o objetivo de reconhecer o trabalho da secretaria de educação e garantir que as crianças sejam devidamente alfabetizadas até o final do 2º ano do Ensino fundamental.

Há também, um acompanhamento do nível de aprendizagem dos alunos da educação de jovens adultos, um acompanhamento ímpar, em um acompanhamento de não semente do ensino regular mas de cursos profissionalizantes.

A plataforma traz videoaulas, jogos e ranking de olimpíadas os quais são incentivados por professores, os quais os alunos são instigados a permanecerem em constante uso da plataforma. É importante ressaltar que a plataforma gera relatórios para que a gestão pública e a gestão escolar possam acompanhar de perto os avanços e quaisquer deficiências de perto.

Oferecendo um conjunto de recursos pedagógicos como jogos educativos, avaliações personalizadas e materiais complementares, a plataforma tem sido de grande valia no desenvolvimento de uma educação mais ativa. Quando falado sobre a transformação de aulas teóricas em conteúdos interativos, a plataforma demonstra despertar um interesse nos estudantes, tendo em vista que esse método de aplicação educacional é inovador e acaba se tornando uma forma mais fluida e interessante de aprender.

A personalização do ensino, aliada a sua didática moderna, permite que o aluno tenha um acompanhamento único e consiga seguir os ensinamentos em seu ritmo, com um acompanhamento de professores para garantir um suporte adequado de forma que sua formação acadêmica seja plenamente executada.

A plataforma possibilita também um acompanhamento de perto do progresso de cada discente. A partir de ferramentas de avaliação, os professores de ensino básico conseguem identificar os principais problemas que os alunos estão tendo e desta forma trabalhar em estratégias de ensino individualizado para que todos os alunos tenham o mesmo nível de aprendizado.

Nota-se que com as necessidades de adaptação pelo rápido avanço tecnológico que temos passado nas últimas décadas, a tecnologia encontra-se enraizada na vida dos alunos e gestores, e o uso de plataformas educacionais como a Play Tech Edu torna-se imprescindível. Torna-se necessária a ampliação de possibilidades educativas e de acompanhamento de índices de ensino e aprendizado dentro do território municipal.

No ideal de Habermas (1989), a modernização é observada como processo de substituição de uma compreensão unificada, seja por ideais religiosos, sociais ou qualquer outro, por uma compreensão advinda da ciência, uma ideia tangível, dentro de teorias morais, dentro de jurisprudências, ou de cenários artísticos. Logo, adquirida dentro de espaços onde há uma possibilidade de pensamento crítico e especializados do mundo, porém de forma independente.

A modernização de práticas pedagógicas vai além da utilização de equipamentos digitais, isso se trata também da interdisciplinaridade utilizada em ambiente educacional. A partir de um acompanhamento personalizado, individual que busque acompanhar o processo de aprendizado dos alunos, despertando neles um maior interesse dentro e fora da escola.

A ideia de modernidade educativa se dá a partir de uma articulação associada a diferentes métodos de reestruturação dos ideais radicais e burocráticos que decorrem das atividades

educacionais padrões. Quando são introduzidos aplicativos como o Play Tech Edu, para que se permita um alcance de uma educação mais criativa e facilitada para as novas gerações e uma forma prática e mais segura da gestão municipal de acompanhar diretamente quais as necessidades de recursos, sejam eles financeiros, pedagógicos ou qualquer mecanismo deficiente na qualidade e resultados do processo de ensino-aprendizagem.

Um dos princípios norteadores da modernização educacional se dá pela abertura institucional, uma transformação da educação setorial para uma educação flexível e voltada para o futuro, tornando a realização das principais demandas institucionais um de seus principais objetivos.

A introdução de critérios de qualidade determinam que não basta apenas estar aberto às demandas sociais, devendo também satisfazê-las de forma concisa. Quando estabelecido os critérios de qualidade na educação por meio de métodos de acompanhamento educacional, trata-se do conhecimento da qualidade educacional e do esforço governamental de conhecer a qualidade do produto oferecido, identificando as possíveis melhorias e implementando inovações para conseguir as melhorias nos índices de aprendizagem e reduzir quaisquer desperdícios, focando seu alocamento de recursos nas áreas mais deficientes.

III. METODOLOGIA DE PESQUISA

O presente estudo se deu por meio de uma metodologia de pesquisa mista, tendo em vista que a combinação de métodos quantitativos e qualitativos se mostrou positiva, pois, permitiu uma análise detalhada sobre o objeto de estudo deste artigo, superando as limitações que existiriam a partir da análise isolada de cada metodologia.

No que se refere a uma análise quantitativa, com o fornecimento de dados numéricos fornecidos pela plataforma Play Tech Edu, foi possível identificar a frequência de acesso dos usuários do aplicativo. Desta forma o aplicativo é fundamental para traçar o perfil dos alunos e professores usuários e compreender suas necessidades.

