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CONTENTS

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Exploring the Role of Higher Education Institutions in Promoting Climate Control and Justice in Uganda

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Abstract

This exploratory qualitative study focused on exploring the role of Higher Education Institutions in advancing Climate Control and Justice in Uganda with a focus on; climate control efforts; research and advocacy; and climate-related educational programs. Findings indicated that the universities had introduced programs such as advocacy for climate control and justice, adoption and assessment of science-based programs to integrate climate and also involved student activists who often prioritized enforcing environmental curricular changes which stimulated knowledge growth through educational awareness to the staff, and students. However, the efforts were inadequate due to the economic status of our country which largely depends on donor funds. The study concluded that Higher Education Institutions were not adopting enough interdisciplinary approaches to address climate control and justice adequately, aligning educational goals with global climate challenges and thus they should continue to incorporate climate education into all academic programs and integrate climate-related topics across various academic disciplines.

Keywords: higher education, climate control, climate justice, climate education

1. Background of the Study

Education in Uganda is categorized into various periods namely, Before-colonial, During-Colonial, and After-colonial. Before the colonial period, education was informal or indigenous and based on practical skills for daily life like hunting, fishing, farming, and craftwork (Ssekamwa J.C, 1997). Universities were not there at the time. During the colonial period, missionaries established primary and secondary schools. Universities were still not there at that time. Those who wanted a university education would go either abroad or to neighbouring countries like Tanzania and Kenya. Makerere College was established in 1922, originally as a technical school, then later as a centre for higher learning. It became part of the University of East Africa in 1949. After independence, Makerere College became Uganda's fast fully- fully-fledged university, a symbol of academic excellence in East Africa (Semali, L. M., 1999). There was only one university in the country until liberalization policy reforms (in the 1990s) where private institutions of all levels including universities were allowed to operate. There are now very many universities both public and private in operation controlled by the National Council for Higher Education (NCHE) to regulate and monitor them. The climate control in Uganda is influenced by tropical climate diverse ecosystems like savannas, forests and wetlands. People used to practice

sustainable activities (Muweesi, C., 2021). With the increase of people, and social-economic activities proportionally the increase, National Environmental Management Authority (NEMA) was introduced to address environmental issues. The Government also ratified international commitments to climatic changes like the United Nations Framework Convention on Climate Control (UNFCCC) and the Tokyo Protocol for climate action. People believe that universities are crucial in addressing issues of climate control and justice (Ssekamwa J.C, 1997). They contend that those universities are key actors in promoting research to advance climate control and justice. Many universities have embraced seminars, talks, conferences, etc. which have been focal think as well as platforms for climate control debates these have heavily been attended by university scholars, professors, and students and a lot of debates have accumulated into policy recommendations that governments more so the government of Uganda has embraced with the help of various stakeholders who participate in these debates such as inter-ministerial representations, members of parliament, among others (Rwabuhinga, R., et al., 2024). The universities contribute by generating knowledge, shaping leaders, and driving innovations in climate-related fields (Leal Filho, 2010). Research from universities forms public policy and contributes to international climate agreements (Anderson, Teisl, Noblet, & Klein, 2015). Universities are hubs for developing sustainable solutions, including carbon capture technologies, which contribute to both mitigating climate change and promoting social equity (Leal Filho, 2010). However, incorporating climate justice into university curricula which is vital for preparing students to understand and address the complex ethical issues surrounding climate change has been lacking. Yet, climate justice promotes inclusivity by highlighting how vulnerable populations, such as Indigenous communities and women, are disproportionately affected by climate change (Stephens et al., 2008). According to Schlosberg & Collins, (2014), climate justice is the ethical dimension of climate change, emphasizing the fair treatment of all people in efforts to address and mitigate its effects. The concept stems from the recognition that climate change exacerbates existing social inequalities, disproportionately impacting low-income communities, indigenous peoples, and developing nations, even though these groups contribute the least to global emissions (Charles, M., Sarah, N., & Anthony, M. M. 2024). Climate justice advocates argue for a fair distribution of the benefits and burdens of climate action, ensuring that marginalized communities are protected and empowered in decision-making processes.

1.1 Purpose of the Study

The purpose of the study was to explore the role of Higher Education Institutions in advancing climate control and justice in Uganda.

1.2 Research Objectives

The study objectives were;

1) To establish how Higher Education Institutions contributed to climate control and justice efforts.
2) To examine how Higher Education Institutions engaged in research and advocacy to address climate control and promote climate justice.
3) To identify how Higher Education Institutions catered for marginalized communities in climate-related educational programs.

1.3 Research Questions

The study was guided by the following study questions;

1) How Higher Education Institutions were contributing to climate control efforts?

2) How Higher Education Institutions were engaging in research and advocacy to address climate control and promote climate justice?

3) How do Higher Education Institutions cater for marginalized communities in climate-related educational programs?

1.4 Theorization

This study was conducted within the context of environmental justice (Bullard, 1993) and sustainability education theory (Sterling, 2010). The environmental justice theory posits that marginalized communities bear the burden of climate change impact, a concept that was reflected in the inequitable distribution of climate-related educational resources across universities. Sustainability education theory suggests that educational institutions play a pivotal role in shaping societal responses to climate challenges. The research study supports these theoretical insights, showing that universities that integrated climate justice into their curricula were better positioned to promote equitable climate solutions. However, the marginalization of social justice perspectives in climate control education suggests a gap in current sustainability theories, which often prioritize the environment over the social aspect of climate change. Furthermore, the study proposes an expanded theoretical framework, incorporating critical pedagogy (Freire, 1970) to highlight the role of student

activism in reshaping university policies. Critical pedagogy underscores the importance of empowering students to challenge existing structures and advocate for systemic change, a theme that emerged strongly in the interviews with climate activists in the institution. This research suggests that future theoretical models must incorporate both environmental sustainability and social justice, recognizing the role of universities in promoting an integrated approach to climate action.

2. Literature Review

2.1 How Higher Education Institutions Contributed to Climate Control Efforts

Universities and research institutions generate scientific knowledge that informs climate policy and offers technological solutions to mitigate climate change. For instance, academic institutions have contributed to advancements in renewable energy, such as solar and wind power, as well as carbon capture technologies. Research has shown that interdisciplinary collaborations within universities have been instrumental in developing low-carbon technologies and sustainable solutions (Bauer, 2020). Universities also frequently partner with local governments, NGOs, and industries to implement community-level climate control projects. According to Evans et al. (2016), universities can act as catalysts for local sustainability initiatives, providing expertise and resources that help communities transition to more including energy efficiency, waste reduction, and the use of renewable energy (Lazarus, 2018). These initiatives demonstrate the feasibility of large-scale operational changes that can be replicated in other sectors.

2.2 Higher Education Institutions Advocate Addressing Climate Control and Promoting Climate Justice

Universities are not only advancing scientific and policy knowledge to address climate control but also ensuring that the pursuit of climate solutions is equitable and inclusive. For instance, researchers at Makerere University have explored the relationship between climate variability and food security in Uganda's rural areas, revealing how smallholder farmers face greater challenges in adapting to climate change (Mukwaya & Tumushabe, 2018). According to Tumushabe et al., (2019), Makerere University's College of Agricultural and Environmental Sciences (CAES) offers training on climate-smart agricultural practices, including agroforestry, rainwater harvesting, and drought-resistant crops. Uganda Martyrs University has been active in hosting climate justice forums that bring together academics, policymakers, community leaders, and the general public to discuss how marginalized groups, such as women and indigenous peoples, are disproportionately impacted by climate change (Kakande, 2020). The partnership between Gulu University and local communities in northern Uganda is commendable. Through this collaboration, the university has worked with local farmers to study the impacts of climate change on crop production and develop community-driven solutions, such as diversified cropping systems and soil conservation techniques.

2.3 Tracking Communities in Climate-Related Educational Programs

Programs offered by Gulu University have shown that climate-related education is effective in raising awareness about sustainable practices, such as energy conservation, carbon footprint reduction, and the adoption of renewable energy technologies. Extracurricular programs that involve hands-on learning experiences, such as campus sustainability initiatives, environmental clubs, and participation in climate conferences encourage students to actively engage in climate control measures, turning theoretical knowledge into practical applications. Studies have shown that such experiential learning programs (Charles, M., et al., 2024) can lead to long-term behavioural changes that contribute to reduced carbon emissions and the adoption of climate-friendly practices (Anderson et al., 2017).

According to Simpson (2019), Universities in Europe and North America have successfully implemented campus-wide sustainability initiatives that serve as models for local communities. The University of Edinburgh's "Zero Carbon by 2040" campaign not only reduces the institution's carbon footprint but also educates the local population on energy conservation and waste reduction techniques. According to Ochieng & Muthoni (2021), awareness programs also create a ripple effect by influencing public policy. Communities in Canada due to climate change. The course explores the intersection of environmental degradation, colonialism, and social inequality, encouraging students to engage in climate advocacy that prioritizes indigenous rights and knowledge systems (Collins et al., 2020). Universities in Uganda, such as Makerere University, have implemented community-based climate adaptation projects that focus on empowering smallholder farmers, women, and rural communities who are most affected by climate variability (Mukwaya & Tumushabe, 2018). According to González & Martinez (2020), Universities in regions such as Latin America and Sub-Saharan Africa also play a critical role in facilitating access to climate finance and resources for marginalized communities. Awareness programs in these institutions emphasize the importance of equitable access to climate funds, ensuring that vulnerable populations receive the financial and technical support needed to adapt to climate change. By advocating for fair distribution mechanisms, universities contribute to climate justice at both local and global levels. According to UNFCCC (2021), during the United Nations Climate Change Conference (COP26), several

universities, including those from Africa and Asia, played an active role in advocating for climate finance mechanisms that prioritize least-developed countries (LDCs) and vulnerable communities.

3. Methodology

3.1 Research Design

The study used a qualitative design to gather data from multiple cases at a specific point in time. This approach allows for efficient data collection by reaching all respondents at once, saving time and cost. The sample size was determined using the (Krejcie & Morgan, 1970) table for determining sample size as cited by Amin (2005). The sample size and selection for this study from Iganga Technical Institute is presented in Table 1 below.

Table 1. Sample size and selection strategies

Category	Gender	Target Population	Sample size	Percentage	Sampling technique
Academic staff	Male	12	4	33%	Purposive sampling
	Female	8	3	38%	
Graduate students	Male	30	6	20%	
	Female	24	5	21%	
Total		**74**	**18**	24%	

Source: Primary Data.

The study's purposive sampling approach focused on key stakeholders and experts, enabling a comprehensive understanding of the research issues while addressing potential bias through transparent documentation and data validation. The interviews generated from respondents were gained through open-ended questions designed to align with the study's topic and objectives. This approach allows for a comprehensive exploration of facts, beliefs, feelings, motives, and behaviours, providing rich and detailed data. The selected interviewees' knowledge and experiences made them valuable sources of information.

4. Presentation of Findings

The study analysed qualitative data following the purpose of the research of exploring the role of higher education in advancing climate control and justice in Uganda, and summarized in a narrative form as a representative of the major findings:

4.1 Climate Control and Justice Efforts in Higher Education Institutions

Respondents highlighted the importance of universities in playing a pivotal role in addressing climate change by fostering a culture of environmental stewardship, advancing climate science, and equipping future leaders with the knowledge and skills necessary to implement sustainable solutions. One lecturer said,

> "*As academic institutions, our mission transcends the boundaries of imparting knowledge; we are responsible for shaping the values and competencies of future professionals, policymakers, and researchers to respond effectively to global challenges like climate change. Through interdisciplinary research in areas such as renewable energy, sustainable agriculture, and climate modelling, universities can provide the scientific evidence and innovations needed to inform policy decisions and industrial practices.*"

This implied that universities are hubs of knowledge generation, where cutting-edge research can lead to the development of sustainable technologies and climate mitigation strategies. Equally important, is their role in education and capacity building, by integrating climate change and sustainability into curricula across disciplines, universities can prepare students not only in environmental sciences but in all fields to understand the implications of climate change in their respective professions. An administrator of the University said,

> "*Business students, for example, can learn about green finance and corporate sustainability, while engineering students can explore sustainable design and energy efficiency. Graduating students equipped with such knowledge will be better prepared to implement climate control measures in their professional careers. Universities can create networks and collaborations with institutions, researchers, and organizations around the world to share knowledge and best practices. Participating in global initiatives such as the United Nations Sustainable Development Goals (SDGs) allows Higher Education to contribute to a coordinated global effort to address climate control.*"

A senior lecturer said,

> "*Universities in Uganda are well-positioned to influence national and local climate policies by providing research-based evidence and engaging with policymakers to ensure that climate justice is at the forefront of policy formulation. Institutions like Makerere University have been involved in policy discussions at both the national and regional levels, advocating for climate action that considers the needs of marginalized communities. This included pushing for policies that support fair access to resources, such as land and water, which are often disproportionately affected by climate change in rural and impoverished areas.*"

Universities have a responsibility to foster a global mindset and collaboration. Climate control is a global issue that requires international cooperation.

4.2 Research and Advocacy to Address Climate Control and Promote Climate Justice by Universities

Academic staff responses indicated that universities in Uganda play a significant role in advancing climate justice, especially in marginalized communities. Another senior lecturer said,

> "*Climate justice focuses on addressing the disproportionate impacts of climate change on vulnerable populations, such as rural communities, women, and the poor, who contribute the least to global warming but suffer the most from its effects. Through a variety of initiatives, universities in Uganda are leveraging their expertise, research, and community engagement to promote climate justice in several meaningful ways.*"

Many Ugandan universities have developed partnerships with rural and underserved communities to assess the local impacts of climate change, such as droughts, floods, and food insecurity. A student leader stated,

> "*These collaborations often involve engaging community members in identifying challenges and co-creating solutions that are culturally and economically appropriate. For example, researchers from Makerere University and other institutions work with smallholder farmers in rural areas to introduce climate-smart agricultural practices, such as drought-resistant crops and sustainable water management. This not only improves the resilience of marginalized communities to climate change but also ensures that the solutions are tailored to their specific needs and contexts.*"

By integrating climate justice into academic curricula, universities are preparing students to understand the social and ethical dimensions of climate change. This was confirmed by another student leader who noted that,

> "*Many Universities offer courses and programs focused on sustainable development, environmental management, and climate control, ensuring that students from various disciplines are equipped to address the unique challenges faced by marginalized communities. Graduates, particularly those studying social work, law, agriculture, and environmental science, are empowered to advocate for policies and practices that promote both environmental sustainability and social equity.*"

A senior lecturer emphasized that,

> "*Universities in Uganda are well-positioned to influence national and local climate policies by providing research-based evidence and engaging with policymakers to ensure that climate justice is at the forefront of policy formulation. Institutions like Makerere University have been involved in policy discussions at both the national and regional levels, advocating for climate action that considers the needs of marginalized communities. This includes pushing for policies that support fair access to resources, such as land and water, which are often disproportionately affected by climate change in rural and impoverished areas.*"

4.3 Extensive Community Role in Climate-Related Educational Programs

A student mentioned that climate-related education and awareness programs implemented by universities have a profound impact on promoting both climate control and justice; and explained that,

> "*These programs contribute significantly to creating an informed society that is capable of addressing the challenges posed by climate change, while also ensuring that vulnerable populations are not left behind in the pursuit of sustainable solutions. Higher Education is uniquely positioned to influence how climate change is understood and tackled, particularly through their research, education, and community outreach initiatives.*"

Another student added,

> "*One of the most visible effects of these programs is the enhanced public understanding of climate change and its consequences, both at the local and global levels. By integrating change and sustainability into curricula across various disciplines, universities equip students with the scientific, social, and economic knowledge needed to understand the complexities of climate issues. This education often goes beyond environmental science departments to include students in fields such as*

> *business, law, agriculture, engineering, and social work. As a result, future professionals in all sectors are trained to incorporate climate-conscious thinking into their work, which contributes directly to climate control efforts. Graduates become advocates for sustainability, incorporating principles of resource efficiency, renewable energy, and environmental protection into industries, government policy, and local practices.*"

Climate-related education programs encourage students to take on leadership roles in sustainability efforts both on campus and in their wider communities. In confirmation of this finding, another student leader said,

> "*Many universities facilitate student-led environmental organizations, where students actively engage in tree-planting campaigns, waste reduction initiatives, and awareness-raising activities. This sense of responsibility and agency extends beyond the classroom, with many graduates entering careers focused on environmental advocacy, policy development, and organizing grassroots. These platforms for public dialogue increase awareness of climate issues and mobilize communities to take collective action. The awareness generated through these programs often leads to community-led initiatives, such as the adoption of climate-smart practices in agriculture, energy conservation efforts, and local campaigns for environmental justice.*"

Universities also play a critical role in influencing national and international climate policy. Through their research and academic expertise, they contribute to the body of knowledge that informs policy decisions on climate control and justice. Climate-related education programs often encourage interdisciplinary research that links environmental science with economics, social justice, and law, providing a comprehensive approach to climate solutions. This research not only supports the development of effective climate mitigation strategies but also emphasizes the importance of social equity, ensuring that the most vulnerable populations are considered in policy-making processes.

5. Discussions

According to findings, universities are at the forefront of research and innovation in climate science, renewable energy, and sustainable technologies. This is in agreement with a report by UNESCO (2017), that universities can contribute to climate change mitigation by developing new technologies, such as clean energy solutions, and by conducting research that informs sustainable practices in sectors such as agriculture, transportation, and energy production.

Researchers at universities in the Global North and South are investigating climate-resilient agricultural techniques that can help reduce greenhouse gas emissions while ensuring food security in the face of changing climate patterns. This research is particularly vital for developing countries, where climate change disproportionately affects livelihoods and economic stability (UNESCO, 2017). Through these efforts, universities play central roles in driving the technological innovation required to achieve global climate targets, such as those set by the Paris Agreement. One of the most significant contributions of universities to climate control is their role in educating future generations of leaders, professionals, and citizens about climate change. By integrating climate science and sustainability into curricula across disciplines, they prepare students to address climate-related challenges in their respective fields. UNESCO (2020) emphasizes the importance of education in empowering individuals to adopt sustainable practices and promote environmental stewardship. Graduates equipped with this knowledge are better positioned to influence climate control measures in sectors such as business, law, engineering, and public policy. For instance, universities in rural areas often work directly with local farmers to implement sustainable agricultural practices that reduce emissions while improving resilience to climate-related shocks. Gulu University is setting examples for climate control through the implementation of sustainability initiatives on its campus. These initiatives, often referred to as "living laboratories," allow the university to experiment and model sustainable practices, such as energy conservation, waste reduction, and the use of renewable energy sources (Filho, 2018). Through advocacy and knowledge dissemination, universities ensure that scientific evidence informs climate policy. According to Filho (2018), universities act as knowledge brokers, bridging the gap between climate science and policymaking. For instance, universities often collaborate with international organizations such as the United Nations to contribute to global initiatives like the Sustainable Development Goals (SDGs), which include targets related to climate action (SDG 13).

Gulu University, like other universities, has engaged in participatory research with rural communities, developing sustainable practices that mitigate climate impacts while improving livelihoods. According to Nakabugo et al. (2018), universities in Uganda have been instrumental in introducing climate-smart agricultural practices in partnership with smallholder farmers in rural areas. Those efforts include promoting drought-resistant crops, sustainable land management techniques, and innovative water conservation methods. Gulu University runs outreach programs that focus on educating rural populations about sustainable practices. For instance, extension services train farmers in climate-resilient agricultural techniques, helping them reduce

crop failure rates due to erratic weather patterns (Nakabugo et al., 2018). Through specialized programs, Gulu University provides training to women on sustainable farming, water management, and renewable energy solutions. Those programs not only help women improve their economic resilience but also empower them to take leadership roles in advocating for climate action within their communities, as also observed by Mfitumukiza et al. (2020). Gulu University has contributed to shaping national discourse on climate justice by providing policymakers with evidence-based research on the socio-economic impacts of climate change. This research is vital for creating policies that address the needs of marginalized communities, such as smallholder farmers and slum dwellers who are particularly vulnerable to extreme weather events about what is stated by Kyazze (2019). Universities work closely with civil society organizations to raise awareness about climate justice and advocate for policies that prioritize the needs of marginalized populations, ensuring that national climate action is both inclusive and fair (Mfitumukiza et al., 2020). Another significant contribution by Gulu University to climate justice is its involvement in developing and promoting green technologies that are accessible to marginalized communities. Several universities, in collaboration with non-governmental organizations (NGOs) and international partners, have introduced renewable energy solutions, such as solar energy, in rural areas that lack access to reliable electricity (UNESCO, 2021).