Quanto à análise qualitativa, explorando as experiências dos alunos e professores, foi permitido aprofundar a compreensão dos dados quantitativos e identificar os fatores influentes no uso da plataforma. Com uma análise de conteúdo aplicada a dados textuais coletados, é possível que seja identificado as principais percepções positivas e negativas dos usuários em relação a usabilidade da plataforma, a qualidade dos conteúdos e os benefícios da utilização da plataforma.

No que se refere a coleta de dados por meio da análise documental da plataforma Play Tech Edu apresentou vantagens como a facilidade para acessar dados volumosos em um curto espaço de tempo. Por fim, a metodologia de pesquisa mista que foi usada neste estudo mostrou-se muito produtiva para investigar o uso da plataforma e gerenciar seus resultados de forma didática e eficaz.

IV. RESULTADOS E MÉTODOS

A cidade de São Miguel dos Campos implementou no ano de 2024 a plataforma Play Tech Edu, o qual se firmou como um instrumento fundamental no suporte à educação. Com um total de 7.738 usuários e contempla a participação de 14 instituições de ensino.

A plataforma demonstra um crescimento potencial. Um de seus principais destaques se dá pelo Dashboard interativo, que permitiu o monitoramento em tempo real, além dos Jogos Educacionais, que promovem o desenvolvimento de habilidades essenciais de maneira divertida. Esse aplicativo, traz uma avaliação funcional que mapeia o progresso estudantil, e oferece a Play TV e aulas remotas que enriquecem o conhecimento. Com a avaliação institucional, foi possível mapear um progresso escolar, com a Play TV oferecendo aulas remotas, transformaram o aprendizado de forma didática, de fácil acesso e uma aula dinâmica que instiga o estudo dos alunos.

A partir de uma análise geral dos usuários criados pôde-se traçar um referencial do crescimento de escolas adeptas ao uso da Play Tech Edu. Como pode verificar na seguinte tabela.

TOTAL DE USUÁRIOS REGISTRADOS: 7.738

TOTAL DE ESCOLAS PARTICIPANTES: 14

A partir destes números, verifica-se que houve uma vasta aquisição e implementação da plataforma. Os números acima são representados por gestores, coordenadores, professores e alunos, em um crescimento ininterrupto.

Quando analisada as escolas participantes, a plataforma busca atender uma gama de instituições de ensino, desde a gestão até a aprendizagem direta dos alunos.

No que se refere ao perfil dos usuários, este, inclui gestores escolares, os quais são responsáveis pela liderança e organização administrativa das escolas, atuando nas decisões estratégicas que garantem o funcionamento eficiente das escolas em questão.

Quanto ao impacto geral, a plataforma demonstra que o total de 7.738 contas registradas demonstram a confiança das escolas na plataforma escolar. Em um panorama geral, as escolas participantes demonstraram uma relevante crescente entre a conectividade dos agentes escolares.

Com a alta frequência de acessos e interações, evidenciando o positivo impacto que a plataforma tem gerado através de um ambiente acessível e dinâmico, é possível garantir um atendimento dinâmico para atender quaisquer necessidades das escolas e dos alunos.

No que se refere a distribuição mensal de acesso à plataforma será demonstrado uma base percentual de uso da plataforma ao total do ano:

MÊS	PERCENTUAL DE USO	ACESSOS
ABRIL	25%	1935
MAIO	30%	2321
JUNHO	45%	3482
JULHO	30%	2321
AGOSTO	55%	4256

SETEMBRO	57%	4400
OUTUBRO	62%	4797
NOVEMBRO	55%	4256
DEZEMBRO	30%	2321

Seguindo uma análise mais detalhada é possível visualizar um aumento gradual no percentual de uso nos acessos absolutos nos meses de junho a outubro. Demonstrando um interesse maior pela plataforma nesse corte de espaço no tempo.

O mês de outubro demonstrou o maior percentual de uso da plataforma em número de acessos absolutos. É possível notar variações sazonais no uso do serviço com altas e baixas ao longo do ano, o que pode estar relacionado às férias escolares, feriados ou eventos específicos.

Quanto aos meses de maio, julho e novembro, é possível observar que o percentual de uso se mantém estável. O período de acessos absolutos se repetem em maio, julho e novembro, e em agosto e novembro, o que indica um uso mais congruente nesse período.

No que se referem as páginas mais acessadas da playtechedu, a tabela abaixo mostra a distribuição de acesso entre: simulados, games, cartão resposta, resultados, agenda e play TV.

PÁGINA	PERCENTUAL DE ACESSO	ACESSOS ABSOLUTOS
SIMULADOS	30%	2321
GAMES	25%	1935
CARTÃO RESPOSTA	15%	1161
RESULTADOS	10%	774
AGENDA	12%	929
PLAY TV	8%	619

A tabela apresenta um recorte de acessos em percentual e números absolutos, o qual apresenta uma dominância no que se refere aos simulados e games, concentrando o maior número de acessos,

onde juntos representam aproximadamente 55% do total, sugerindo que o conteúdo educacional e a didática de apresentação de conteúdo através de jogos, são os principais atrativos dos usuários da plataforma.