Furthermore, Gulu University has been instrumental in promoting the adoption of clean cooking technologies, such as improved cookstoves, which reduce indoor air pollution and decrease reliance on firewood, a major driver of deforestation. By making these technologies available to marginalized communities, Gulu University is addressing both environmental degradation and public health issues, while also promoting economic empowerment through energy independence (Kyazze, 2019). Gulu University is also involved in global networks that advocate for climate justice. By participating in international conferences, collaborations, and research projects, Gulu University ensures that the voices of marginalized communities are included in global climate discussions. For instance, academicians have been part of global initiatives such as the United Nations' Sustainable Development Goals (SDGs), which prioritize climate action and social equity (UNESCO, 2021). Through these networks, Universities not only contribute to the global understanding of climate justice but also bring back valuable insights and resources that can be applied to local contexts.

By integrating climate science, environmental sustainability, and climate policy into academic curricula, Gulu University ensures that students are well-equipped with the knowledge required to mitigate and adapt to the effects of climate change. This climate literacy is essential for preparing future leaders who can drive climate control measures in various sectors, including industry, policy, and community development as was noted by O'Brien et al. (2018). For instance, students at Gulu University offering courses on renewable energy, sustainable agriculture, and environmental economics graduate with the capacity to develop and implement strategies to reduce greenhouse gas emissions. These graduates often become advocates for clean energy technologies, conservation, and efficient resource use, contributing directly to climate control efforts as supported by Leal Filho et al. (2019). Climate justice recognizes the disproportionate impact of climate change on marginalized communities, including those in developing countries, low-income communities, and indigenous populations. Through education and awareness programs, Gulu University helps to raise awareness of the social and ethical dimensions of climate change, encouraging students and communities to view climate action through a justice lens as supported by Schlosberg & Collins (2014). Climate justice is increasingly incorporated into environmental science, law, and social science programs, where students learn about the unequal distribution of climate impacts and the need for fair and inclusive solutions. This is in line with Okereke & Coventry (2016). Gulu University is often involved in interdisciplinary research that combines climate science with economics, sociology, and political studies to understand the complex interactions between climate change and society. The knowledge generated through such research informs climate policies and ensures that they are both effective in reducing emissions and equitable in their implementation (Leal Filho et al., 2019). Research often emphasizes the need for targeted interventions in marginalized communities that are disproportionately affected by climate impacts, such as droughts, floods, and heat waves. Gulu University also engages in advocacy efforts, using its academic credibility to influence policy decisions and push for climate justice at the national and international levels. This is also supported by Schlosberg & Collins (2014). By raising awareness about the environmental and social consequences of unsustainable practices, Gulu University helps shift public attitudes toward more sustainable lifestyles. Gulu University engages in public outreach initiatives, such as workshops, seminars, and community projects, aimed at educating the broader public about climate change and encouraging them to adopt climate-friendly behaviours (Barth et al., 2016).

6. Conclusions

According to findings, universities play vital roles in promoting climate control measures through their multifaceted contributions to research, education, advocacy, and community engagement. By generating cutting-edge research and fostering innovation in sustainable technologies, universities provide essential knowledge and tools for effective climate mitigation and adaptation strategies (Leal Filho et al., 2019).

Moreover, universities are instrumental in cultivating climate literacy among students and the wider community, equipping future leaders with the skills necessary to tackle climate-related challenges (O'Brien et al., 2018). Furthermore, by engaging in policy advocacy and promoting sustainable practices on their campuses, universities set examples of climate leadership and accountability (Barth et al., 2016). Their involvement in global networks enhances collaboration and amplifies their impact, ensuring that climate action is informed by scientific evidence and social equity considerations (Schlosberg & Collins, 2014). As the urgency of climate change continues to grow, the contributions of universities will be increasingly essential in shaping a sustainable and resilient future for all.

Universities are pivotal in advancing climate justice initiatives, particularly for marginalized communities. Through community-based research, education, and direct engagement, these universities empower vulnerable populations to understand and address the impacts of climate change on their lives and livelihoods. By promoting sustainable practices, facilitating capacity-building programs, and advocating for equitable policies, universities ensure that the voices of marginalized groups are heard in the climate discourse (Mfitumukiza et al., 2020; Nakabugo et al., 2018). Furthermore, their involvement in global networks amplifies local concerns, highlighting the need for inclusive climate action on an international scale (Kyazze, 2019).

Climate-related education and awareness programs implemented by universities have a transformative effect on both climate control and justice. These programs foster a deeper understanding of the intersection between environmental and social justice, ensuring that climate action is both equitable and inclusive (Leal Filho et al., 2019). By raising awareness and promoting sustainable practices, universities help shape a generation of informed citizens and leaders who advocate for climate control while upholding justice (Schlosberg & Collins, 2024). The integration of climate science and policy, universities are thus essential for achieving sustainable development goals and addressing the global climate crisis fairly and effectively (O`Brien et al, 2018).

7. Recommendations

Universities should continue to incorporate climate education within all academic programs, not just environmental science. This interdisciplinary approach will ensure that all graduates, regardless of their field, are equipped with a fundamental understanding of climate issues and sustainability practices. Universities should prioritize research initiatives focused on the specific climate challenges faced by local communities. By collaborating with community stakeholders, Universities can develop targeted solutions that address local vulnerabilities and promote adaptive strategies.

Universities should create platforms for students to engage in climate activism and innovation, such as funding sustainability projects or providing resources for student-led initiatives. Encouraging student involvement fosters a culture of responsibility and leadership in addressing climate challenges.

Universities should facilitate the distribution of climate adaptation resources, such as sustainable agricultural practices, water management techniques, and renewable energy solutions, to marginalized communities. Collaborating with government agencies and NGOs can ensure that these resources reach those most in need, and vulnerable groups to ensure that their voices are heard in climate action planning. Universities should support student initiatives aimed at addressing climate justice in marginalized communities. By providing resources and guidance, universities can encourage students to lead climate action projects that empower local populations and drive meaningful change. Universities should focus on conducting localized research that explores the effects of climate change on specific communities, especially those vulnerable to climate impacts. By tailoring education and awareness programs to the local context, universities can develop targeted strategies that address both climate control and social equity. Universities should actively engage with local and national governments to ensure that their research and education programs inform policy decisions. Collaborative efforts will ensure that policies aimed at climate control are grounded in scientific evidence and prioritize justice for marginalized communities. Universities should encourage and support student-driven climate initiatives, including awareness campaigns, sustainability projects, and advocacy for policy change. Empowering students to lead will help instill a sense of responsibility and agency in tackling climate control and justice issues.

Finally, the government and all donor agencies should increase funding to universities to enable them to reasonably cater for climate control and justice. The government should strengthen and implement climate control and justice policies; and enforce existing environmental laws. The government and all stakeholders should embrace renewable energy promotion like solar and biogas as well as encourage sustainable agriculture such as climate-smart agriculture (CSA) practices. Government should also empower vulnerable groups like women, youths and communities in climate programs; address the land issues as well as embrace international collaboration to access technical and financial support. They should continuously monitor and evaluate the effectiveness of climate control and justice interventions. While communities should be guided on water resource management; and the meteorological department should guide people on early warning signals to avoid disasters. Universities can collaborate with the government, and all relevant stakeholders in pursuit of their

activities of climate control and justice.

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Quality Improvement Initiatives and Outcomes: A Study of Public Schools in Ghodaghodi Municipality, Nepal

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Abstract

This study aims to identify the challenges and gaps in providing quality education, examines Ghodaghodi municipality initiatives for improvement, assesses their impacts, and offers recommendations for further improvement. The study sampled 15 public schools out of 49, using stratified random sampling. Respondents included teachers, head teachers, parents, students, school management committee, municipal authorities, policymakers, teachers' union leaders, and political leaders — 10 respondents from each school and 25 from municipal policy making sector altogether 175. Information was gathered through surveys, questionnaires, and document analysis using both primary and secondary sources. Since the last five years, municipal budget/ program has been focusing significantly on the areas of infrastructure, materials, ICT, and teacher management. Different levels of government invest on schools without long term plan and vision. So, the facilities at schools are not sufficient and proper. School mapping and student teacher ratio (STR) is not properly maintained. Teachers participated in professional development activities, but the effectiveness was rated as average. They identified a need for further development in subject matters, special needs education, and ICT skills. School supervision was found to be less effective, below the average. Teachers rated the overall school quality as average. Policymakers faced challenges such as budget constraints, employee indifference, and teacher politics affecting quality improvement programs. Based on the findings and conclusion, the research has recommended some improvements in the areas of restructuring schools, maintaining STR, infrastructural modernization, visionary academic leadership, teacher incentives, TPD opportunities, monitoring and evaluation, and the like.

Keywords: Ghodaghodi municipality, public schools, quality education, quality improvement initiatives, restructuring schools

1. Introduction

In recent years, quality education has become a global priority. Governments and educational institutions are continuously seeking effective strategies and initiatives to improve the quality of education. However, many public schools in developing countries face challenges in providing quality education due to various factors such as limited resources, inadequate infrastructure, and a lack of trained teachers. Ghodaghodi municipality in Nepal represents one such region where public schools encounter numerous obstacles in delivering quality education.

So many initiatives in the past have been made for socially inclusive schools, gender sensitiveness, child centered learning, mother tongue instruction, school as peace zone, strengthening early childhood development, promote gender equity, education for all and so on. While numerous initiatives have been implemented globally to improve the quality of education, it is essential to evaluate their effectiveness in specific contexts. This study

seeks to measure the outcomes of Ghodaghodi municipality reform initiatives like municipal strong exam system, school merger, mother tongue instruction, model school policy, free school education and so on.

Teachers are strongly seen as political groups. Are they accountable to professionalism and academic career growth? If not how to make them accountable and how their beliefs about teaching learning can be changed is the serious concern. The shift from classroom teaching to individual students is the need of the time for expected quality. The problem of not learning — in central and south Asia 81% (Brinkmann, 2018, p. 2) — massive dropout rate, rigorous national assessment systems are to be considered while making education policy at local level. This research highlights the need to investigate the effectiveness and impact of quality education improvement initiatives implemented in public schools within Ghodaghodi Municipality, with the goal of informing future educational policies and practices.

The areas of problematics demand exploration on the questions like what specific improvement initiatives implemented in public schools in Ghodaghodi municipality; what challenges and barriers are faced by public schools in implementing quality education initiatives; what outcomes/ impacts of the initiatives are witnessed on student learning, school infrastructure, teaching method, and parental involvement; and how the effectiveness of the initiatives can be enhanced for the further improvement of quality education in Ghodaghodi municipality. So, the objectives of this research have been set forth to identify the initiatives implemented by the municipal education authorities; to identify the current challenges and gaps in providing quality education in public schools; to assess the outcomes/ impact of these initiatives on the quality of education; and to provide recommendations for further improvements in education quality based on the findings and conclusion.

2. Literature Review

New constitution of Nepal has brought significant transformation in the area of school education development. It falls under the jurisdiction of municipal government. Municipalities can formulate quality improvement framework, plan, and deliver results with the involvement of local communities. However, Neupane (2020) has pointed out some limitations that local government without strong institutional back up and the lack of “know how, expertise, resources, and regulatory framework” (p. 89). Changed context has also created significant opportunity on the one hand and challenge on the other in one such area where quality education improvement initiatives are crucial for enhancing the educational outcomes of students.

Neupane (2017) has made investigation on the barriers in quality education in rural Nepal to be “caste, religion, ethnicity, and gender based diversity” (p. 70). Phyak and Ojha (2019) have also pointed out the need to address the inequalities for quality education. Studies in the past have pointed out the need to address diversity and disparity. It has been treated as a barrier. Now the time has come for paradigm shift in research and way of thinking for bringing about transformation in the area of quality education.

Brinkmann (2018) has prepared a review report for UNICEF’s efforts in improving education quality in South Asia. She has highlighted some recent shifts like children friendly school to children’s access to quality learning, learning outcomes to quality inputs, and child centered to learning centered education. Joshi (2010) has also investigated on the effectiveness of teacher training in Nepal — on the one hand, knowledge and skill accumulated from training is not sufficient, and on the other, transfer of the skills in the field heavily depends on teachers’ attitude, thinking and ideal, affected by internal and external world of the school. Bhattarai (2015) has identified ethics of educational administrators to be the significant factor for forming healthy atmosphere at school. Ethics need to be defined within the school setting coping with local culture and context. Ethics helps in healthy growth and development of an institution.

Itegi (2016) has made investigation on Kenya’s strategic planning of school, practiced as capacity development of education managers, and working as a tool for systemic quality improvement. But what Itegi (2016, p. 952) has observed is something different: “majority of schools have strategic plans in Kenya as formality to meet policy requirement but not to guide their operations”. Hired consultants can make strategic plans on the part of school to meet policy requirements but it lacks the spirit of potential implementation into action. In the case of Nepal also School Improvement Plan (SIP) and its status has to be observed.

3. Quality Education Reviews

Among 17 sustainable development goals (SDGs) set by the UN, SDG 4 was added in 2012, which aims to ensure inclusive and quality education for all and promote lifelong learning (Government of Canada, 2021). According to the goal, quality education helps reduce inequality, fosters tolerant and peaceful societies. Millions of boys and girls are now in school, which does not necessarily mean that they are learning. Barrett & Tikly (2012) from university of Bristol conducted quality education research program in low-income countries, identified three levels of environment; “policy environment, institutional environment, and home and community environment” that determine the quality of education.

Recent education reformation in Delhi, since 2015, has received considerable critical acclaim. Raghunath (2020)

has reviewed the book written by the reformer and Education Minister of Delhi government; “the success of educational system of any country lies in the hands of its teachers and the training they receive to create inclusive and equitable society, the manner in which they interpret the text book, the way the text books are created” (p. 90). Happiness curriculum, modernization of school infrastructure, and massive increment in education budget are some of the pivotal aspects of the improvement in Delhi. Classrooms have been transformed into resourceful and inspirational. Teachers’ salaries have been increased. Parents, teachers, and students respect the system with deeper involvement.

Directorate of Education (2017) states the outcomes of Delhi education reformation — the pass percentages have been improved from 52 to 57 in 2017 in comparison to 2015. The outcomes have been witnessed as a result of reading campaigns, summer camps for slow learners, happiness curriculum, quality classroom activities, time with happiness period every day, and so on (p. 7). The principals in Delhi schools visited Cambridge University and Finland to understand school education model in the respective countries (p. 12). The government has recruited 200 mentor teachers to look after 5 to 6 schools each.

Barrett et al. (2006) have explored multiple meanings of quality. In some countries, educating people in institutionalized setting itself is the indication of quality. Ideological and socio-political values also affect quality markers. They have reviewed two dominant traditions within quality discourse: economist view of education and progressive humanist tradition (p. 2). The former uses quantitative measurable outputs like enrolment ratio, retention rates, rates of return on investment in terms of earnings and cognitive achievement. The latter is based on what happens in schools and in classrooms — learner centered pedagogy, democratic school governance, and inclusion.

UNICEF (2006) has sought consensus around the basic dimensions of quality education. The learner must be healthy, well nourished, ready to participate and learn, and supported by family and community. The trained teachers are to use child centered approaches in the well-managed classrooms and schools. The outcomes related to knowledge, skill, and attitude to be linked to national goals of education and positive participation in society (p. 4). UNICEF definition of quality education thus focuses on the dimensions like quality learners, learning environment, content, process, and outcomes (p. 5).

Quality education discourse, improvement initiatives in low-income countries, and Delhi education improvement initiatives and positive outcomes suggest that it is a complex process. The countries working on improvement of quality education consider education to be investment rather than expenditure, this sector needs huge increment in budget. Schools and classrooms are to be equipped with technology and materials.

4. Methodology

In order to achieve the goal of this research, Ghodaghodi municipality plan, policies, programs since last five years have been analyzed in the light of quality education discourse. Tools include survey, questionnaires, and document analysis. A representative sample of public schools within Ghodaghodi municipality was selected using stratified random sampling. The sample included a diverse range of schools in terms of type, location, size, and performance. The schools were divided into four clusters according to their level: schools with classes 1-12, 1-10, 1-8, and 1-5, their total numbers being 8, 10, 19, and 12 respectively. Fifteen schools were selected (choosing 2, 3, 6, and 4 samples respectively from schools with classes 1-12, 1-10, 1-8, and 1-5) so as to ensure proportional representation from each cluster. Ten respondents from each school were selected comprising teachers, students, guardians, management committee members, and head teacher. Moreover, municipal authority, policy makers, teachers’ union leaders, political leaders altogether 25 respondents were included in the sample. In this way sample size for the study in total was 175.

Primary data like condition of infrastructure, technology, and teaching materials have been obtained from observation of sample schools. Questionnaire containing rating scale, closed ended, and open ended questions to sample school respondents have been used to collect primary data. Survey sheets for schools, questionnaires for municipal authorities at policy level have also been used for collecting primary data. Quantitative data have been analyzed using descriptive statistics, while qualitative data are subjected to thematic analysis.

5. Presentation and Discussion

5.1 Municipal Initiatives for Improvement of Quality

There are eight big secondary schools with classes 1-12, ten secondary schools with classes 1-10, nineteen basic schools with classes 1-8, and twelve primary schools with classes 1-5. The table below shows the number of schools that receive allocated budget under different topics by the municipality in the last five years, among all 49 total numbers of public schools.

5.1.1 Budget Allocation for Educational Reformation in Public Schools of Ghodaghodi Municipality

Among eight big secondary schools in the municipality, the biggest three in terms of student numbers (Kanti,

Taranagar, and Sukhad with 1854, 1514, and 1451 students respectively) have received both model school and big school status grants. One more school (Dashrath with student numbers 1142) has received the central government model school grants. Two more such types of schools, Harinagar and Ganeshpur, with student numbers 1157 and 734 respectively, have received big school status. Student numbers in these six schools range from 734 to 1854. Remaining two schools (Ambasa and Birat with student numbers 634 and 223 respectively) have not received the grant in the topic of model school or big school so far. All of eight schools have Science laboratory, ICT, and library established within the stated five years or before that. All of the eight schools have sufficient numbers of buildings, classrooms, toilet, and drinking water; however, all the infrastructures are crowded, traditional, and less spacious, constructed without any long-term master plan. One model school selected in central government list has master plan of construction. Among all four clusters of schools, a massive amount of municipal budget is being allocated to teacher management.

Among 10 secondary schools (classes 1-10), the biggest three in terms of student numbers (Belar, Dipnagar, and Rampur with numbers 721, 704, and 614 respectively) have received ICT, Science laboratory, and library grants from municipality or upper level of government. Rampur, Sundarpur, and Nakfodua with student numbers 614, 571, and 350 respectively have received municipal model school grants so far. Among ten schools under this cluster nine have received one or two benefits from ICT, Science laboratory, and library. One school has received all of them and one school has received none of them. All the schools in the cluster are satisfactory in physical infrastructure but here also the quality of them is not proper.

Table 1. The number of schools receiving grants in the stated topics in the last five years

Budget allocation topics	Fiscal Year BS				
	2075-76	**2076-77**	**2077-78**	**2078-79**	**2079-80**
			1-12 Big schools		
Science laboratory	-	-	2	2	-
Library	1	-	2	-	-
ICT	2	-	3	3	-
Building	-	4	3	2	1
Toilet	1	-	2	-	-
Water	-	1	-	-	-
Teacher management	-	-	5	1	-
Model school	3	-	4	1	-
Big School	-	-	4	1	-
Special school	-	-	1	1	-
			1-10 Medium schools		
Science laboratory	2	1	-	2	2
Library	2	-	1	-	2
ICT	1	3	-	3	1
Building	1	1	6	2	1
Toilet	-	2	-	-	-
Water	-	3	-	-	-
Teacher management	-	1	9	9	-
Model school	3	-	1	-	-
Wall	-	1	3	-	-
Ground	-	2	2	-	-
Teaching materials	2	-	-	-	-

Source: Adapted from Ghodaghodi Municipality annual educational status report 2079-80 BS.

In the same way, both types of schools, basic and primary, are seen to be supported with similar grants titles. Among 19 basic schools, 10 schools under basic cluster have received model school grants by the municipality

two times. Out of the total under this cluster 17 schools have received ICT and / or teaching materials grants. In the same way considerable numbers of schools have received wall and ground. The schools under primary school cluster also follow similar tendency. The physical and teaching-learning infrastructural support to schools by different levels of government shows that schools have access to necessary facilities in the area but not sufficient and proper.

5.2 Description of Principals

Principals are the academic leaders for schools. They are to be highly ethical, qualified, responsible, and accountable. They are responsible for developing schools as a centre of excellence. Ghodaghodi municipality 49 public school principals are described in the following table:

Table 2. Description of principals in schools

	Description	School type			
		Secondary 1-12	Secondary 1-10	Basic 1-8	Primary
Qualification of principals	School level	0	2	7	1
	Bachelors'	1	5	8	10
	Masters'	7	3	4	1
	Higher secondary	0	0	-	-
Level of service	Secondary	6	0	-	-
	Lower secondary	2	1	4	-
	Primary	0	9	15	12
Type of service	Permanent	5	5	6	2
	Temporary	3	5	13	10

Source: Municipal data on principals of public schools, 2080 BS.

In terms of qualification, seven principals among eight big secondary schools have required qualification for the level. Among eight principals six are found to be employed for secondary level and two for lower secondary level. In terms of the type of service also five principals are permanent and three are temporary for the job of teaching. Schools in the second cluster also portray even serious picture. Only three principals out of ten have required qualification for the level. None of the principals under second cluster are qualified in terms of the level of service, since nine of them belong to primary level and one of them is in lower secondary level.

Description of principals in 19 basic schools also depicts the same picture as above. According to the data 36% of the principals in basic schools do not have required qualification for the post. More than 78% of the principals in the same clusters are found to have appointed in the primary level. The only data that looks satisfactory in terms of the stated topics is about the primary school principals.

5.3 Description of Teachers

Job security is essential for employee satisfaction from work. Job satisfaction affects in performance as well. Isn't it a matter of shame for a country that its employees are working in the status of relief post or any sort of temporary status throughout their life? They get low salary to comparable government jobs. When they get out of the job in retirement, they receive nothing.

Table 3. Teachers posts in municipality public schools

Level	Types of teachers' posts				
	Permanent	Relief post	Municipal grant	Central grant	Total posts
Primary 1-5	75	118	23	-	216
Basic 6-8	20	51	45	12	128
Secondary 9-10	10	30	13	16	69
Secondary 11-12	-	21	-	-	21

Total	105	220	81	28	434

Source: Adapted from Ghodaghodi municipality annual educational status report 2079-80 BS.

The above table shows that among the total of 434 teachers, 76% are different sorts of temporary teachers. Relief teachers do not get benefits like grade incentives, leave facilities, promotion opportunities, and the like. It is human tendency that without job security or hope for the future growth of the post, they are unwilling to perform with higher level of energy. Municipality allocates its large portion of education budget on teacher management every year. But the salary the teachers on municipal grants get is shameful, far below even the teachers on relief posts. Since teachers are the drivers for the implementation of quality education initiatives, best people must be attracted to the profession. In Delhi, for example, as reviewed earlier, the major part of transformation has been observed in the areas of teachers, their attractive salaries, training, about tenfold increment in education budget, and so on.

5.4 Student Data in the Year 2080 in Public Schools of Ghodaghodi Municipality

Table 4. Student teacher ratio

Description	Student numbers	Teachers for the level	Student teacher ratio
Classes 1-5	6624	216	31:1
Classes 6-8	5599	128	44:1
Classes 9-10	4270	69	62:1
Classes 11-12	2227	21	106:1
Total	18720	434	43:1

Source: Adapted from municipal data on students and teachers, 2080 BS.

Student teacher ratio, as a whole, has been observed to be tolerable but the observation of individual schools reveals that it has drawbacks. There is not fair distribution of number of teachers and students. In primary level the ratio is seen lower in comparison to the higher levels. The ratio has been observed highest in classes 11-12. Classes 1-5 are in all of 49 schools; classes 1-8 in 37 schools; classes 1-10 are in 18 schools; and classes 1-12 are in 8 schools only. So, the ratio also appears unequal. For maintaining equal ratio at all levels, classes 1-5 can be withdrawn from both 1-10 and 1-12 big schools. Three types of schools can be developed, namely, 1-5, 6-8, and 9-12, on the basis of proper mapping. When many schools are merged, even 1-5 types of schools can be big schools with transportation and other sorts of facilities.

5.5 Ward Wise Description of Schools in Ghodaghodi Municipality

Table 5. Ward-wise description of schools in Ghodaghodi municipality

Ward Numbers	Type/numbers of schools and per school student ratio (Sc-St)							
	1-5	(St-Sc) Ratio	1-8	(St-Sc) Ratio	1-10	(St-Sc) Ratio	1-12	(St-Sc) Ratio
1	2	76:1	-	-	2	614:1	2	814:1
2	1	88:1	1	233:1	-	-	1	1044:1
3	-	-	4	212:1	-	-	-	-
4	2	78:1	3	236:1	1	584:1	1	693:1
5	1	42:1	2	267:1	1	368:1	1	1116:1
6	-	-	1	431:1	1	404:1	-	-
7	-	-	2	209:1	-	-	-	-
8	3	100:1	2	494:1	1	670:1	1	1505:1
9	1	71:1	1	173:1	2	300:1	-	-
10	-	-	2	196:1	1	322:1	1	1800:1
11	1	74:1	1	174:1	-	-	1	609:1
12	1	21:1	-	-	1	327:1	-	-

Total	12	75:1	19	258:1	10	450:1	8	1049:1

Source: Adapted from 2080 BS municipal data on schools and the number of students in them.

Table 5 shows even amazing picture of student school ratio in different types of schools in all wards of the municipality. The picture of primary schools is compelling. Per school student numbers in these schools has been observed from 21 to 100 which is total waste of resources. Either the policy is to help increase the number of students in such schools or to collapse the school altogether.

5.6 Students' Response on Quality of Public Schools

5.6.1 Available Technologies and Infrastructure at School

For our study we selected 15 sample schools. From each school there were three student respondents. One of the responses in the questionnaire was about the availability of different facilities and learning infrastructures at school. The following table shows the responses from the students:

Table 6. Available technologies and infrastructure at school

Facilities	Excellent	Good	Mediate	Bad	Very Bad	Mean	S.D	N
Science lab	6	8	13	4	14	2.73	1.4	45
Computer lab	5	10	19	5	6	3.07	1.14	45
Library	11	7	14	2	6	3.38	1.34	40
Sports	22	13	6	4	-	4.14	0.97	45
ECA	19	10	8	2	3	3.95	1.21	42
Toilet	23	10	10	1	1	4.18	1.0	45
Safe drinking water	20	11	14	-	-	4.13	0.86	45
Sanitary pad	23	11	3	1	-	4.47	0.75	38

Source: Primary data collection by the researchers.

In the above table, there are five different scales for respondents to rate. Students responded higher than average in all facilities available at school except the facility of science lab with standard deviation of 1.4, indicating the higher variability in response. The table depicts sports, toilet, drinking water and sanitary pad facilities are likely to be available at schools and the standard deviation is lower regarding the availability of those facilities.

5.6.2 Club Activities and Satisfaction Level

In the study, we included a question about the availability of club activities, Scout, and Red Cross at school, and students' satisfaction on the activities. The responses showed 80.8% having Red Cross, 48.8% eco-club, 46.6% scout, and 44.4% child club in their schools. The level of satisfaction on existing institutions seems more than average on the activities of scout and child club with standard deviation of 1.03 and 0.97 respectively. Having the high availability of Red Cross, i.e., mean value of satisfaction on its activities is 2.46 with standard deviation 1.26.

5.6.3 Use of Teaching Materials in Classroom

One of the affecting factors of quality learning is the proper use of teaching materials in the classroom. In this study, students were asked about the use of different teaching materials, and the responses were recorded in a four point rating scale. Majority of the schools use traditional teaching, more than average schools (mean value of 3.8) use white board and black board in teaching with standard deviation of 0.54 in responses, and other materials (computer, projector, audio-visual, digital board, photo, newspaper, word card, sentence card, and demonstration) are used below the average with lower standard deviation in responses. This shows that most of the schools are not ready to adapt with new technology and innovative teaching.

5.6.4 Teaching Methods in Classroom

During the study, students were asked about the methods used by teacher in the teaching learning process. The responses were recorded in the 5 point Likert scale with the mean value of 3. Among 45 respondents (students), more than average number responded that their teachers used discussion, self-study and lecture methods with mean value of 3.2, 3.0 and 2.9 respectively with the standard deviation with 0.9, 0.83 and 0.95. It was found that majority of the teachers used discussion methods. Role play, demonstration, lab work seem to be rarely used

methods in teaching.

5.6.5 Subject Wise Understanding Level

To identify the subject wise understanding or satisfaction level of students, they were asked to provide their responses in five-point Likert scale. It was found that students' satisfaction level in all subjects to be above the mean value with lower standard deviation. According to the responses, the highest level of satisfaction was recorded in Nepali with an average value of 3.84 and standard deviation 0.42 followed by mathematics and science with mean value 3.62 and 3.47 and the standard deviation of 0.53 and 0.65 respectively. The lowest mean value was found for English (3.22) with standard deviation 0.76.

5.7 Teachers' Response

Teachers are considered as the drivers for quality enhancement in schools. Altogether 45 teachers including head teachers participated from the selected 15 schools for this study. Their responses were recorded in Likert scales.

5.7.1 Involvement in Teachers' Professional Development in Last 2 Years

Majority of participants took part in course dissemination (62.79%), indicating that it is the most accessible or frequently offered activity. But its effectiveness was rated to be average. Workshop and subject teacher network both have participation rates of 51.22%. The lowest participation rate is in additional degree (32.35%). Mean values of effectiveness for workshop (3.08) and subject teacher network (3.09) are also perceived more than average (2.5). Other school visit (2.88) and supervision/ peer observation (2.89) have lower effectiveness scores in comparison, indicating mixed or less favorable experiences.

5.7.2 Need of Teachers' Professional Development

According to the 4-point Likert scale responses, ICT Skill has the highest mean score of need (3.51). This reflects the increasing importance of technology in education. Special need students' pedagogy (mean value 3.43), subject matter and presentation (3.22), and students' counseling (3.18) also show high perceived needs. Teaching in multilingual context (3.16) and school management/ administration (3.10) reflect the need for skills in diverse teaching environments and administrative capabilities. Classroom management has the lowest mean score (2.82), Instructional Practice (2.98) and knowledge/ understanding of subject (3.00) show moderate needs.

5.7.3 Supervision, Evaluation, Feedback and Reward to the Teacher

This response was also recorded in a four-point Likert scale. The scales recorded for supervision were monthly, quarterly, annually, and never by the head teachers, SMC, parents, and school inspector. Most frequent supervision by head teachers is monthly (53.57%), with a mean score of 2.0 indicates that they are moderately involved in supervision, evaluation, feedback, and reward activities. The mean score for SMC was observed 2.41. Quarterly supervision by PTA is the most frequent (31.71%), with a mean score of 2.54 which reflects their higher perceived involvement in evaluation processes. The highest percentage falls under "Never" (43.18%), but there is significant annual involvement (34.09%), with a mean score of 2.43. The analysis of this part shows diverse involvement by different responsible parties. Head teachers and SMC are more regular in their interactions, whereas guardians and school inspectors provide less frequent supervision and feedback. Policy makers also responded that there was doubt in the effectiveness of inspection and supervision.

5.7.4 Self-Assessment of Existing Quality of School

For the self-assessment of existing quality by the teachers 5-point Likert scale was used to record the response. The assessment showed the higher mean scores in teachers' regularity (4.21), human resource (3.56), ECA/ students' participation (3.82), and physical infrastructure (3.51). Parents' education received the lowest mean score (1.91), suggesting a need for enhanced parental involvement and support. Teachers' workload and ICT also received relatively lower mean scores 2.88 and 3.0 respectively, indicating potential areas for improvement in workload management and integration of technology. The self-assessment reveals both strengths and areas for improvement. While aspects like teachers' regularity and human resource are perceived positively, there is room for enhancement in areas such as parents' education, teachers' workload, and ICT integration.

Majority of teachers perceive the quality of education in their own school as "Average" (59.09%). A significant portion also perceives it as "Good" (29.55%), while very few rate it as "Poor" (9.09%). None rated the quality as "Very Poor". The mean score of 3.23 in a 5-point Likert scale indicates that teachers rate the quality of education in their school slightly above average, leaning towards good.

To record the response under challenges in quality education, 4-point Likert scale was used. Inadequate budget has the highest mean score (3.12), indicating it is perceived as the most significant challenge by teachers. Lack of physical facilities (2.67) and weak government policies (2.59) also have relatively high mean scores. Weak leadership of school has the lowest mean score (1.88), suggesting it is perceived as a lesser challenge in comparison to other factors. The data suggests that the most significant challenges perceived by teachers are

inadequate budget, lack of physical facilities, and weak government policies.

5.8 Policy Makers' Perspective

To collect responses from policy makers, we prepared questionnaire for the respondents comprised of Mayor, Deputy Mayor, Ward Chairpersons from all 12 wards of Ghodaghodi municipality, municipal Chief Executive Officer, two officials from municipal education unit, four political parties' leadership representing the municipality, and four teachers' union leaders.

5.8.1 Challenges Faced in Implementation of Program

The policy makers were asked what challenges they faced in the implementation of the policies. The response was represented in 5-point Likert scale. Majority of them responded lack of budget as the main challenges in implementation of the policy. More than average (4.12) found the budget factor as the challenge of policy implementation with standard deviation 0.83. Lack of visionary policy (3.73), indifferences of employees (3.4), and teacher politics (3.24) were also pointed out as obstacles of policy implementation, whereas the cause of weak academic leadership (2.9) and obstacles by political parties (2.25) in the implementation of policy was responded by below average respondents.

5.8.2 Evaluation Check List of Quality Indicators at School

Policy makers were asked to evaluate the existing aspects based on a checklist in a 5-point Likert scale with average mean value of 3. The evaluation checklist consisted of 10 different indicators related to quality education. Out of 10, only two indicators, i.e., school merger needs/ student teacher ratio adjustment (4.12) and sufficient teaching manpower (3.18) are seen to have responded higher than mean value. All other indicators (ICT literacy of teachers, teacher regularity and quality classroom time, teaching plan/ teaching materials use, parent participation, appropriate policy and implementation, complaint address and student support, teachers' professional satisfaction, and parent education) are found to have responded with less than average rating. The indicators like parent education (1.59) and complain address and student support (1.88) are found to have rated with very low scales. The responses seem to be found most scattered in the indicators school merger/ student teacher ratio adjustment and teachers' professional satisfaction, however, the responses are seen to be least scattered in the indicators parent education and complaint address/ student support.

5.8.3 Satisfaction Level of Respondents with the Outcomes

Policy makers were asked to rate their satisfaction, in a 5 point Likert scale, on the outcomes of efforts made for the quality improvement of schools. The result showed policy makers were not very much satisfied with the outcomes of the efforts for educational quality of schools. Out of total respondents, 59 percent chose the third rating category and 41 percent chose the second rating category, with overall mean value of satisfaction 3.8 which is more than average.

6. Findings and Conclusion

Some wards in the municipality have multiple schools located close to each other with declining student numbers. The current setup results in inefficient resource utilization, especially in primary schools where student numbers range from 21 to 100 per school, indicating a potential waste of resources. This uneven distribution leads to unequal student-teacher ratios across different school levels. While the overall student-teacher ratio is tolerable, individual school observations show significant imbalances. Number of students in primary level (1-5) is 35% of the total students in 49 public schools in the municipality. Whereas in 6-8, it is 29%, in 9-10, 22%, and in 11-12, it is 11%. But the primary level face scarcity of students and classes 11-12 are most crowded. The reason behind this uneven distribution of students is that classes 1-5 are in all 49 schools, 6-8 in 37 schools, 9-10 in 18 schools, and 11-12 in 8 schools. Student teacher ratio is seen appropriate in classes 6-8 only.

Students rated most facilities above average, except for science labs. Facilities such as sports, toilets, drinking water, and sanitary pads are widely available. Physical infrastructure across the schools is generally adequate but not modernized, indicating a need for improvements in building design and space utilization. Basic and primary schools have received grants for ICT, teaching materials, and infrastructure improvements. Despite these efforts, the facilities provided are not sufficient or properly maintained, indicating a gap between the allocation of resources and their effective utilization.

Principals must be ethical, qualified, responsible, and accountable. They are responsible for developing school as centre of excellence. But in Ghodaghodi municipality, among 49 principals, only 33 have required qualification for level of school, only 18 principals are permanent teachers for the job, and 27 are appointed to the lower levels than the level of school they lead. When a principal lacks required qualification, (s)he does not gain authority for the proper exercise of power.

A significant proportion of teachers (76%) are employed in various temporary types of job. This indicates the prevalence of job insecurity, lower salaries, and lack of benefits (leave facility, provident fund, grade facility, job

promotion, retirement fund, and pension) compared to permanent positions. The high rate of temporary employment affects teacher morale and performance, ultimately impacting the quality of education. The municipality allocates a large portion of its education budget to teacher management, but the funding is insufficient to ensure quality education. Teachers are the drivers for the implementation of quality education initiatives. Best people must be attracted to the profession by bringing about transformation in the areas of attractive salary, training, and other benefits.

ICT skills and special needs pedagogy are the highest priority areas for teacher development. Subject matter expertise, counseling, and multilingual teaching also show significant needs, reflecting the multifaceted nature of teaching competencies required in modern education. Traditional teaching methods dominate, with most schools using whiteboards and blackboards. More demanding teaching methods like role play, demonstration, project work, and lab work are underutilized. Discussion, self-study, and lecture methods are used more frequently.

SMC, PTA, representatives, and school inspectors must provide frequent and impactful supervision and feedback. Most respondents favored regular inspection and supervision although some were skeptic about the effectiveness of these measures.

The overall quality of education is compromised due to insufficient resources, inadequate infrastructure, lack of qualified principals, and a high percentage of temporary teaching staff. Inadequate budget has been perceived as the most significant challenge. Lack of physical facilities and vague government policies also posit considerable obstacles. A significant majority of policymakers identified the lack of budget as the primary challenge in policy implementation. Additional challenges include the lack of visionary policies, employee indifference, and teacher politics. There are notable challenges in parents' ability to guide their children's learning.

7. Recommendations

1) **School merger**, **restructuring school levels, STR maintenance**: Conduct proper mapping to identify optimal locations for schools, ensuring sufficient number of students. Consider merging smaller schools, to create larger, more resource-efficient institutions. Implement a restructuring of school levels to create three school types: 1-5, 6-8, and 9-12, three big schools in each ward of the municipality, at most 36 schools in 12 wards of the municipality for the available student number at present. This can help balance the student-teacher ratio across all levels, if some teachers' posts are added to the 9-12 level.

2) **Develop long-term infrastructural modernization plan for all schools**: Different levels of government support physical and teaching learning infrastructure, but the investment is not proper and sufficient. So, it is suggested to formulate and implement long-term master plans for all schools, similar to the central government model school, to ensure sustainable and well-planned development of school infrastructure, including transportation or residential facilities.

3) **Enhance principal qualifications and employment status**: Implement policies to ensure school principals meet the required qualifications and are employed permanently to enhance leadership ethics, accountability, plan, and vision. Provide professional development and training programs for principals to improve their leadership skills and educational management capabilities.

4) **Job security, TPD opportunities, and benefits for teachers**: Convert temporary teaching positions to permanent ones to improve job security and morale among teachers. Increase teacher salaries and provide benefits comparable to other government jobs to attract and retain quality educators. Invest in TPD, to improve their knowledge and skills, to deliver high quality education, and to help teachers stay updated with the latest educational practices and technologies.

5) **Continuous monitoring and evaluation**: Establish a robust system for monitoring and evaluation whether the quality improvement initiatives are well implemented, or the resources are effectively utilized. Establish a system for continuous monitoring and evaluation of student-teacher ratios and resource allocation to ensure ongoing improvements and adjustments as needed. Engage with stakeholders, including teachers, parents, and community members, in the monitoring process to ensure transparency and responsiveness to community needs.

6) **Improve home learning environment**: Ensure that all students have access to basic learning facilities. Provide additional support and resources to parents to enhance their ability to guide their children's learning at home. Develop programs to increase parent-teacher interactions, emphasizing the importance of regular communication between parents and educators.

7) **Clubs and extracurricular activities**: Encourage the establishment of Eco clubs, scout, Red Cross, and child clubs in all schools to enhance engagement and personality development of the students. Provide ECA opportunities and resources.

8) **School is an ideal place**: School is also to be dedicated to enhance ethics, morality, and good practices.

Teachers are people with high morale, role models for students to be imitated. Students store the memories related to school in their mind and remember their ideals throughout their life, wherever they go or whatever they may do.