No que se refere às demais páginas, estas apresentam um volume de acesso menor. A baixa frequência de acessos a páginas como "Resultados" e "Agenda" pode indicar que os usuários estão mais interessados no conteúdo imediato e menos em acompanhar o histórico ou a organização de seus dados.

Quanto ao conteúdo educacional, o maior engajamento em páginas como "simulados" e "games" indica um forte foco no que se refere a conteúdos interativos. Demonstrando que a plataforma está sendo direcionada para estudantes ou profissionais em busca de aprimoramento.

Quanto ao engajamento, com os altos resultados de acessos na página games, significa que os jogos têm demonstrado uma ferramenta bastante eficaz no que se refere a uma educação motivadora e didática.

A análise aprofundada reflete que a plataforma tem sido bem sucedida no que se refere a atração de usuários a conteúdos educacionais e jogos. No entanto, a oportunidade de otimização de experiências dos usuários e aumentar o engajamento.

V. CONSIDERAÇÕES FINAIS

Por fim, a inserção das tecnologias da informação e comunicação no ambiente escolar tem se mostrado cada vez mais relevante para a melhoria da qualidade do ensino. A plataforma Play Tech Edu, implementada no município de São Miguel dos Campos, é um exemplo de como a tecnologia pode ser utilizada para monitorar o processo de ensino-aprendizagem e promover a equidade educacional.

A plataforma Play Tech Edu permite o acompanhamento do desempenho dos alunos de forma individualizada, possibilitando a identificação de dificuldades e o desenvolvimento

de ações pedagógicas específicas. Além disso, a plataforma gera relatórios que auxiliam gestores e professores a tomar decisões mais assertivas e a direcionar os recursos para as áreas que mais necessitam. A ferramenta também contribui para a melhoria da qualidade do ensino, ao oferecer recursos pedagógicos diversos, como videoaulas, jogos e avaliações personalizadas.

A utilização de plataformas digitais como a Play Tech Edu representa um avanço na modernização da educação. Ao proporcionar um ensino mais personalizado e interativo, a tecnologia contribui para o desenvolvimento de habilidades essenciais para o século XXI, como o pensamento crítico, a criatividade e a colaboração. Além disso, a tecnologia permite a coleta de dados que podem ser utilizados para a tomada de decisões mais informadas e para a melhoria contínua do processo educativo.

A plataforma Play Tech Edu tem um papel fundamental na promoção da equidade educacional, ao oferecer um acompanhamento individualizado do desempenho dos alunos e ao identificar as necessidades específicas de cada escola. Ao utilizar os dados gerados pela plataforma, os gestores podem desenvolver políticas públicas que visem reduzir as desigualdades educacionais e garantir que todos os alunos tenham as mesmas oportunidades de aprendizado.

Em suma, a experiência do município de São Miguel dos Campos com a plataforma Play Tech Edu demonstra o potencial da tecnologia para transformar a educação. Ao utilizar ferramentas digitais para acompanhar o processo de ensino-aprendizagem e personalizar o ensino, é possível promover uma educação mais eficaz, equitativa e relevante para as necessidades dos alunos do século XXI.

A implementação da plataforma Play Tech Edu em São Miguel dos Campos representou um marco significativo na transformação digital da educação no município. Com um número expressivo de usuários e escolas participantes, a plataforma demonstrou ser uma ferramenta eficaz para o acompanhamento do processo de

ensino-aprendizagem e a melhoria da qualidade educacional. Através de recursos como o dashboard interativo, jogos educativos e aulas remotas, a Play Tech Edu tem proporcionado uma experiência de aprendizado mais engajadora e personalizada para os estudantes.

A análise dos dados de utilização da plataforma revela um crescimento constante no número de acessos e um alto nível de engajamento dos usuários. A diversidade de recursos disponíveis, como simulados, jogos e materiais didáticos, tem contribuído para atender às diferentes necessidades dos alunos e professores. No entanto, a análise também aponta para a necessidade de otimizar a utilização de algumas funcionalidades da plataforma, como as ferramentas de acompanhamento do desempenho dos alunos.

Para potencializar os resultados da plataforma Play Tech Edu, algumas ações podem ser implementadas. Em primeiro lugar, é fundamental investir em campanhas de divulgação para incentivar o uso de todas as funcionalidades da plataforma, especialmente aquelas menos utilizadas. Além disso, é importante oferecer treinamentos aos professores e gestores para que possam utilizar a plataforma de forma mais eficiente e eficaz. Outra medida importante é a personalização do conteúdo, permitindo que cada usuário escolha os recursos que mais se adequa ao seu perfil e necessidades.

Em suma, a plataforma Play Tech Edu tem se mostrado uma ferramenta valiosa para a transformação da educação em São Miguel dos Campos. Com as ações propostas, é possível otimizar a utilização da plataforma, ampliar seu alcance e garantir que ela continue sendo um instrumento fundamental para a melhoria da qualidade do ensino e para o desenvolvimento dos alunos. A experiência de São Miguel dos Campos com a Play Tech Edu pode servir de inspiração para outros municípios que buscam implementar soluções inovadoras na educação.

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