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From Informal Learning to Formal Recognition: Policy Perspectives on Integrating Micro-Credentials into EQF-Aligned Vocational Education

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Abstract

As the European workforce navigates a rapidly changing skills landscape, the need to recognize learning beyond traditional education structures has become increasingly urgent. This paper explores the strategic role of micro-credentials in bridging informal and non-formal learning with formal vocational education and training (VET) systems, particularly in alignment with the European Qualifications Framework (EQF). Drawing on current EU policy developments, institutional practices, and emerging quality assurance mechanisms, the study outlines how micro-credentials can be embedded into national qualification systems, mapped to learning outcomes, and validated with trust and transparency. Special attention is given to stakeholder engagement, system readiness, and policy innovation, offering actionable recommendations for establishing a coherent and scalable micro-credential ecosystem. The findings underscore the potential of micro-credentials to support lifelong learning, enhance employability, and promote inclusive education systems across Europe.

Keywords: micro-credentials, informal learning, vocational education and training (VET), European Qualifications Framework (EQF), non-formal education

1. Introduction

In today's rapidly evolving labor market, informal learning has emerged as a vital dimension of vocational competence development. Unlike structured, institutionalized education, informal learning occurs outside traditional classrooms—through work experience, self-study, community engagement, and increasingly, digital platforms. Its relevance is underscored by the growing demand for adaptable, job-ready skills that cannot always be acquired through formal education alone.

The World Economic Forum estimates that by 2025, 50% of all employees will need reskilling due to the rise of automation and digital transformation, yet many of these skills are acquired informally or non-formally through on-the-job learning or online modules (World Economic Forum, 2020). For vocational education systems, this shift highlights a pressing need to integrate and recognize these alternative learning pathways.

Moreover, the European Centre for the Development of Vocational Training (Cedefop) emphasizes that informal learning plays a key role in upskilling low-qualified adults, especially in sectors with high levels of experiential knowledge like construction, caregiving, and hospitality (Cedefop, 2022). Without mechanisms to validate this learning, such individuals often face barriers to mobility and career advancement despite substantial skill mastery.

The growing mismatch between formal credentials and real-world capabilities has prompted policy-makers to consider how informal learning can be better mapped, validated, and integrated into structured frameworks like the European Qualifications Framework (EQF). In doing so, vocational education systems can enhance

inclusivity, promote lifelong learning, and respond more effectively to labor market needs.

2. Framing Micro-Credentials within European Education Policy

2.1 Clarifying Definitions and Functional Characteristics

As the digital and green transitions accelerate, European policy has increasingly emphasized the need for flexible, inclusive, and learner-centered education systems. Micro-credentials have been positioned as a core mechanism to support this shift, offering an alternative to traditional long-cycle qualifications. However, their successful deployment requires a shared understanding of what micro-credentials are—and what they are not.

The European Commission's Council Recommendation on micro-credentials (2022) proposes a working definition that is both inclusive and policy-ready: micro-credentials are short, focused learning experiences that lead to assessed and validated learning outcomes, which are then documented and shareable through trusted systems such as Europass. This definition underlines the importance of:

- Structured learning outcomes, aligned with qualification frameworks or industry-defined skill sets;
- Formalized assessment, ensuring that the credential represents more than just participation;
- Clear metadata, including information on issuer, workload, level, and validation method, fostering comparability and trust.

Crucially, micro-credentials are intended to be purposeful and demand-driven, designed in response to skills shortages, technological shifts, or learner mobility needs. The OECD (2021) noted that well-designed micro-credentials could help governments respond rapidly to emerging labor market needs, particularly in areas where full degrees are unnecessary or inefficient.

Micro-credentials also align well with European lifelong learning policy, serving workers, job seekers, and marginalized learners who may not otherwise engage with traditional education systems. As of 2023, over 30 pilot projects across EU Member States have explored their application in continuing vocational education and training (CVET), including digital literacy, sustainable construction, and advanced manufacturing (ETF, 2023).

In practice, their modularity enables stacking or bundling into larger qualification pathways, allowing for personalization and progressive learning. For example, an individual might earn micro-credentials in data analysis, cloud computing, and cybersecurity—each with a distinct outcome—before combining them into a more comprehensive ICT certification pathway.

2.2 Distinctions from Other Digital Certifications

To ensure policy effectiveness, it is critical to distinguish micro-credentials from other forms of digital certification that have proliferated in online learning ecosystems. While digital badges, MOOCs, and certificates of attendance contribute to recognizing participation, they typically lack assessment rigor, alignment with formal qualifications, or standardized metadata that support recognition and portability.

Digital badges, for instance, are often used to signal soft skills, achievements, or participation in informal activities (e.g., attending a workshop or volunteering). However, these badges vary widely in credibility and are not always based on measurable learning outcomes. Open badges, created by platforms such as Mozilla, aim to promote transparency, but their uptake in formal education remains limited due to the absence of quality assurance or regulatory alignment.

MOOC certificates (from platforms like Coursera, edX, or FutureLearn) may involve peer-graded assignments or automated quizzes, but generally fall short of the formal validation required for qualification recognition. A 2020 study by the Joint Research Centre (JRC) observed that less than 10% of MOOC learners completed courses with formally assessed outputs that could be considered for academic credit (JRC Science for Policy Report, 2020).

In contrast, micro-credentials are explicitly designed for formal or semi-formal recognition, often linked to National Qualifications Frameworks (NQFs) and referenced to the EQF. This ensures that learners can use them to access further education, gain credits toward full qualifications, or demonstrate job-relevant competencies to employers across borders.

Furthermore, the European Commission's support for a micro-credential metadata standard (via Europass) provides a crucial digital infrastructure for interoperability. This allows institutions and employers to read and verify credentials issued in different countries and sectors—an essential feature for cross-border learning and labor mobility in the EU.

In sum, the fundamental distinction lies in purpose, structure, and recognition: while digital badges and MOOC certificates signal informal learning, micro-credentials are policy-integrated, learner-verifiable, and qualification-aligned instruments of skills recognition. This clarity is essential for advancing their legitimacy and

fostering trust among VET providers, employers, and learners.

3. Strategic Alignment with EQF and National Frameworks

3.1 Embedding Micro-Credentials into Existing Structures

Integrating micro-credentials into the European Qualifications Framework (EQF) and national qualification systems requires thoughtful adaptation of existing educational and vocational structures. Rather than replacing traditional qualifications, micro-credentials are intended to complement them—offering short, stackable modules that address specific competency needs while maintaining structural coherence with established frameworks.

The EQF, with its eight reference levels based on learning outcomes in terms of knowledge, skills, and responsibility/autonomy, provides a strong foundation for integrating micro-credentials. However, mapping micro-credentials onto these levels requires explicit descriptors, workload estimations (typically in ECTS or hours), and quality assurance alignment.

Several countries have initiated integration strategies. For example, Ireland's National Framework of Qualifications (NFQ) allows micro-credentials to be formally referenced to existing award levels via Quality and Qualifications Ireland (QQI). Similarly, France is experimenting with incorporating *blocs de compétences* (blocks of competences) into national certifications, serving a similar function to micro-credentials and supporting partial recognition of learning outcomes (CEDEFOP, 2023).

This integration requires not only technical alignment but also capacity-building within awarding bodies, sectoral skills councils, and VET providers, who must understand how to evaluate and structure micro-credentials in ways that are EQF-compatible and industry-relevant.

3.2 Ensuring Policy Coherence and Interoperability

A major challenge in embedding micro-credentials lies in avoiding fragmentation across education systems, sectors, and borders. Without coordinated policy guidance, the risk is a proliferation of disconnected credentials that lack comparability, trust, or transferability.

To address this, the European Commission's 2022 Council Recommendation on Micro-Credentials encourages Member States to develop national strategies that are consistent with a European-wide approach, based on shared principles of quality assurance, learner agency, and transparency.

Interoperability is being actively pursued through the Europass Digital Credentials Infrastructure (EDCI), which allows issuers to create credentials in a standardized, machine-readable format. By embedding metadata such as EQF level, learning outcomes, and issuing institution, the EDCI aims to create a single European space for recognition and mobility.

Additionally, micro-credentials must interact seamlessly with other instruments, such as:

- The European Credit System for Vocational Education and Training (ECVET),
- The European Skills, Competences, Qualifications and Occupations (ESCO) classification, and
- National Qualifications Frameworks (NQFs) that align with EQF.

By ensuring that micro-credentials can be decoded, trusted, and transferred across systems, the EU promotes learner mobility and employer confidence, avoiding duplication or undervaluation of learning achievements.

3.3 Supporting the Shift Through Regulatory Innovation

Realizing the full potential of micro-credentials requires not only alignment with existing frameworks but also regulatory innovation to accommodate new learning pathways. Traditional qualifications frameworks are typically rigid, built for long-form degrees and vocational diplomas, and may not be well-suited to short-form, modular learning.

To address this, some countries have introduced legislative or regulatory reforms to legitimize micro-credentials as recognized learning units. In Finland, for instance, the national digital skills strategy incorporates micro-credentials as part of official upskilling programs, with public funding attached. In Italy, pilot programs have integrated micro-credentials into adult learning and employment requalification schemes under national recovery and resilience plans.

Regulatory innovation may also involve adjusting accreditation rules, revising institutional mandates to include micro-credential design and delivery, and updating funding formulas to recognize modular learning. For example, some European funding instruments such as ERASMUS+ and the European Social Fund Plus (ESF+) now explicitly support the development of micro-credentials within recognized frameworks.

Furthermore, policymakers are exploring legal recognition pathways, allowing learners to convert validated micro-credentials into credits that count toward formal qualifications or professional licensing. This legal

backing is essential to avoid micro-credentials becoming a parallel, but ultimately peripheral, learning track.

In sum, aligning micro-credentials with EQF and national frameworks is both a technical and political undertaking, requiring harmonized policy approaches, cross-sector coordination, and institutional innovation. The success of this alignment will largely determine whether micro-credentials can genuinely bridge the gap between informal learning and formal recognition within vocational education systems.

4. Mechanisms for Quality Assurance and Recognition

4.1 Validation Tools for Informal and Non-Formal Learning

A critical enabler for the integration of micro-credentials into formal education and vocational systems is the validation of informal and non-formal learning (VNFIL). Across the EU, significant progress has been made in establishing national validation systems, guided by the Council Recommendation on the Validation of Non-formal and Informal Learning (2012).

Validation typically includes four stages: identification, documentation, assessment, and certification of competences. This process ensures that learning acquired through work experience, self-directed study, or short courses is recognized in the same way as learning obtained through formal settings. In 2020, 85% of EU Member States reported having national frameworks for validation, though implementation varies in scope and accessibility (Cedefop, 2020).

Micro-credentials can act as validated outputs of non-formal or informal learning if tied to transparent learning outcomes and accompanied by quality-assured assessments. Key validation tools include:

- Recognition of Prior Learning (RPL) systems, allowing learners to gain credit or exemptions based on prior experience;
- Digital portfolios documenting evidence of competencies;
- Standardized skill assessments, aligned with sectoral standards.

For instance, the Netherlands operates a robust RPL framework where micro-credentials may be used as documented proof during validation interviews or assessment centers. Similarly, Austria's wba (Weiterbildungsakademie) system links validated adult learning to national certification, providing a model for integrating micro-credentials into broader qualification structures.

4.2 Mapping to Learning Outcomes and EQF Levels

The credibility of micro-credentials largely depends on their alignment with established learning outcomes frameworks, particularly the European Qualifications Framework (EQF). Mapping ensures that micro-credentials are level-referenced, outcome-based, and comparable across institutions and borders.

Effective mapping involves:

- Defining explicit learning outcomes (knowledge, skills, and autonomy/responsibility);
- Estimating learning volume, typically in ECTS credits or hours;
- Clarifying assessment methods and criteria;
- Specifying EQF level equivalence and referencing to NQFs.

To facilitate consistent mapping, the European Commission has supported the development of a metadata standard for micro-credentials within the Europass Digital Credentials Infrastructure (EDCI). This standard includes fields for EQF level, workload, issuing body, and quality assurance reference—ensuring that each micro-credential carries structured, verifiable information.

One notable example is Ireland's National Micro-credentials Framework, which requires all micro-credentials to be level-referenced to the Irish NFQ, use validated learning outcomes, and be approved through the QQI's quality assurance procedures. This ensures interoperability within the wider qualifications system and enables stackability toward full awards.

Without such mapping mechanisms, micro-credentials risk being perceived as fragmented or informal—undermining their potential to serve as bridges between different learning contexts and between education and labor markets.

4.3 Addressing Trust, Transparency, and Stakeholder Buy-in

Establishing trust among learners, employers, and education providers is essential for the widespread adoption of micro-credentials. Without shared confidence in their quality and utility, micro-credentials risk being seen as lesser credentials rather than meaningful indicators of learning and competence.

Transparency is the foundation of this trust. Each micro-credential should include clear metadata, disclose

learning outcomes and assessment processes, and be linked to a recognized quality assurance framework. The European Commission's guidance emphasizes the need for public registers or repositories of validated micro-credentials, similar to credential transparency systems in the U.S. or New Zealand.

Equally important is the involvement of social partners, particularly employers and sectoral bodies, in the design and endorsement of micro-credentials. A 2021 survey by BusinessEurope found that while 72% of employers support the idea of micro-credentials, only 34% were actively using them in hiring or internal upskilling decisions—largely due to uncertainty over quality and relevance.

To bridge this gap, several countries have created multi-stakeholder governance models for micro-credential validation. In Finland, national pilots involve collaboration between universities, employers, and unions to co-design micro-credentials that meet both academic standards and occupational profiles. Similarly, Lithuania's Skills Council plays a key role in vetting and endorsing credential content for industry recognition.

Ultimately, stakeholder buy-in requires a cultural shift toward valuing modular, lifelong learning pathways. This shift must be supported by clear legal frameworks, funding mechanisms, and communication strategies, ensuring that micro-credentials are not just technically valid, but socially and economically recognized across sectors.

5. Stakeholder Engagement and System Readiness

5.1 Perspectives from Employers, Learners, and Institutions

The successful adoption and sustainability of micro-credentials within EQF-aligned vocational systems hinges on broad stakeholder engagement. Each group—employers, learners, and education institutions—plays a distinct yet interdependent role in shaping the credibility, demand, and usability of micro-credentials.

Employers are central to ensuring relevance and uptake. Many industries, especially those undergoing digital transformation, view micro-credentials as tools for targeted skills validation. A 2022 Cedefop survey revealed that 61% of employers in the EU consider micro-credentials useful for upskilling and hiring, but only 28% reported direct involvement in their design or recognition (Cedefop, 2022). Their limited engagement is often due to uncertainty around quality assurance, EQF alignment, and lack of standardization across sectors.

Learners, particularly adult learners and those in career transition, tend to value micro-credentials for their flexibility and short duration. In the context of the green and digital transition, they are increasingly seeking just-in-time learning to remain competitive in the labor market. However, learners also face concerns around the recognition and transferability of micro-credentials. Without clear assurances that credentials will be acknowledged by employers or lead to formal qualifications, motivation to invest time and resources may diminish.

Education and training institutions are simultaneously embracing and adapting to micro-credential frameworks. Higher education institutions, in particular, are exploring how micro-credentials fit within modular degree pathways. According to the European University Association (EUA), over 70% of surveyed universities in 2021 were developing or piloting micro-credential offerings, though many raised challenges related to internal quality procedures and workload crediting (EUA, 2021).

To align incentives, national governments and EU bodies must foster multi-stakeholder collaboration platforms, ensuring that employers, providers, and learners co-create credential formats that are relevant, recognized, and responsive to societal needs.

5.2 Capacity-Building for Implementation at Scale

Embedding micro-credentials within national systems and scaling their implementation across sectors and regions requires robust institutional capacity and infrastructure. While pilot initiatives across Europe have shown promise, large-scale integration demands systemic support in three key areas: governance, resources, and digital infrastructure.

Firstly, VET systems and quality assurance bodies need clear operational guidance on how to design, validate, and issue micro-credentials aligned with EQF and NQFs. This includes training staff in outcome-based curriculum development, digital credentialing tools, and assessment frameworks. The European Training Foundation (ETF) has highlighted the need for upskilling national agencies and providers to manage modular qualifications and transition toward learning-outcome cultures.

Secondly, capacity-building requires financial investment. EU instruments such as ESF+ and Erasmus+ can play a strategic role by funding pilot programs, cross-border credential recognition mechanisms, and public-private partnerships. However, in many countries, VET providers still lack stable funding streams to experiment with or sustain micro-credential offerings.

Thirdly, digital infrastructure is essential for secure, interoperable issuance and verification of micro-credentials. The Europass Digital Credentials Infrastructure (EDCI) offers a foundational tool, but it must be accompanied

by national-level digital literacy training, administrative system upgrades, and interoperability with existing education databases and HR systems.

Finally, political will is key. Without coordinated national strategies and policy roadmaps, micro-credential initiatives risk remaining fragmented and localized. Countries like Estonia, Finland, and Ireland have demonstrated how aligning national qualifications policy, labor market demand, and digital innovation can enable credible, scalable micro-credential systems.

6. Policy Futures and Recommendations for a Recognized Micro-Credential Ecosystem

The consolidation of micro-credentials into a recognized and functional component of EQF-aligned vocational education requires a shift from experimentation to structured system-building. This transformation must be guided by coherent policies that foster quality, inclusivity, transparency, and portability—while also remaining agile enough to respond to the evolving demands of learners and labor markets.

To move forward, five interconnected policy directions are recommended:

1) Establish Comprehensive National Frameworks for Micro-Credentials

Member States should develop dedicated micro-credential frameworks embedded within their national qualifications systems. These frameworks should define credential types, issuance conditions, referencing to EQF/NQF levels, and recognition mechanisms—ensuring compatibility with the EU-wide approach.

2) Mandate Quality Assurance and Transparent Credential Standards

Clear requirements for learning outcomes, assessment methods, metadata, and workload must be universally applied. National quality assurance agencies should be empowered to accredit micro-credential programs and audit providers using consistent criteria derived from EQAVET and Bologna Process tools.

3) Strengthen Stakeholder Co-Governance and Sectoral Relevance

Policymakers must institutionalize cooperation between educational institutions, employers, social partners, and civil society. National and regional platforms should be formalized to co-design credentials that are demand-driven and responsive to technological and sectoral changes.

4) Leverage EU Funding and Infrastructure to Support Scale-Up

Programs such as Erasmus+, Digital Europe, ESF+, and Horizon Europe should continue to support capacity-building, cross-border pilots, and credential interoperability. Countries should integrate the Europass Digital Credentials Infrastructure into their national education and employment systems to ensure secure, standardized recognition across Europe.

5) Promote Legal Recognition and Pathways to Formal Qualifications

Micro-credentials must not remain peripheral; their legitimacy depends on their integration into pathways that lead to full qualifications, career advancement, or professional licensing. National legislation should support conversion of validated micro-credentials into formal credits or qualifications, following procedures aligned with ECTS or national credit systems.

As the EU and Member States progress toward a more flexible, inclusive, and competency-based learning ecosystem, micro-credentials offer a unique opportunity to bridge the divide between informal learning and formal recognition. Realizing this potential will require vision, coordination, and sustained political and financial commitment—but the reward is a more agile, learner-centered vocational education system fit for the 21st century.

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Curriculum Adjustment and Cultural Adaptation of Chinese Normal Schools in Malaya (1935-1957)

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Abstract

This paper examines the development of Chinese teacher education in Malaya during the transition period from colonial system to national independence from 1935 to 1957, focusing on the interactive relationship between teacher curriculum adjustment and cultural inheritance. Through the analysis of official education reports, decrees and Chinese vernacular schools archives, this study divides this period into three stages: marginal situation under the colonial system (1935-1945), post-war reconstruction and systematic development (1945-1952), and policy shift and cultural adaptation (1952-1957). The study finds that under the inequality of resources and policy restrictions, Chinese teacher education achieved the transformation from the Chinese model to Malayan local adaptive education through strategies such as curriculum localization, multilingual education integration and community organization mobilization, while maintaining the basic continuity of cultural identity. This adaptive transformation not only reflects the Chinese community's positive response to environmental changes, but also reflects the historical experience of minority education seeking survival and development in a multicultural society. It has important implications for understanding the interactive relationship between education policy and ethnic identity.

Keywords: Malaya, Chinese teacher education, curriculum adjustment, cultural inheritance, colonial education policy

1. Introduction

1.1 Research Background and Significance

The period from 1935 to 1957 was a critical historical stage for Malaya from the deepening of colonial rule to the struggle for independence. It was also an important period when the Chinese education system experienced marginalization, reconstruction and adjustment. In this historical process, Chinese teacher education, as the core pillar of the Chinese education system, was not only subject to the constraints of colonial policies, but also shouldered the dual mission of cultural inheritance and local adaptation. This study focuses on the development and changes of Chinese teacher education in Malaya from 1935 to 1957, with a special focus on the adjustment strategies of teacher education courses and their complex interactive relationship with cultural protection.

This period can be divided into three key stages: marginal status under the colonial system (1935-1945), post-war reconstruction and systematic development (1945-1952), and policy shift and cultural adaptation (1952-1957). In the first stage, Chinese teacher education was subject to unequal distribution of educational resources and policy restrictions, and mainly relied on the Chinese community to raise funds to maintain simple teacher training classes, showing obvious marginalization characteristics. After the war, with the need for social reconstruction, Chinese teacher education received limited official recognition, established a multi-level training

system, and teacher training courses began to be localized. After 1952, with the introduction of educational policies such as the *Barnes Report* and the *Razak Report*, Chinese education faced greater survival pressure. The Chinese community fought for survival space for Chinese teacher education through organizational mobilization and curriculum adaptation.

By analyzing the evolution of Chinese teacher education courses, this study attempts to reveal how Chinese teacher education, under the dual pressures of colonial rule and nation-state construction, can adapt to the political environment and protect the cultural bottom line through strategies such as curriculum adjustment, textbook localization, and multilingual integration. This study not only helps to understand the historical transformation of Chinese education, but also provides a historical perspective for understanding how ethnic minorities in a multicultural society can safeguard their educational rights and interests in policy changes. In the process of Malaya's transformation from a colony to an independent country, the adaptation experience of Chinese teacher education demonstrates the dialectical relationship between cultural adaptation and cultural persistence, which has important implications for understanding the interaction between education and identity politics in a multicultural society.

1.2 Literature Review and Research Gap

At present, the research on Chinese education and teacher development in Malaysia mainly focuses on the fields of education policy, Chinese society and cultural identity. Chinese scholars such as Bie Biliang and Lin Zhiguang mostly start from the history of overseas Chinese education to explore the source and training of teachers in modern overseas Chinese vernacular schools, but generally lack in-depth analysis of the local teacher system in the host country. In *Resistance and Persistence*, Wang Huanzhi systematically sorted out the development process of Chinese teachers, but the overall focus is more on macro narrative, and the development of micro-levels such as teacher curriculum adjustment, textbook localization and multilingual teaching adaptation is still insufficient. Malaysian local scholars such as Zheng Liangshu and Kua Kia Soong have described in detail the historical context and resistance experience of Chinese education, but the detailed exploration of teacher training mechanisms and educational practices is relatively limited. English literature such as Tan Liok Ee and Lee Kam Hing analyzed the challenges faced by post-war Chinese vernacular schools from the perspective of educational policy changes, providing a reference for understanding the external environment of teacher development.

In general, existing research has achieved certain results in macro-level historical narrative and policy analysis, but there are still obvious deficiencies in specific areas such as the evolution of the Chinese teacher education system, the adjustment of teacher education curriculum content, and the teacher training system. This study aims to make up for this deficiency, focusing on the development process of Chinese teacher education in Malaya from 1935 to 1957, and exploring its institutional adaptation and cultural adherence practices under the background of colonial rule and national transformation.

1.3 Research Objectives and Methods

This study aims to explore how Chinese teacher education in Malaya achieved a balance between cultural inheritance and local adaptation through curriculum adjustment between 1935 and 1957. Specific research objectives include: analyzing the marginal situation and adaptation strategies of Chinese teacher education during the colonial period; examining the reconstruction and diversified development of the post-war Chinese teacher training system; exploring the localization adjustment of teacher education curriculum and the actual practice of multilingual education integration; and evaluating the interactive relationship between the organizational mobilization and cultural protection of the Chinese community under the background of policy shifts.

In terms of research methods, this paper mainly adopts historical document analysis, systematically combing the official education reports of the British colonial government, education laws, Chinese vernacular schools archives and other primary historical materials, supplemented by educational journals and newspaper materials, to construct a historical narrative from multiple perspectives. At the same time, this paper uses comparative research methods to reveal the evolution of its adaptation strategy by comparing the changes in the curriculum structure and training model of Chinese normal schools in different periods.

Through systematic review and analysis, this study not only fills the gap in existing literature on the study of Chinese teacher education curriculum and training system, but also provides an important case and historical perspective for understanding the self-adjustment and cultural adaptation of minority education during the transition from colonial system to national independence.

2. The Transformation Process of Chinese Language Teacher Education

2.1 The Marginal Situation of Chinese Teacher Education Under the Colonial System: 1935–1945

2.1.1 Unequal Distribution of Educational Resources and the Dilemma of Teacher Training

The *Memorandum on the Notes by Advisory Committee on Education in the Colonies on Federated Malay States and Straits Settlements Reports for 1935* recorded the length of education in schools for different ethnic groups: 5 years for Malay schools; 6 years for Chinese vernacular schools (primary school curriculum); 6 years for Tamil schools (in fact, few students studied for more than 4 or 5 years).[1] Under the superficial institutional differences, there is a more fundamental problem of unequal resource allocation.

According to official education statistics from 1933-1934, more than half (about 51.6%) of the Chinese vernacular schools in Malaya were fully Unaided Schools.[2] Even for aided schools, the funding they received was much lower than that of English and Malay schools. This unfair allocation of funds directly led to three difficulties in the development of Chinese teacher education: first, there was a lack of stable funds to establish specialized teacher training institutions; second, it was impossible to provide sufficient subsidies to attract and retain high-quality teachers; third, the training facilities were rudimentary and teaching resources were long-term scarce.

The marginalization of Chinese teacher education is also reflected in the source of teachers. The 1935 Malay Federation Annual Education Report shows that of the 142 teachers employed by Chinese schools at that time, only 27 were born locally, and the rest were graduates of higher education from China, including 21 Chinese university graduates, 29 undergraduates, 18 Higher Normal graduates (i.e., qualified teachers), and many holders of the Cambridge School Certificate, Senior Middle School classes or graduates of the Special Training College in China.[3] This high reliance on imported teachers from China not only reflects the inadequacy of the local training system, but also becomes a reason for the colonial government to strengthen control.

In addition, further observation from the perspective of enrollment rates shows that the differences in educational opportunities between different ethnic groups are also very obvious. According to the 1931 census data, the enrollment rate of Malay school-age children in mother tongue schools is generally higher than that of Chinese (108% of Malay boys and 35% of girls in Straits Settlements; 96% of boys and 36% of girls in Federated Malay States), while the enrollment rate of Chinese children is relatively low (63% of boys and 24% of girls in S.S.; 60% of boys and 21% of girls in F.M.S.). In English schools, the enrollment rate of Chinese boys is even more limited (23.9% in S.S. and 11.1% in F.M.S.), and the enrollment rate of girls is even lower, at only 9.38% and 5.72%.[4] This pattern shows that although the Chinese community as a whole still focuses on mother tongue school education, its interest in English education has increased. Under the dual pressure of official resource tilt and insufficient financial support, the development of Chinese vernacular schools is difficult.

In general, the Chinese teacher education system around 1935 was deeply marginalized due to multiple structural obstacles such as finance, policy and talent supply, which laid the groundwork for the reconstruction and localization transformation of the post-war teacher system.

2.1.2 Policy Restrictions and Obstacles to the Development of Chinese Teacher Education

In the 1930s, the British colonial government gradually strengthened institutional restrictions on the Chinese education system in order to maintain colonial rule and prevent subversive political activities.[5] The Registration of Schools Ordinance, 1920 required all schools (with more than 15 students), teachers, and directors to register. At the same time, the government reserved the right to revoke the registration of schools, directors, principals or teachers at any time. Textbooks used in schools must be reviewed and approved by the Education Bureau.

The 1925 Amendments to the School Enactment further expanded the powers of the Director of Education and strengthened supervision and restrictions on the teaching content and activities of Chinese vernacular schools. In 1932, the colonial government stipulated that new schools must teach in English or Malay.[6] This policy

[1] *Memorandum on the Notes by Advisory Committee on Education in the Colonies on Federated Malay States and Straits Settlements Reports for 1935*. CO 717/119/1.

[2] *Johore Annual Report on Education for the Year 1934*. CO 717/111/12. Appendix 34–35.

[3] Federated Malay States, (1935). *Annual Report of the Education Department for the Year 1935*. Federated Malay States Government Press, Kuala Lumpur. CO 717/119/1. P51.

[4] *Memorandum on the Notes by Advisory Committee on Education in the Colonies on Federated Malay States and Straits Settlements Reports for 1935*. CO 717/119/1.

[5] Chinese Vernacular Education in Malaya, (1930). CO 717/74/4, The National Archives, p. 9.

[6] Lin Kaizhong, (2002, Oct.). *Constructing Chinese Culture: Ethnic Relations, Nation, and the Chinese Education Movement* (Jian Gou Zhong de Huaren Wenhua: Zuqun Guanxi, Guojia yu Huajiao Yundong, 建构中的华人文化：族群关系、国家与华教运动). Kuala Lumpur: Centre for Malaysian Chinese Studies, p. 63. Quoted in Ye Yuxian. *Language Policy and Education: A Comparative Study of Malaysia and Singapore*. Avant-Garde Publishing, 1st ed., p. 15.

essentially ruled out the possibility of building new Chinese and Tamil schools, reinforcing the marginalization of the education system for minorities.

Under this policy environment, the development of Chinese teacher education was seriously hindered. The *Annual Report of the Education Department for the Year 1935* clearly stated: "No normal training for teachers in Chinese vernacular schools was supplied during 1935; the classes which were formerly held in the Davidson Road School, Kuala Lumpur, were discontinued in 1932."[1] It was not until 1936 that four Normal training Classes for Chinese Teachers were conducted at various centers.[2] However, the scale was limited and it was difficult to meet the actual needs.

2.1.3 Early Attempts to Adapt Chinese Language Teacher Training to Local Conditions

Faced with the restrictions of colonial policies and resource shortages, Chinese teacher education began its initial exploration of local adaptation between 1935 and 1945. Chinese teacher education began with the Teacher Training Institute established by Penang Chung Hwa Confucian School (槟城中华学校) in 1906.[3] After the British colonial government promulgated the *Registration of Schools Ordinance in 1920*, it required Chinese vernacular schools teachers to be localized, prompting some Chinese vernacular schools to set up simple Normal Classes with the support of local education bureaus or communities to train their own teachers. Such as Chung Hwa Nan Girls' School in Muar (麻坡中化化南女校，1923), Penang Bin Hua Girls' School (槟城槟华女校，1927), Confucian Private Secondary School in Kuala Lumpur (吉隆坡尊孔，1936), Kuen Cheng School in Kuala Lumpur (吉隆坡坤成，1936), Nam Wah School in Tianding (天定南华学校，1936), and Penang Union Girls' School (槟城协和女校，1936).[4]

However, the overall Chinese teacher education at this stage still showed the following characteristics: First, it mostly existed in the form of simple classes, with small scale and loose system; second, it lacked a systematic training mechanism, and most teacher training classes were actually just extensions of secondary school courses, with limited specialization; third, teacher training classes were mostly funded by school directors, local Chinese communities or Chinese groups, and government support was extremely limited. Despite the lack of specialization, Penang Bin Hua Girls' School and Nan Hua Girls' School lasted for 14 and 12 classes respectively, and gradually trained a group of teachers with local adaptability.

By the 1930s, it was still a huge problem to provide suitable Chinese teachers for Chinese vernacular schools in Malaya. On the one hand, few Peranakan Chinese had sufficient knowledge of their mother tongue to be qualified as Chinese teachers. On the other hand, Chinese teachers introduced from China often had political tendencies and became propagandists for the Kuomintang, or even worse, were influenced by communism. Therefore, it was crucial for Malaya to train its own Chinese teachers.[5]

During this period, although Chinese teacher education was generally marginalized, it began to explore local adaptation in the midst of difficulties, laying a preliminary foundation for more systematic reforms after the war.

2.2 Postwar Reconstruction and Systematization: 1945–1952

2.2.1 Reconstruction and Diversification of the Teacher Training System

After the end of World War II, Malaya was in urgent need of reconstruction. Education systems of all ethnic groups generally faced an extreme shortage of teachers, and the Chinese education system was particularly serious. Before the war, the channel of importing teachers mainly relied on China, but it was interrupted due to the dramatic changes in the situation in China after the war, forcing the colonial government and the Chinese community to jointly explore new localized teacher training paths.

In 1946, the British colonial government launched the first systematic Chinese vernacular schools teacher

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[1] Federated Malay States, (1935). *Annual Report of the Education Department for the Year 1935.* Federated Malay States Government Press, Kuala Lumpur. CO 717/119/1, p. 51.

[2] *Memorandum on the Notes by Advisory Committee on Education in the Colonies on Federated Malay States and Straits Settlements Reports for 1935*. CO 717/119/1.

[3] Zheng, Liangshu, (1999). *The History of Chinese Education Development in Malaysia, Volume 2* (Malai Xiya Huawen Jiaoyu Fazhanshi Di 2 Fence, 马来西亚华文教育发展史 第 2 分册). Malaysia: United Chinese School Teachers' Association of Malaysia (Jiao Zong), p. 348.

[4] Ibid.

Mo, Shunsheng, (2017). *The History of Education in Malaysia, 1415–2015, and the Development of Chinese Education* (Malai Xiya Jiaoyu Shi 1415–2015 yu Huajiao Fazhan, 马来西亚教育史 1415–2015 与华教发展). New Era University College, Tan Lark Sye Research Institute, p. 24.

[5] Chinese Vernacular Education in Malaya, (1930). CO 717/74/4, The National Archives, p. 48.

training program, the Simplified Normal Training Course, which was set up in Penang, Perak, Selangor and Negeri Sembilan.[1] This project was aimed at training grassroots Chinese vernacular schools teachers in a short period of time, but due to hasty preparations and insufficient teaching materials and teachers, it was discontinued after only two sessions (1946 and 1947).[2] According to statistics in 1947, the Simplified Normal Training Course trained a total of 207 students,[3] which was far from meeting the needs of the rapidly expanding Chinese vernacular schools system.

In order to make up for the limitations of the scale and effectiveness of the teacher training courses, the colonial government has been promoting vacation teacher training courses and weekend teacher training courses since 1948. Vacation teacher training courses mainly recruit in-service teachers who do not meet the academic qualifications or qualifications (including those who were temporarily allowed to teach by the Education Bureau before or after the war), those who have passed the junior high school examination, high school dropouts or those with equivalent academic qualifications. After completing the course and passing the examination, they can officially become qualified primary school teachers. The weekend teacher training course was originally set up as a three-year system with classes every weekend, but due to inconvenient transportation, it was later adjusted to a concentrated vacation teaching mode, which was held during the first and second semester holidays of the school and shortened to two years.[4] Both types of training courses are aimed at rapidly expanding the ranks of qualified primary school teachers.

At the same time, in the face of the extreme shortage of teachers at the secondary school level, the Ministry of Education of the Federation of Malaya established a higher-level Federation of Malaya Chinese Senior Normal in 1948. The Senior Normal Class provides two years of full-time professional training for junior high school graduates who have passed the government junior high school diploma examination. The course content covers the basic subjects of Chinese, English, arithmetic, history and geography, art, handicraft, music, physical education, as well as professional training in educational principles, psychology, teaching methods, educational statistics, educational administration, etc., emphasizing the combination of theory and practice.[5]

The Advanced Teacher Training Classes were initially set up in major Chinese secondary schools in Penang, Perak, Selangor, etc.[6] The training courses for the Advanced Teacher Training Classes were completely free of charge. After passing the examination and the teaching practice supervised by the inspector, the graduates could be immediately assigned to teach in various primary schools and receive A-level salary.

In May 1952, the first and only specialized normal college in Malaya using Chinese as the medium of instruction, Green Lane School, was established in Penang, marking a new level in Chinese teacher education.

From 1948 to 1957, the Normal School trained 62 classes and 2,233 qualified teachers,[7] which greatly alleviated the shortage of teachers in Chinese vernacular schools and laid a talent foundation for the sustainable development of Chinese education.

2.2.2 Localization of Teacher Training Courses and Integration of Multilingual Education

After the war, Chinese teacher education underwent significant curriculum adjustments, mainly reflected in the localization of teaching content and the emphasis on multilingual education.

In terms of teaching content, the teacher training courses also showed a clear “Malaysianization” orientation. The content of Chinese history and geography was gradually reduced in the textbooks, and the proportion of

[1] Mo, Shunsheng, (2017). *The History of Education in Malaysia, 1415–2015, and the Development of Chinese Education* (Malai Xiya Jiaoyu Shi 1415–2015 yu Huajiao Fazhan, 马来西亚教育史 1415–2015 与华教发展). New Era University College, Tan Lark Sye Research Institute, p. 65.

[2] Cai, Lihao, (editor) (2017). The 70th Anniversary Commemorative Publication of the Senior Normal School (Gaoshi 70 Zhounian Jinian Tekan, 高师 70 周年纪念特刊). Government Chinese Senior Normal Graduates’ Association, Selangor, p. 137.

[3] United Chinese School Teachers’ Association of Malaysia, (1987). *33 years of UCSTAM* (p. 802). Kuala Lumpur: United Chinese School Teachers’ Association of Malaysia.

[4] Cai, Lihao, (editor) (2017). The 70th Anniversary Commemorative Publication of the Senior Normal School (Gaoshi 70 Zhounian Jinian Tekan, 高师 70 周年纪念特刊). Government Chinese Senior Normal Graduates’ Association, Selangor, p. 137.

[5] Ibid. p. 21.

[6] Mo, Shunsheng, (2017). *The History of Education in Malaysia, 1415–2015, and the Development of Chinese Education* (Malai Xiya Jiaoyu Shi 1415–2015 yu Huajiao Fazhan, 马来西亚教育史 1415–2015 与华教发展). New Era University College, Tan Lark Sye Research Institute, p. 65.

[7] Cai, Lihao, (editor) (2017). The 70th Anniversary Commemorative Publication of the Senior Normal School (Gaoshi 70 Zhounian Jinian Tekan, 高师 70 周年纪念特刊). Government Chinese Senior Normal Graduates’ Association, Selangor, p. 30.

local history, geography and social common sense was increased to adapt to the national identity policy promoted by the colonial government. In particular, in the civic education subject, there was basically no content related to Chinese consciousness.[1] This curriculum adjustment enabled teacher training students to better adapt to the local teaching environment.

In terms of school system and curriculum, Chinese teacher education gradually broke away from the traditional model of the Chinese education system and turned to combining with the local reality of Malaya. In 1949, the Federal Legislative Council decided that all government-run and government-subsidized schools must implement a three-semester system and add Malay and English courses.[2] Chinese teacher training classes were adjusted simultaneously, from the original single-type curriculum with Chinese and arithmetic as the core to a diversified curriculum system including Chinese, English, Malay, arithmetic, general knowledge, civic education, history and geography, physical education, etc., gradually guiding teachers to adapt to a multilingual environment.

This change is also evident in the curriculum arrangement of basic education in Chinese vernacular schools. For example, Chinese and arithmetic are the main subjects in the first and second grades of primary school; English is introduced in the third grade; Malay is added in the fourth grade, and the proportion of history, geography, civics and other subjects is strengthened in the fifth and sixth grades.[3] In the secondary school stage, Chinese and English classes occupy nearly half of the 36 classes per week, and mathematics and science education are also strengthened simultaneously.[4] This curriculum structure not only cultivates basic language and science skills, but also provides comprehensive training for the language adaptation and teaching ability of Chinese teachers themselves.

In general, between 1945 and 1952, Chinese teacher education achieved a preliminary transformation from the traditional Chinese model to a localized Malayan education system through curriculum localization, multilingual education integration, and institutional adjustments. This not only improved the professional capabilities of the teaching staff, but also laid an important foundation for Chinese education to survive and develop in the dramatic changes in the social environment before and after independence.

2.2.3 Malayanization of Textbook Reform

Before the war, Chinese vernacular schools in Malaya widely used textbooks published in China, which lacked reflection of local society. Although there were initial attempts to localize textbooks in the 1930s, overall, the Chinese vernacular schools curriculum was still centered on Chinese nationalism and was difficult to adapt to the actual environment in Malaya. After World War II, textbook reform became an important part of the localization of Chinese teacher education.

In 1951, William Purviance Fenn and Wu Deyao were invited to inspect the situation of Chinese vernacular schools and proposed that textbooks should replace Chinese background with Malayan background.[5] In December of the same year, the Ministry of Education established the Chinese School Textbook Revision Committee. In 1952, the “Central Committee for the Revision of Chinese School Textbooks” and the “Advisory Committee for the Revision of Chinese School Textbooks” were established, officially launching the process of Malayanization of textbooks.

The first set of Malayan Chinese textbooks, *Guo Yu*, published in 1953, emphasized the connection between the content and the social reality of Malaya and conveyed the concept of patriotism centered on the country of residence.[6] The new textbooks showed a clear trend of localization in content distribution: there was basically

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[1] 见（星洲日报），1952.5.27. 社论.

[2] Zheng, Liangshu, (2001). *The History of Chinese Education Development in Malaysia, Volume 3* (Malai Xiya Huawen Jiaoyu Fazhanshi Di 3 Fence, 马来西亚华文教育发展史 第 3 分册). United Chinese School Teachers’ Association of Malaysia (Jiao Zong), p. 115.

[3] Selangor Education File No.63/5I.

Mo, Shunsheng, (2017). *The History of Education in Malaysia, 1415–2015, and the Development of Chinese Education* (Malai Xiya Jiaoyu Shi 1415–2015 yu Huajiao Fazhan, 马来西亚教育史 1415–2015 与华教发展). New Era University College, Tan Lark Sye Research Institute, p. 70.

[4] Mo, Shunsheng, (2017). *The History of Education in Malaysia, 1415–2015, and the Development of Chinese Education* (Malai Xiya Jiaoyu Shi 1415–2015 yu Huajiao Fazhan, 马来西亚教育史 1415–2015 与华教发展). New Era University College, Tan Lark Sye Research Institute, p. 70.

[5] Fenn, William P., and Wu, Teh Yao, (1955). *Report on the Chinese Education in Malaya* (Fenn-Wu Report).

[6] Sin Chew Daily. 1 Jan. 1953.

Lin, Lianyu, (2001). *Eighteen Years of Struggles through Storms, Volume 1* (Fengyu Shibanian Shangji, 风雨十八年上集). Kuala Lumpur, pp. 32–42.

no Chinese content in the civics course; in the history course, local history accounted for more than 55%, Chinese history 30%, and world history 15%; the geography course also significantly reduced Chinese geography content.[1]

This change in teaching materials had a profound impact on teacher training: first, teacher trainees needed to learn how to use these localized teaching materials; second, teaching methods courses began to be based on local teaching materials; third, the overall orientation of teacher training shifted from inheriting Chinese culture to training teachers who could adapt to the needs of Malayan society. This coordinated change in teaching materials and teacher training promoted the overall localization of Chinese education.

2.3 Policy Shift and Cultural Adaptation: 1952-1957

2.3.1 Education Policy Shift and Challenges to Teacher Education

1952 to 1957 was a critical transition period for Malaya from a colony to independence. Changes in education policies directly challenged the development path of Chinese teacher education.

The Barnes Report advocated the abolition of schools with different language streams and suggested that the official language such as Malay or English be fully implemented as the medium of instruction in order to integrate various communities in national education, achieve local identity among various groups, and finally shape a common Malayan national concept. The report triggered strong opposition from the Chinese community.

In response, the Fenn-Wu Report released in the same year recommended that the government provide more resources for Chinese vernacular schools, encourage a trilingual education system, and recommend that the British colonial government include Chinese education as part of national education.[2]

Nevertheless, the Educational Ordinance 1952 was passed in 1952, which was mainly based on the principles of the Barnes Report and ultimately established a national school system with English and Malay as the medium of instruction.[3] The development of Chinese and Tamil schools was further restricted and they were not fully integrated into the national education system.

In addition, in 1953, Aminuddin Baki proposed the "Melting Pot Theory" to establish national schools, where children of different races could study in the same school and integrate with each other to promote the unity of all ethnic groups.[4] This further intensified the marginal pressure of the Chinese teacher training system.

The 1956 Razak Report further specified that the ultimate goal was to "concentrate all children of all races under one national education system, with Malay as the principal medium of instruction."[5]

In general, between 1952 and 1957, Chinese teacher education struggled to survive under policy pressure and achieved self-transformation, which profoundly affected the future direction of Chinese education and cultural identity.

2.3.2 Organization and Mobilization of the Chinese Community and Maintenance of Teacher Education

Faced with increasingly tightened education policies, the Chinese community has begun to organize to safeguard the rights and interests of Chinese-language education, with teacher education being a core focus.

The United Chinese School Teachers' Association of Malaysia (Jiao Zong), founded on December 25, 1952, aims to "improve Chinese vernacular schools education, promote Chinese culture, and seek the welfare of teachers".[6] In order to protect the autonomy of the school board, the United Chinese School Committees' Association of Malaysia (Dong Zong) was founded on August 22, 1954.[7] After the establishment of Dong Zong,

[1] *Sin Chew Daily*, 27 May 1952.

[2] Ye, Yuxian, (2018). The Impact of Language Education Policy on the School System in Malaysia (1957–2013): A Historical Institutionalism Perspective (Malai Xiya Yuwen Jiaoyu Zhengce Dui Xuexiao Zhidu de Yingxiang 1957–2013 馬來西亞語文教育政策對學校制度的影響(1957-2013)). In *Studies on Language Education Policies around the World*, edited by Li Qinan et al., p. 87.

[3] Watson, J. Keith P., (1980). Cultural Pluralism, Nation-Building, and Educational Policies in Peninsular Malaysia. *Journal of Multilingual and Multicultural Development, 1*(2), 155–174.

[4] Kuala Lumpur: Huaren Research Centre, (2013). *National Primary Schools in Malaya: Their Problems and Suggestions for Extracurricular Activities* (Malaiya Guomin Xuexiao: Qi Wenti Yiji Dui Kewai Huodong de Jianyi, 马来亚国民学校：其问题以及对课外活动的建议). Kuala Lumpur: Huaren Research Centre, p. 31.

[5] Watson, J. Keith P., (1980). Cultural pluralism nation-building and educational policies in peninsular Malaysia. *Journal of Multilingual & Multicultural Development, 1*(2), 155-174.

[6] Sin Chew Dail. 27 Dec. 1951, 7th ed.

[7] Dong Jiao Zong Historical Exhibition Team, (Dec. 1993). *Brilliance of Chinese Education* (Huaguang Shuiyao, 《华光水耀》). Kuala Lumpur: Dong Jiao Zong, p. 6.

it joined Jiao Zong and submitted memoranda, statements, declarations and written speeches in the name of Dong Jiao Zong to jointly safeguard and fight for the rights of Chinese education, oppose the provisions and measures of the Education Act that are unfavorable to Chinese education, and develop Chinese education.[1] Dong Jiao Zong became the defender of the rights of Chinese education.

The MCA Chinese Education Central Committee, established in 1953 within the Malaysian Chinese Association, provided political support for Chinese teacher education. In August of the same year, the MCA Chinese Education Central Committee, together with Dong Zong and Jiao Zong, represented the three parties in fighting for fair and just rights and status for Chinese education from the government.[2] Through cooperation with political parties, it became a helper for Chinese educationists in dealing with the government.[3]

Under the negotiation of Chinese education leader Lim Lian Geok to Education Minister Abdul Razak, the Alliance government did not include the "ultimate goal of education" in the Education Ordinance (1957) promulgated on the eve of national independence in order to maintain the unity of the three major ethnic groups and facilitate the construction of the founding of the country.[4] The ordinance was formulated based on the Razak Report, which established the basic framework of the Malayan education system after independence and put forward the requirement of "Malay becoming the national language, while maintaining and supporting the development of the languages and cultures of other ethnic groups in the country."

During this period, under the pressure of policy shifts, Chinese teacher education achieved adaptive development through curriculum adjustments and community mobilization, creating conditions for continuing to train Chinese teachers after independence.

3. Conclusion

This study focuses on the development of Chinese teacher education in Malaya from 1935 to 1957. It examines the allocation of educational resources, policy intervention, textbook and curriculum adjustments, post-war reconstruction of the teacher education system, and the coping strategies of the Chinese community under the colonial system, revealing the evolution path and cultural adaptation process of Chinese teacher education in a complex historical environment.

First, from 1935 to 1945, Chinese teacher education was marginalized in the colonial education system. Unequal resource allocation and stricter policy control put Chinese vernacular schools in a disadvantageous position in terms of funding, teachers and institutional guarantees. Despite this, the Chinese community still established an education system to cope with colonial restrictions through self-financing and localization of teacher training classes. During this period, although the local teaching materials and training system were still based on the Chinese model, they had shown a trend of adjusting to local methods and adapting to the social environment of Malaya.

Secondly, during the post-war reconstruction period from 1945 to 1952, the Chinese teacher education system entered a new period of systematic development. Chinese vernacular schools actively responded to the call for local identity after the war, promoted the localization of teacher training curriculum content, and strengthened multilingual education and training to adapt to the national policy requirements for Malay and English teaching. At the same time, the colonial government also promoted the training of local teachers by setting up high-level teacher classes and holiday teacher training classes. In terms of teaching material reform, Chinese vernacular schools textbooks began to transform from "China-centered" to "Malaya-centered", emphasizing the training of a new generation of students who are loyal to Malayan society. Teacher education during this period not only achieved the initial integration of teaching language and curriculum structure, but also accelerated the formation of local identity.

Finally, between 1952 and 1957, as the colonial government implemented the education unitization policy and national identity project, Chinese teacher education faced greater institutional challenges. Policy documents such as the Barnes Report and the Razak Report reflected the strong demand for education unification during the transition period between colonialism and independence, advocating the use of Malay as the main medium of instruction and weakening the independence of mother tongue education. Faced with an unfavorable situation,

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[1] Lew, B. H., (2006). *The United Chinese School Teachers' Association of Malaysia and Its Leaders (1951–2005).* Kajang: United Chinese School Teachers' Association of Malaysia, p. 54.

[2] Kua, Kia Soong, (1985). *The Chinese Schools of Malaysia: A Protean Saga.* Kuala Lumpur: 1985, p. 69.

[3] Ang, Ming Chee, (2014). Institutions and Social Mobilization: The Chinese Education Movement in Malaysia, 1951–2011. ISEAS–Yusof Ishak Institute, p. 66.

[4] United Chinese School Teachers' Association of Malaysia (Jiao Zong), Research and Information Division, (2009, Sept.). *An Overview of Chinese Education in Malaysia* (Malai Xiya Huawen Jiaoyu Jiankuang, 马来西亚华文教育简况), p. 4.

the Chinese community quickly organized and mobilized to establish organizations such as Dong Zong and Jiao Zong, and through collective action, they maintained the independence and cultural continuity of the Chinese education system. Although Chinese teacher education was in a difficult situation during this period, it continued to play an important role in inheriting mother tongue education and supporting Chinese cultural identity through the persistence and adaptation of the community.

Overall, the historical evolution of Chinese teacher education in Malaya from 1935 to 1957 was a process of gradual localization, cultural adaptation and institutional integration in the interaction between colonial oppression and social autonomy. This process not only shaped the basic pattern of Chinese education in post-war Malaysia, but also laid an important foundation for the formation of a multicultural education system in the future. As a link between cultural identity and social integration, Chinese teacher education has demonstrated its tenacious vitality and profound historical significance in the historical process of Malaya's move towards an independent country.

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Evaluating the Performance of Seven Large Language Models (GPT4.5, Gemini, Copilot, Claude, Perplexity, DeepSeek, and Manus) in Answering Healthcare Quality Management Inquiries

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Abstract

Large language models (LLMs) are increasingly utilized across education, healthcare, and decision support due to their advanced text processing capabilities. This study evaluated the performance of seven LLMs: ChatGPT4.5, Gemini 2.5 Pro, Copilot, Claude 3.7, Perplexity, DeepSeek, and Manus in answering multiple-choice questions related to healthcare quality management. The assessment included 20 validated questions across four domains: organizational leadership (n = 5), health data analytics (n = 5), performance improvement (n = 5), and patient safety (n = 5). Accuracy rates ranged from 70% to 80%, with ChatGPT4.5, Gemini, and Claude achieving 80%; Perplexity and Manus, 75%; and Copilot and DeepSeek, 70%. All models met or exceeded the predefined accuracy threshold of 70%. Descriptive statistics showed a mean of 15.19 correct responses (SD = 0.83) and 5.00 incorrect responses (SD = 0.85) per model, with a combined average of 12.71 responses (SD = 4.46). A Pearson chi-square test indicated no statistically significant differences in accuracy among the models, χ^2 (6, N = 140) = 1.321, P =.971. A Monte Carlo simulation with 10,000 sampled tables

confirmed this result (*P* =.984, 95% CI).

The findings indicated comparable performance across the evaluated AI models in the context of healthcare quality education. These results support the use of large language models as supplementary tools in this domain, while highlighting the need for further evaluation of performance across specific content domains and their applicability in real-world professional training contexts.

Keywords: AI, artificial intelligence, LLMs, healthcare quality management, education tools, multiple-choice questions

1. Introduction

AI-based Large Language Models (LLMs) demonstrate strong potential across various fields and applications due to their capability to deliver detailed responses to complex inquiries (Li, 2023; Ostapuk & Audiffren, 2024). In healthcare and education, AI-based models are also gaining attention for delivering timely, concise, and actionable information in response to standard query requirements (Hristidis et al., 2023; Khlaif et al., 2023; Kung et al., 2023; Sallam, 2023). Notably, LLMs have demonstrated strong performance on professional and academic examinations originally designed for human respondents (A-Abbasi et al., 2024; Johnson et al., 2023; Sallam et al., 2024a; Sallam et al., 2024b).

Despite these advances, concerns remain regarding the precision and reliability of healthcare knowledge generated by LLMs, which poses a critical challenge to their integration into medical education, quality improvement, and other clinical domains (Benítez et al., 2024).

2. Background

Quality management practices within healthcare organizations continue to evolve through the adoption of innovative tools aimed at enhancing service standards (Sallam, 2024); However, historically, healthcare systems have relied on fragmented approaches to quality improvement, resulting in significant variability in workforce competencies, governance structures, and evidence-based practices (Connor et al., 2023; Spath, 2013). To mitigate these challenges, competency-based education in healthcare quality has emerged to strengthen professional knowledge and align with quality goals (Imanipour et al., 2022). Similarly, efforts to standardize quality improvement competencies have extended to integrating quality improvement into healthcare professionals' education (Myers et al., 2022). As Kazana and Dolansky (2021) noted, this integration addresses the alignment of quality initiatives across the healthcare sector.

In addition, the Joint Commission International Accreditation (JCIA) has gained wide application for its emphasis on quality evaluation, patient safety, and enhanced medication management care standards (Alraimi & Al-Nashmi, 2024; Sallam & Hamdan, 2023; Zabin et al., 2024). Its emphasis on aligning healthcare practices with international standards has attracted growing attention from governments, providers, and consumers as a key driver for improving healthcare quality and safety outcomes (Spath, 2013).

Despite such progress, the inherent complexity of healthcare quality assurance, which spans clinical and administrative functions, emphasizes the need for advanced tools, including artificial intelligence, to support improvement initiatives (Sallam et al., 2024c).

In light of these developments, this study aimed to evaluate the potential of seven AI-based LLMs (ChatGPT4.5, Gemini, Copilot, Claude, Perplexity, DeepSeek, and Manus) as supplementary tools in healthcare education and quality management. The evaluation focused on each model's accuracy in answering multiple-choice questions related to core healthcare quality domains (Chen et al., 2022; Newton & Xiromeriti, 2024; Sallam et al., 2024a).

3. Materials and Methods

3.1 Selection of AI Models

Over a year and nine months have passed since the release of GPT-4 on March 14, 2023, and as of 2025, more advanced large language models are now publicly available.

ChatGPT4, Gemini, Copilot, Claude, and Perplexity are considered AI-powered models or generative AI tools designed to process and generate natural language responses. DeepSeek is a new Chinese chatbot powered by artificial intelligence, designed to resemble and function similarly to ChatGPT in appearance and user experience (Sallam et al., 2025). Manus AI, introduced in early 2025, marks a development in autonomous general-purpose artificial intelligence, engineered to perform a wide range of tasks with limited human input (Shen & Yang, 2025). These tools leverage advanced natural language processing (NLP) techniques to assist with various tasks, including answering questions, providing explanations, and generating content (Liu et al., 2024a). They represent specific implementations of generative AI tailored for conversational and problem-solving applications.

3.2 Selection of Healthcare Quality Management Questions

The preparation of questions was guided by the need to comprehensively cover the four key domains of healthcare quality as defined by widely accepted professional standards and best practices in the field (Brandrud et al., 2017; Weheba et al., 2020). These domains included organizational leadership, health data analytics, performance and process improvement, and patient safety. The MCQ questions were utilized with written permission from Ahmad (2022). A collection of 20 questions was selected stepwise (Salam et al., 2020). The selected questions were then validated through a two-step process: first, by a panel of three certified healthcare quality and patient safety experts who reviewed the content for accuracy, relevance, and alignment with real-world scenarios, and second, by piloting the questions with a sample group of healthcare professionals to ensure clarity and applicability (Gottlieb et al., 2023). This validation process ensured the questions provided a solid foundation for evaluating the capability of AI models to address the selected healthcare quality domains (Ali & Zahra, 2024). Table 1 presents the validated multiple-choice questions with correct answers and associated healthcare quality domains.

Table 1. Details and domains of the ten questions

Question number	**Question details and MCQ options**	**Correct answer**	**Domain**
1	The leadership style that is said to motivate employees and optimize the introduction of change is: A. Autocratic B. Consultative C. Participatory D. Democratic	C. Participatory	Organizational Leadership
2	Which of the following is most important to the successful implementation of quality improvement activities? A. Financial commitment and written quality management plan B. Leadership commitment and organization-wide collaboration C. Leadership commitment and financial commitment D. Information management system and department collaboration	B. Leadership commitment and organization-wide collaboration	Organizational Leadership
3	Strategic leadership is linked to success in meeting: A. Budget Requirements B. Intended Objectives C. Governing Body Policy D. Contract Requirements	B. Intended objectives	Organizational Leadership
4	In a crisis, when a manager must make a rapid decision, the most effective leadership style is: A. Consultative B. Participatory C. Autocratic D. Democratic	C. Autocratic	Organizational Leadership
5	Leadership during a lengthy period of crisis in the organization is: A. Based on the leader's position in the organization. B. A participative activity performed by anyone committed to lead. C. Dependent on a set of personal characteristics. D. An autocratic style with decisions made solely by the leader.	B. A participative activity performed by anyone committed to lead	Organizational Leadership
6	Which of the following is most helpful in integrating data collected in the performance improvement process? A. Discussing performance improvement findings with senior management B. Developing a performance improvement prioritization matrix C. Creating a scatter diagram using the data D. Integrating the data based on team consensus	D. Integrating the data based on team consensus	Health Data Analytics

7	Evaluating the length of stay & outcome data on cardiac catheterization reveals a direct relationship between adverse outcomes & physician practice patterns. This integrated approach involves correlating: A. Case/Care management & finance B. Utilization & quality management C. Finance & utilization management D. Discharge planning & quality improvement	B. Utilization & quality management	Health Data Analytics
8	A surgeon's wound infection rate is 34%. Further examination of which of the following data will provide the most useful information in determining the cause of this surgeon's infection rate? A. Use of prophylactic antibiotics B. Type of anesthesia used C. Mortality rate D. Facility infection rate	A. Use of prophylactic antibiotics	Health Data Analytics
9	The Critical Care QI Team is chartered to improve the admission process to the critical care units. One identified issue, based on preliminary data, relates to admissions by family practice physicians. The medical director drafts the performance measures and criteria for data collection. The critical care nurses collect the data, and the quality management department staff aggregates and displays the data for the team. What key step is missing? A. Collaboration with the medical staff executive committee and family practice department B. Approval of the project by the family practice department C. Data collection and summarization by the medical staff D. Preliminary information proving that assessment is needed	A. Collaboration with the medical staff executive committee and family practice department	Health Data Analytics
10	Based on most quality improvement standards, those responsible for prioritizing data collection to monitor organization-wide performance are: A. The quality council B. The leaders C. Those most knowledgeable about the process D. Those most experienced with statistical analysis	B. The leaders	Health Data Analytics
11	The best evaluation of a performance improvement plan is: A. Process improvement B. Measurable objectives C. Applicable deliverables D. Timeline	B. Measurable objectives	Performance Improvement
12	Quality performance improvement focused on: A. Process B. System C. Individual D. Steps	B. System	Performance Improvement
13	Which of the following is most helpful in integrating data collected in the performance improvement process? A. Discussing performance improvement findings with senior management B. Developing a performance improvement prioritization matrix C. Creating a scatter diagram using the data D. Integrating the data based on team consensus	D. Integrating the data based on team consensus	Performance Improvement
14	All of the following conditions contribute to system improvement except: A. Measuring the performance of processes and their outcomes using valid statistical methods	D. Identifying and responding to individual performance	Performance Improvement

	B. Taking action to improve the way the processes are designed and carried out C. Studying and understanding the complex process that contributes to care D. Identifying and responding to individual performance issues	issues	
15	The best way to evaluate the effectiveness of performance improvement training is through: A. Self-assessment B. Participants' feedback C. Observed behavioral changes D. Post-test results	C. Observed behavioral changes	Performance Improvement
16	Which of the following national patient safety goals applies to everyone in a health care facility? A. Communication B. Medication safety C. Healthcare-associated infection D. Reconcile medication	A. Communication	Patient Safety
17	In assessing the patient safety culture, what should a quality professional do? A. Survey of all employees and physicians B. Survey patients' last 6 months C. Review collected data through incident reporting D. Review post-surgical infection rate data	A. Survey of all employees and physicians	Patient Safety
18	Which of the following are attributes of the culture of safety? A. Transparency & increased patient acuity level B. Error–proof of environment & empowered staff C. Empowered staff & transparency D. Increased patient acuity level & error-proof environment	C. Empowered staff & transparency	Patient Safety
19	Which of the following additional information should be in a patient safety plan? A. Disaster preparedness B. Steps to improve patient satisfaction C. Equipment management D. Efforts to reduce harm	D. Efforts to reduce harm	Patient Safety
20	The most effective way to ensure patient safety as a dimension of performance is to: A. Sponsor a "hotline" for reporting problems B. Focus on processes and minimize individual blame C. Have leaders who commit to and foster a safe culture D. Encourage patients and families to identify risks	C. Have leaders who commit to and foster a safe culture	Patient Safety

3.3 Data Collection and Analysis

The outputs from the seven AI models were documented for each question answered. Data were collected to enable empirical comparison and ensure response consistency across all models. Annotation was performed using Microsoft Excel by categorizing each AI-generated response as 1 (correct) or 2 (incorrect) based on evaluation with the predefined correct answers reviewed and agreed upon by three certified healthcare quality experts. The 20 multiple-choice questions covered four core domains: organizational leadership (n = 5), health data analytics (n = 5), performance improvement (n = 5), and patient safety (n = 5).

To ensure procedural consistency and eliminate input bias, the full set of twenty questions was submitted to each of the seven large language models (ChatGPT4o, Gemini, Copilot, Claude, Perplexity, DeepSeek, and Manus) using the same structured prompt, on the same day (11th May 2025), and in a standardized order. Each full question set was also entered in a new, independent chat session for each model to prevent prior conversation context from influencing responses. The prompt used was:

"*Act as an expert in healthcare quality management and carefully select the most accurate answer (from options A, B, C, or D) for each of the following multiple-choice questions; present your responses clearly in a table format with columns labeled 'Question number,' 'Selected answer,' and 'Answer details'.*"

All questions were submitted in English to maintain consistency across models. This standardized input protocol enabled a fair, replicable, and unbiased model performance evaluation.

The responses were assessed against predefined correct answers. Data processing and analysis were conducted using Microsoft Excel 2021 and IBM Statistical Package for the Social Sciences (SPSS) Version 30.0. Descriptive statistics were used to calculate the mean and standard deviation of correct and incorrect responses. The accuracy of the AI models was assessed against a target passing score of 70%, determined as an internal benchmark agreed upon by the research team to reflect a minimum threshold for acceptable performance. A Pearson chi-square test of independence was conducted to examine statistical differences in accuracy across the models. A Monte Carlo simulation with 10,000 sampled tables was also performed to confirm the robustness of the result, given small expected frequencies in several cells. Statistical significance was defined as $P < 0.05$.

3.4 Ethical Considerations

This study did not involve human participants, identifiable personal data, or clinical interventions. The evaluation focused exclusively on the performance of publicly accessible AI models using predefined and validated educational content.

4. Results

The performance evaluation of the seven generative AI models demonstrated high and relatively consistent accuracy across models. ChatGPT4.5, Gemini 2.5 Pro, and Claude 3.7 each achieved the highest accuracy rate of 80 percent. Perplexity and Manus followed with 75 percent, while Copilot and DeepSeek each recorded 70 percent (see Table 2 and Figure 1).

Table 2. Performance of Generative AI LLMs in Answering Healthcare Quality Questions

Generative AI Chabot	**Answer**	**N (%)**
ChatGPT4.5	Correct	16 (80%)
	Incorrect	4 (20%)
Gemini 2.5 Pro	Correct	16 (80%)
	Incorrect	4 (20%)
Copilot Think Deeper	Correct	14 (70%)
	Incorrect	6 (30%)
Claude 3.7 Sonnet Answer	Correct	16 (80%)
	Incorrect	4 (20%)
Perplexity	Correct	15 (75%)
	Incorrect	5 (25%)
DeepSeek R1	Correct	14 (70%)
	Incorrect	6 (30%)
Manus	Correct	15 (75%)
	Incorrect	5 (25%)

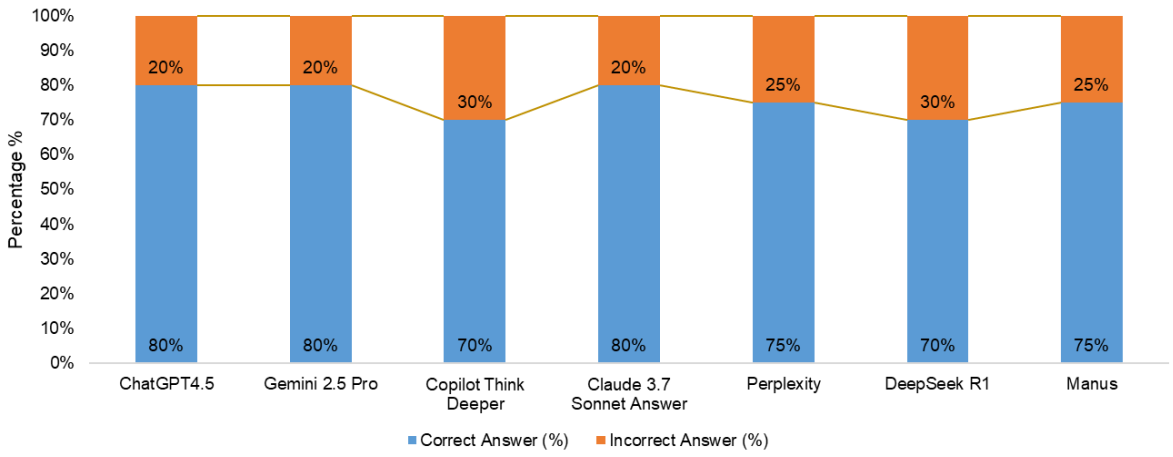

Figure 1. Performance Comparison of Generative AI Models Answering Healthcare Quality Management Questions

Figure 2 illustrates the achieved accuracy scores of each chatbot model relative to the target passing score of 70 percent, showing minor performance differences across models. ChatGPT4.5, Gemini 2.5 Pro, Claude 3.7 Perplexity, and Manus exceeded the benchmark, with the first three achieving the highest score of 80 percent.

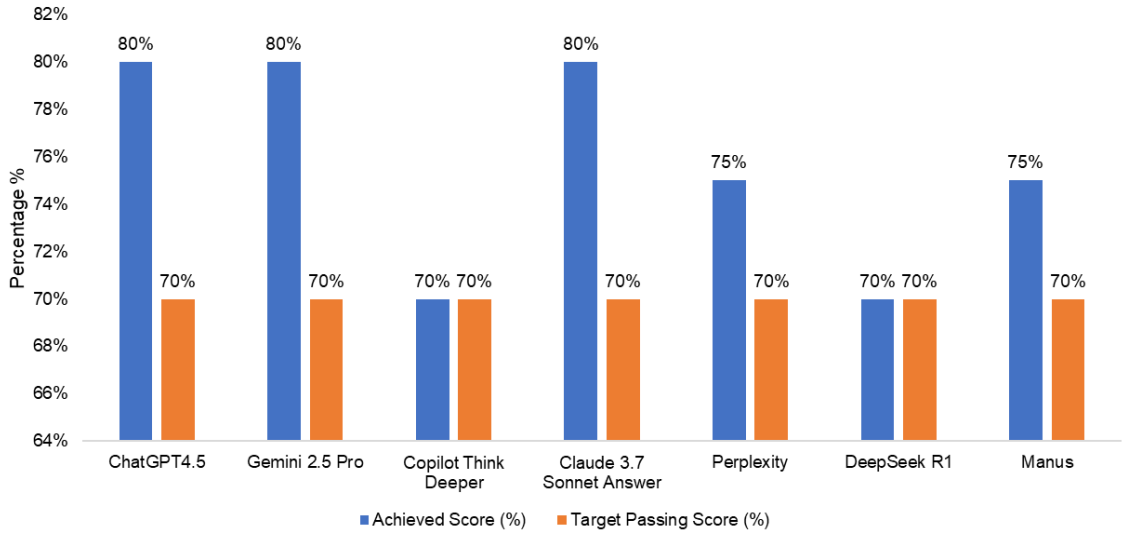

Figure 2. Comparison of Achieved Scores (%) and Target Passing Scores (%) for Generative AI Chatbots in Answering Healthcare Quality Management Questions

Descriptive statistics were used to summarize the responses by answer type across the evaluated large language models (see Table 3). The mean number of correct responses (Answer type 1) was 15.19 (SD = 0.829), while the mean number of incorrect responses (Answer type 2) was 5.00 (SD = 0.853). These findings reflect the overall higher accuracy trend observed across the chatbots, with a total average of 12.71 responses per category (SD = 4.463) out of 140 responses.

Table 3. Mean Number of Responses by Answer Type (Correct vs. Incorrect) Across All Chatbots

Answer response type	Mean	N	Standard Deviation (SD)
1	15.19	106	.829
2	5.00	34	.853
Total	12.71	140	4.463

N: Number of responses.

In addition to overall performance, Table 4 presents the number of correct answers per domain for each model. While all models achieved full scores in the organizational leadership domain, variation was observed in health data analytics, performance improvement, and patient safety, particularly with lower accuracy in selected safety and data interpretation questions.

Table 4. Model Accuracy by Domain (Number of Correct Answers out of 5 per Domain)

Model	**Organizational Leadership**	**Health Data Analytics**	**Performance Improvement**	**Patient Safety**	**Total (out of 20)**
ChatGPT4.5	5/5	4/5	4/5	3/5	16/20
Gemini 2.5 Pro	5/5	4/5	4/5	3/5	16/20
Copilot Think Deeper	5/5	3/5	3/5	3/5	14/20
Claude 3.7 Sonnet	5/5	4/5	4/5	3/5	16/20
Perplexity	5/5	3/5	3/5	4/5	15/20

DeepSeek R1	5/5	3/5	3/5	3/5	14/20
Manus	5/5	4/5	3/5	3/5	15/20

A Pearson chi-square test of independence was conducted to examine the relationship between the type of generative AI chatbot and answer accuracy (correct vs. incorrect). The result was not statistically significant, χ^2 (6, N = 140) = 1.321, *P* = .971, indicating comparable performance across the seven chatbot models. To ensure robustness of the result due to small expected frequencies in several cells, a Monte Carlo simulation based on 10,000 sampled tables was performed. The simulation confirmed the finding, yielding a non-significant *P*-value of .984 with a 95% confidence interval. These results indicate no significant differences in accuracy among the evaluated AI models (see Table 5).

Table 5. Chi-Square and Monte Carlo Test Results for Differences in Accuracy Among Generative AI Models

				Monte Carlo Sig. (2-sided)		
					95% Confidence Interval	
	Value	df	*P*-value	Significance	Lower Bound	Upper Bound
Pearson Chi-Square	1.321[a]	6	.971	.984[b]	.981	.986
Likelihood Ratio	1.314	6	.971	.984[b]	.981	.986
Fisher-Freeman-Halton Exact Test	1.462			.984[b]	.981	.986
N of Valid Cases	140					

a. 7 cells (50.0%) have expected count less than 5

b. Based on 10000 sampled tables with starting seed 2000000

df: Degrees of freedom

5. Discussion

To the best of our knowledge, this is the first study to evaluate the performance accuracy of seven publicly available large language models across four domains of healthcare quality management.

5.1 AI Chatbot Accuracy and Domain-Specific Performance

The performance evaluation revealed that all seven generative AI chatbots met or exceeded the target passing score of 70%. However, a comparison of generative AI models in answering questions demonstrated slightly varying levels of accuracy across the evaluated models (Liu et al., 2024b). ChatGPT4.5, Gemini 2.5 Pro, and Claude 3.7 Sonnet Answer achieved the highest accuracy with 80% correct responses, followed by Perplexity and Manus at 75%, while Copilot Think Deeper and DeepSeek R1 scored 70%. These results showed that the top-performing models slightly outperformed others, but the differences were minor.

The results suggest that the evaluated LLMs exhibit similar accuracy levels when applied to healthcare quality management multiple-choice questions, with no statistically significant variation in their performance. These findings indicate that LLMs, regardless of brand or model, may provide comparable levels of assistance in educational settings. However, while not statistically significant, the observed accuracy differences suggest areas where specific models may require further refinement to enhance reliability in healthcare decision-making.

The analysis revealed that patient safety was the most challenging domain, with all models struggling on multiple questions, suggesting limitations in their ability to interpret complex safety-related concepts. Performance improvement and health data analytics also showed inconsistencies, with several models providing incorrect responses, particularly in data-driven and quality improvement scenarios. In contrast, organizational leadership was the least problematic, as most models performed well. These findings highlighted the need for further refinement in AI models, particularly in domains requiring deeper contextual understanding and clinical reasoning (Ainingkun et al., 2025). Also, AI models can supplement healthcare education but should not replace expert review in high-stakes decisions.

The degree of trust in accuracy and capability will be crucial in shaping the scope and speed of AI LLM adoption in future certification, education, and decision-making processes (Sallam et al., 2024c; Waldock et al., 2024).

5.2 Study Strengths, Limitations, and Recommendations for Future Studies

This study offers several strengths, including a comprehensive comparison of seven widely available large language models—ChatGPT4.5, Gemini 2.5 Pro, Copilot Think Deeper, Claude 3.7 Sonnet, Perplexity, DeepSeek R1, and Manus—in the context of healthcare quality education. The inclusion of validated questions across four core domains and the use of standardized inputs contributed to the reliability and reproducibility of the evaluation. The findings highlight the consistent accuracy of the evaluated models, with all achieving or exceeding the internal benchmark score of 70 percent. The observed performance consistency across chatbots suggests that LLMs may be viable supplementary tools for supporting foundational knowledge in healthcare quality management.

Using accuracy rates as objective performance metrics provided quantifiable insights into model outputs, while including diverse AI platforms strengthened the generalizability of the findings (Sarker, 2022). Moreover, the structured question input and domain-level breakdown enabled a focused assessment of chatbot performance across specific content areas, identifying potential variation in domain-specific accuracy.

However, the study has certain limitations. The number of multiple-choice questions was limited to 20, which may constrain the scope of assessment and overlook broader functional capabilities of the models. The evaluation focused solely on accuracy and did not examine the quality or completeness of chatbot explanations. Additionally, while statistical testing revealed no significant differences among the models, the analysis did not explore model performance variability across individual domains using inferential methods.

As Perkins and Pregowska (2024) noted, overreliance on AI-generated outputs without human oversight may also impact critical thinking and introduce bias embedded in model training data. Furthermore, the findings reflect a specific snapshot in time and may not account for ongoing model updates or changes in API behavior.

Future research should explore the integration of LLMs into real-world healthcare education and assess their effectiveness in supporting professionals in more complex, context-dependent decision-making scenarios (Blacker et al., 2024). Upcoming studies may also benefit from including a larger and more diverse set of questions, comparing chatbot responses with human experts, and evaluating response quality, reasoning depth, and user-friendliness (Strachan et al., 2024). Investigating domain-specific performance using inferential statistics and the models' role in blended learning environments may provide additional insights. Future studies could also incorporate higher-order reasoning assessments to evaluate how well LLMs address conceptual and context-rich healthcare challenges (Mondorf & Plank, 2024).

6. Conclusion

This study evaluated the accuracy of seven large language models, including ChatGPT4.5, Gemini, Copilot, Claude, Perplexity, DeepSeek, and Manus in answering multiple-choice questions related to healthcare quality management. All models met or exceeded the predefined accuracy threshold of 70 percent, with performance ranging from 70 to 80 percent. ChatGPT4.5, Gemini, and Claude achieved the highest accuracy rates at 80 percent, followed by Perplexity, Manus at 75 percent, and Copilot and DeepSeek at 70 percent. The findings indicated comparable levels of accuracy across the models, with no significant differences observed in response distribution. This study highlighted the need for ongoing refinement of AI models to enhance reliability and contextual accuracy in healthcare quality education. Future research should examine the integration of LLMs into professional training and evaluate their effectiveness in real-world decision-support environments.

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Authors Contribution

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Conflicts of Interest

The authors declare no conflicts of interest.

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Abbreviations

AI: Artificial Intelligence

NLP: Natural Language Processing

LLMs: Large Language Models

ChatGPT: A Chatbot Based on Generative Pre-Trained Transformer Large Language Model

JCIA: Joint Commission International Accreditation

MCQs: Multiple-Choice Questions

SPSS: Statistical Package for the Social Sciences

χ^2: Chi-Square test

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Gamification as a Strategy for Enhancing Long-Term Memory of Low-Frequency Vocabulary in Primary English Education

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Abstract

This paper explores the potential of gamification as a strategy to enhance the long-term retention of low-frequency vocabulary in Chinese primary English education. Low-frequency vocabulary—words that occur less frequently in everyday discourse yet are crucial for advanced comprehension and academic success—poses a significant challenge for young learners, particularly in contexts where English is a foreign language. The paper examines the unique obstacles faced by Chinese primary students, including limited exposure to authentic language input, an overreliance on rote memorization, cognitive overload, and a lack of motivation, all of which hinder the deep, meaningful acquisition of rare words. Drawing on cognitive theories of memory, affective engagement, and constructivist learning principles, the paper argues that gamification offers a promising solution by embedding vocabulary learning within interactive, emotionally engaging, and context-rich activities. By facilitating repeated exposure, spaced retrieval, and active use of vocabulary in diverse scenarios, gamified approaches may strengthen memory encoding and retrieval pathways, leading to improved retention of low-frequency words. The paper also discusses potential challenges in implementation, such as balancing fun with learning depth, managing competition and motivation, ensuring age-appropriate design, and addressing issues of equity and access. Ultimately, the paper advocates for the thoughtful integration of gamification into primary English education in China, emphasizing the need for context-sensitive design, empirical research, and pedagogical support to maximize the benefits of gamified learning for vocabulary development.

Keywords: gamification, vocabulary acquisition, low-frequency vocabulary, long-term memory, Chinese primary English education, contextual learning

1. Introduction

Vocabulary acquisition plays a foundational role in language learning, particularly in primary education where learners are building their linguistic competence for the first time. For young learners in Chinese primary schools, acquiring English vocabulary presents unique challenges that stem from linguistic, cultural, and instructional differences. English, as a second language in China, is often introduced in a formal classroom setting with limited opportunities for authentic communication. In these contexts, students frequently encounter a “vocabulary gap,” where high-frequency words receive repeated exposure through textbooks and drills, while low-frequency vocabulary—terms essential for nuanced comprehension and advanced literacy—remains underrepresented and poorly retained.

Low-frequency vocabulary includes words that are less commonly used in everyday conversation but are critical for academic achievement, standardized testing, and global communication. For Chinese primary learners, the cognitive demands of learning English are further compounded by the lack of language-rich environments. Outside the classroom, exposure to English is often minimal, leading to a reliance on rote memorization strategies that may fail to support long-term retention. Research suggests that while students may initially memorize low-frequency words for exams, these words are often forgotten without meaningful reinforcement,

resulting in shallow learning that hinders future language development.

Gamification has emerged as a promising strategy to address these challenges. By integrating game-like elements such as points, badges, levels, and storytelling into educational activities, gamification aims to transform vocabulary learning from a passive task into an interactive and motivating experience. The underlying premise is that engagement, repetition, and emotional involvement—hallmarks of effective games—can significantly enhance the encoding and retrieval processes in long-term memory. Moreover, gamification aligns with contemporary theories of language learning that emphasize active participation, social interaction, and meaningful context over isolated drills. Gamification offers unique potential, it can compensate for the lack of real-life English immersion by creating virtual or classroom-based environments where learners repeatedly encounter and apply low-frequency vocabulary in fun, meaningful ways. Additionally, the competitive and cooperative aspects of games may resonate with cultural learning preferences in China, where group activities and shared goals are highly valued. This paper examines how gamification, as an instructional strategy, can enhance the long-term retention of low-frequency English vocabulary among Chinese primary learners. By exploring cognitive theories of memory, principles of gamified learning design, and the specific needs of Chinese students, this discussion aims to highlight the practical implications and challenges of implementing gamification in the primary classroom setting.

2. The Challenge of Low-Frequency Vocabulary Acquisition

Low-frequency vocabulary refers to words that occur less frequently in everyday language but are nonetheless essential for achieving advanced levels of comprehension, critical thinking, and academic success. These words—often drawn from academic texts, literary works, and subject-specific disciplines such as science, history, or geography—form the backbone of a learner's ability to engage with complex materials, participate in higher-order discussions, and comprehend nuanced information. They are the building blocks of academic literacy, enabling learners to access a wider range of texts, express precise ideas, and succeed in standardized assessments and global communication.

For Chinese primary English learners, the acquisition of low-frequency vocabulary presents a formidable challenge, shaped by a complex interplay of linguistic, cognitive, and pedagogical factors. Firstly, the limited exposure to authentic English contexts in China creates a significant barrier. Unlike high-frequency words—such as "apple," "go," or "happy"—which appear frequently in daily conversations, textbooks, and media, low-frequency vocabulary items like "compass," "generate," or "consequence" are often introduced only sporadically in textbooks, typically within isolated reading passages or exam-oriented exercises. Students may encounter these words briefly during a unit or a test preparation phase but seldom have the opportunity to interact with them in diverse, meaningful contexts. Without repeated exposure, these words remain fragile memory traces, easily forgotten after the immediate learning task has passed.

The prevalence of rote learning in Chinese classrooms exacerbates this issue. English instruction in many primary schools continues to emphasize mechanical vocabulary drills, list memorization, and test-focused preparation. Students are often expected to memorize definitions or word-meaning pairs without engaging in activities that require them to use the words productively in sentences, stories, or conversations. As a result, while learners may be able to recite word lists for a test, they struggle to retrieve and apply these words in authentic communication. This lack of contextual learning undermines the formation of semantic networks—the interconnected mental representations that allow for flexible and meaningful use of language.

The linguistic distance between English and Mandarin further compounds the challenge. English orthography, phonology, and syntax differ significantly from Chinese, making the acquisition of unfamiliar, low-frequency vocabulary a cognitively demanding task. Learners must navigate unfamiliar sounds, spellings, word forms, and grammatical structures, often with minimal support. For primary students, whose cognitive capacities are still developing, this additional cognitive load can lead to overwhelm and reduced retention, particularly when new words are introduced without adequate scaffolding or engaging learning strategies.

Motivation and affective factors play a crucial role as well. Low-frequency words often feel abstract, irrelevant, or disconnected from learners' immediate experiences. Without personal relevance or intrinsic interest, students may perceive these words as tedious or burdensome, leading to disengagement and shallow processing. The absence of emotional engagement reduces the likelihood of elaboration and limits opportunities for creating meaningful, memorable connections to the vocabulary.

Compounding these issues are assessment practices in Chinese primary English education, which often prioritize recognition over productive use. Standardized tests and classroom quizzes frequently focus on matching words to definitions or identifying the correct word in a multiple-choice context, rather than requiring learners to actively use vocabulary in writing or speech. This approach encourages surface-level learning strategies, reinforcing a cycle where students temporarily memorize words for an exam but fail to integrate them into their

working vocabulary for long-term use.

The acquisition of low-frequency vocabulary among Chinese primary English learners is hindered by a lack of authentic exposure, rote memorization practices, cognitive overload, low intrinsic motivation, and inadequate assessment frameworks. These challenges underscore the need for innovative, learner-centered strategies that can create meaningful, repeated encounters with vocabulary, foster deep cognitive engagement, and stimulate emotional connections that promote long-term retention. Gamification, with its capacity to transform learning into an interactive, motivating, and emotionally rich experience, emerges as a promising approach to address these challenges—providing a pathway for students to move beyond memorization towards genuine, durable vocabulary knowledge.

3. Gamification: Definition and Educational Application

Gamification, as a concept, originates from the application of game-design elements and principles to non-game contexts to increase user engagement, motivation, and participation. In educational settings, gamification involves integrating features such as points, badges, leaderboards, levels, challenges, narratives, feedback loops, and rewards into learning activities to transform routine academic tasks into interactive, immersive experiences. The aim is not merely to make learning "fun," but to harness the psychological mechanisms that make games so compelling—such as curiosity, autonomy, competition, collaboration, and a sense of progression—to improve learning outcomes.

In the context of vocabulary acquisition, especially for low-frequency vocabulary, gamification serves several crucial educational purposes. Firstly, it encourages repeated exposure, a key factor in long-term memory formation. Games typically require players to encounter information multiple times across varying contexts—this repetition strengthens memory traces, facilitating the transfer of vocabulary from short-term to long-term memory. For example, a word might appear in multiple mini-games, quizzes, or story-based challenges within a gamified platform, allowing learners to encounter it in different forms, such as spelling, meaning, usage, and pronunciation.

Gamification enhances emotional engagement, which is a critical component of memory retention. According to the affective filter hypothesis in second language acquisition (Krashen, 1982), learners acquire language more effectively when their anxiety is low, and motivation and interest are high. Gamified learning environments, by design, create a sense of excitement and curiosity, reducing stress and fostering a positive emotional climate that is conducive to deeper learning. Gamification facilitates contextual learning. Instead of presenting vocabulary in isolation, gamified tasks often embed words within meaningful narratives or problem-solving scenarios. For instance, a digital game might place learners in a fantasy world where they must solve quests using newly learned words, thus promoting semantic richness and helping learners form stronger mental associations between words and their meanings. Gamification aligns with constructivist learning theories, which emphasize active participation, exploration, and discovery over passive reception of information. Learners in a gamified environment are often given autonomy and choice, such as selecting challenges, customizing avatars, or exploring virtual spaces, which can lead to greater ownership of the learning process. These elements align with self-determination theory (Ryan & Deci, 2000), which posits that motivation is enhanced when learners feel competent, autonomous, and connected to others—qualities that gamification inherently fosters. In addition to cognitive benefits, gamification can address motivational challenges faced by learners of low-frequency vocabulary. Such words are often perceived as abstract, disconnected, and tedious to learn. Gamified approaches transform this learning into a goal-oriented activity with clear rewards, providing instant feedback and tangible markers of progress. For example, achieving a "Vocabulary Master" badge or climbing a leaderboard can instill a sense of achievement, motivating learners to continue engaging with the material.

Gamification has a scalable potential in the digital era. With the advent of educational technologies, teachers can leverage apps, learning management systems, and platforms like Kahoot, Quizlet, or custom-designed games to integrate gamified vocabulary learning into classrooms. These tools allow for adaptive learning, where the system adjusts the difficulty of tasks based on individual learner performance, ensuring that each student receives an appropriate level of challenge. Gamification in vocabulary learning is not simply about entertainment; it is a pedagogical strategy grounded in cognitive science and motivational psychology. It offers a dynamic, student-centered approach that can address the unique challenges of low-frequency vocabulary acquisition in Chinese primary English education. By fostering engagement, providing repeated and meaningful exposure, and creating emotional connections, gamification has the potential to transform vocabulary learning from a passive chore into an active, enjoyable, and effective process.

4. Mechanisms Linking Gamification to Long-Term Memory

Gamification enhances long-term memory retention through a convergence of cognitive, affective, and social mechanisms that are deeply rooted in both educational psychology and neuroscience. Understanding these

mechanisms provides a theoretical foundation for why gamification can be particularly effective in supporting the acquisition of low-frequency vocabulary in Chinese primary English education.

4.1 Repetition, Spaced Retrieval, and the Spacing Effect

One of the most well-established principles in cognitive psychology is the spacing effect, which suggests that information is more effectively encoded into long-term memory when exposures are distributed over time rather than massed in a single session. Gamification naturally lends itself to spaced retrieval, as learners engage with vocabulary across multiple game sessions, levels, and challenges. This distributed practice strengthens the neural pathways associated with each word, reducing the rate of forgetting (as described by Ebbinghaus's Forgetting Curve) and facilitating more durable retention.

In a gamified system, repetition is not monotonous but varied and contextualized, which further enhances retention. For instance, encountering a word in a quiz, a matching game, and a role-playing scenario provides multiple retrieval pathways—supporting the elaboration of memory traces. Each retrieval acts as a form of "memory re-consolidation," reinforcing and updating the mental representation of the word.

4.2 Emotional Engagement and Affective Memory Encoding

Emotions play a powerful role in learning and memory. According to neuroscientific studies, emotionally charged experiences trigger the release of neurotransmitters like dopamine and norepinephrine, which enhance the encoding of information in the hippocampus—the brain's memory center. Games, by design, evoke emotions such as excitement, curiosity, and even tension (in competitive settings), which contribute to stronger and more vivid memory traces. The reward system in the brain, particularly the dopaminergic pathways, is activated when learners achieve goals or overcome challenges in a game. The anticipation of rewards, such as points or badges, can increase motivation and dopamine release, which not only enhances engagement but also reinforces the salience of the learned material. This emotional connection creates a more meaningful and memorable learning experience compared to traditional rote learning.

4.3 Contextual Learning and Semantic Networks

Gamification situates vocabulary within rich, meaningful contexts, which is essential for building robust semantic networks in the brain. Unlike isolated word lists, games embed words into narratives, challenges, and problem-solving scenarios, facilitating deeper processing (Craik & Lockhart, 1972). For example, learning the word "compass" in the context of a treasure hunt game allows learners to associate it with navigation, adventure, and exploration, forming a multi-dimensional memory trace that is easier to retrieve later.

Contextual learning also promotes dual coding (Paivio, 1986), where verbal and visual representations of a word are processed simultaneously. A word learned through an interactive game with visual cues, animations, and sounds is encoded more richly than a word seen in a static list, leading to stronger recall and transfer.

4.4 Active Learning, Problem-Solving, and Cognitive Load Management

Games inherently encourage active learning, where students interact with content rather than passively receive information. This interactivity supports constructivist learning theories (Vygotsky, 1978), which posit that learners build knowledge through exploration and social interaction. Gamified environments often include problem-solving tasks, which require the application of vocabulary in new contexts, reinforcing comprehension and retention. Gamification can help manage cognitive load by breaking complex tasks into manageable chunks (levels or quests) and providing scaffolding such as hints, feedback, and immediate corrections. This supports learners in navigating the challenge of low-frequency vocabulary without becoming overwhelmed, facilitating more efficient cognitive processing and encoding into long-term memory.

4.5 Social Interaction and Collaborative Memory

Many gamified learning environments incorporate social elements, such as team challenges, leaderboards, or peer feedback, which create opportunities for collaborative memory formation. Research shows that discussing and negotiating meaning with others can deepen understanding and improve retention. When learners work together to solve a puzzle or win a team-based game, they reinforce vocabulary knowledge through peer teaching, repetition, and elaboration, which are key strategies for durable learning.

5. Empirical Evidence

While empirical studies specifically targeting Chinese primary English learners and gamification for low-frequency vocabulary acquisition remain relatively limited, a growing body of international research highlights the positive impact of gamification on vocabulary learning across various age groups and educational contexts. These findings offer valuable insights that can be cautiously extrapolated to the Chinese primary education context, given shared cognitive and motivational mechanisms in language learning.

5.1 Gamification and Vocabulary Gains: Global Findings

Numerous studies have demonstrated that learners exposed to gamified vocabulary activities consistently outperform those in traditional, non-gamified environments. For example, research by Viberg and Grönlund (2013) found that mobile-assisted language learning platforms incorporating gamified features (e.g., points, challenges, leaderboards) led to higher levels of vocabulary retention compared to textbook-based learning. Similarly, Plass et al. (2015) highlighted that game-based learning environments promote deeper engagement, resulting in better recall in both immediate post-tests and delayed assessments.

Meta-analyses, such as those by Huang and Soman (2013) and Hamari et al. (2014), further reinforce the effectiveness of gamification, noting that the motivational impact of game elements (e.g., immediate feedback, rewards, progression systems) enhances learners' willingness to engage in repetitive practice, a key factor in vocabulary retention.

5.2 Digital Tools and Chinese Learners

Within the context of Chinese EFL learners, preliminary studies have begun to explore the impact of gamified learning tools on motivation and vocabulary acquisition. For instance, research on the use of Kahoot and Quizlet in Chinese classrooms (e.g., Zhang, 2020) has shown significant improvements in learner engagement, participation, and self-reported vocabulary growth. Students reported that gamified platforms made learning "less boring" and "more like playing," leading to increased voluntary participation in vocabulary review activities.

A study by Li and Tsai (2021) investigating a gamified mobile app for English vocabulary learning among Chinese primary students found that learners in the gamified group exhibited higher post-test scores and improved delayed recall after a 4-week intervention, compared to a control group using traditional flashcards. The researchers attributed these gains to the emotional engagement and contextual variety provided by the gamified activities.

5.3 Sustained Motivation and Long-Term Effects

Empirical research also suggests that gamification not only boosts short-term vocabulary acquisition but also supports long-term retention—a critical goal for low-frequency vocabulary learning. For example, Chen et al. (2018) demonstrated that students using a gamified vocabulary app showed significantly higher recall rates even six weeks after the initial learning session compared to a control group. This sustained retention was linked to the use of spaced repetition algorithms, adaptive challenges, and reward systems embedded in the app.

While these findings are promising, the field still faces notable gaps. Most existing studies focus on secondary and university-level learners, with limited research directly examining primary-aged learners in the Chinese EFL context. Furthermore, few studies differentiate between high-frequency and low-frequency vocabulary outcomes, making it difficult to draw definitive conclusions about the specific impact of gamification on rarer vocabulary items. Given these limitations, there is a pressing need for context-specific studies that explore how gamification interacts with cultural, linguistic, and pedagogical factors unique to Chinese primary education. Questions remain about the optimal design of gamified activities for younger learners, the balance between intrinsic and extrinsic motivation, and the long-term transferability of gamified vocabulary learning to real-world language use.

6. Challenges and Considerations

While gamification offers exciting opportunities for enhancing vocabulary learning, its implementation in Chinese primary English education presents several critical challenges and considerations that must be addressed to ensure its effectiveness, inclusivity, and alignment with broader educational goals.

6.1 Balancing Engagement and Learning Depth

One of the most significant risks of gamification is the potential for superficial engagement—where students become more focused on earning points, badges, or winning competitions than on deeply understanding and applying the vocabulary. This phenomenon, sometimes called "pointsification," can result in shallow learning, where learners memorize words for short-term gains but fail to develop meaningful, long-term retention. Teachers must ensure that gamified activities are designed to prioritize cognitive engagement, requiring students to use vocabulary in meaningful contexts rather than merely recognizing definitions or completing low-level tasks.

6.2 Managing Competition and Motivation

While competition can be a powerful motivator for some students, it can also create a demotivating and anxiety-inducing environment for others—particularly for younger or less proficient learners who may feel discouraged by consistently low rankings on leaderboards. In the Chinese cultural context, where educational success is highly valued, excessive competition can lead to fear of failure, loss of face, and withdrawal from participation. To mitigate this, educators should design gamified systems that balance competitive and

collaborative elements, such as team challenges, cooperative quests, and opportunities for peer support, ensuring that all learners feel included and valued.

6.3 Cognitive Load and Age-Appropriateness

For primary learners, gamified activities must be carefully tailored to developmental stages and cognitive capacities. Games that are overly complex, fast-paced, or rich in stimuli can lead to cognitive overload, where learners struggle to process both the game mechanics and the vocabulary content simultaneously. This is particularly relevant when introducing low-frequency words, which already pose a higher cognitive challenge. Effective gamification should employ age-appropriate designs, provide clear instructions, and incorporate gradual scaffolding to support learners in navigating new words without overwhelming them.

6.4 Alignment with Curriculum Goals and Assessment Practices

Gamification should not exist in isolation from the broader curriculum and assessment frameworks of Chinese primary English education. Teachers must ensure that gamified activities align with syllabus objectives, vocabulary lists, and national standards, such as the Ministry of Education's English Curriculum Standards for Compulsory Education (2022 Edition). Moreover, while gamified platforms often track participation and scores, these metrics may not always reflect deeper language competencies like productive use, contextual understanding, or long-term retention. Educators must thoughtfully integrate formative assessments into gamified activities—such as reflective tasks, oral presentations, or contextual sentence writing—to capture a more holistic picture of vocabulary learning.

6.5 Equity, Access, and Digital Divide

The increasing reliance on digital tools for gamified learning raises important questions about equity and access. Not all schools in China, especially in rural or under-resourced areas, have access to reliable internet connections, digital devices, or technical support. This digital divide can exacerbate educational inequalities, leaving some students with fewer opportunities to engage in innovative learning activities. Additionally, teachers may require professional development and training to effectively implement gamification tools, as unfamiliarity with technology or game design principles can lead to ineffective or tokenistic applications.

6.6 Teacher Workload and Pedagogical Shifts

Designing and integrating effective gamified learning experiences requires time, creativity, and pedagogical expertise. Teachers must select appropriate tools, align activities with learning objectives, monitor student progress, and adapt games to meet individual needs. In contexts where teachers already face heavy workloads and tight curriculum schedules, this additional demand may lead to burnout or superficial implementation. Schools and educational authorities must therefore provide institutional support, including training, resources, and time allocation for lesson design.

7. Conclusion

Gamification holds significant promise as a transformative strategy for enhancing the long-term retention of low-frequency vocabulary in Chinese primary English education. By integrating game mechanics such as points, rewards, challenges, and narratives into vocabulary learning, gamification creates a motivating, interactive, and emotionally engaging environment that directly addresses the challenges faced by young learners, including limited exposure, low intrinsic motivation, and the tendency for rote memorization. The dynamic nature of gamified learning aligns with core principles of memory science, such as spaced repetition, retrieval practice, and contextual learning, offering a powerful means to consolidate vocabulary into long-term memory. Beyond cognitive benefits, gamification reshapes the emotional landscape of learning by transforming abstract, infrequent words from static list items into meaningful, emotionally resonant experiences. Whether through solving puzzles, collaborating with peers, or achieving personal milestones, learners engage with vocabulary in ways that foster curiosity, a sense of achievement, and social interaction—factors essential for sustained attention and deeper retention.

The successful implementation of gamification in Chinese primary classrooms is not without challenges. It requires careful pedagogical design to ensure that activities align with curriculum standards, are age-appropriate, and promote equitable access for all students. Without thoughtful integration, there is a risk that gamification could lead to superficial learning focused on point accumulation rather than deep understanding. Furthermore, cultural sensitivity is critical, as excessive competition or overemphasis on extrinsic rewards may have unintended effects on student motivation and classroom dynamics. Technological infrastructure and teacher training also play vital roles, as access to digital tools and the ability to design meaningful gamified activities vary widely across schools in China. Ethical considerations, such as data privacy, screen time management, and the potential psychological impacts of gamification, must also be carefully addressed to ensure that gamified learning environments remain safe, healthy, and focused on pedagogical goals. Future research should explore

the longitudinal effects of gamification on vocabulary retention, particularly for low-frequency words, and investigate which game elements are most effective for different learner profiles. Studies that examine cultural factors, the balance between intrinsic and extrinsic motivation, and the impact of gamification on productive language use, rather than mere recognition, are urgently needed. Additionally, research into how teachers can be empowered through training and resources to effectively implement gamified learning is essential for sustainable integration. While gamification is not a panacea, it represents a promising, evidence-informed strategy for addressing persistent challenges in vocabulary learning. By harnessing the motivational power of games and embedding them in sound pedagogical practice, educators can create rich, meaningful learning environments that support Chinese primary learners in developing the linguistic skills they need for academic success and lifelong language learning. The future of gamification in vocabulary learning lies in collaborative efforts among researchers, educators, and policymakers to ensure its thoughtful, inclusive, and effective application in diverse educational settings.

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