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Development and evaluation of E-Learning for Professional Bus drivers in Tanzania

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Abstract

The commercial transport sector is threatened with many (severe) traffic injuries and deaths, especially in African countries like Tanzania. The primary causes are limited driving skills and knowledge about traffic safety, and risky driving behaviours (e.g., driving at high speed, driving while under the influence of alcohol, being distracted by mobile phones, and tiredness. The study assesses the effectiveness of e-learning for professional bus driver training in Tanzania. The research involved document analysis, interviews, and a survey of 153 participants, including drivers and trainers. Results indicate that e-learning is well-received and effective in improving knowledge and potentially reducing road accidents. Customized e-learning training modules with a tailored learning management system were developed to address the specific needs of commercial drivers in Tanzania and improve road safety. The interviewed experts positively reacted to the developed e-learning program, hoping it would improve safety and eco-driving. Overall, the study indicates that e-learning can be a valuable tool for modernizing driver training, improving safety standards, and creating a safer driving environment in Tanzania and beyond.

Keywords: professional bus drivers, curriculum, e-learning, Tanzania

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1. Introduction

Professional drivers, such as bus and truck operators, are crucial in ensuring road safety ([1] [2]. Their job is not just about transporting passengers or goods safely; they also carry the responsibility to their profession through their training programs on a global scale [3]. Previous studies and organizations emphasize the importance of proper education for these drivers [4] [5]. For example, the International Labour Organization (ILO) points out the importance of keeping drivers safe and healthy at work, supporting the argument for prioritizing their education [6] [7].

The United Nations (UN) advocates for standardized driver education worldwide [8]. As part of its efforts, the UN supports the implementation of comprehensive training programs aimed at reducing road accidents and fatalities by 50% by 2030 [9]. Programs like the Graduated Driver Education (GDE) in the European Union help improve driver knowledge, make drivers more aware of risks, and encourage them to think about their driving habits [10]. Moreover, e-learning in countries like the UK, Germany, and the US makes driver training more flexible and accessible, which could help reduce road accidents [11].
In Africa, however, progress is hindered by limited resources and inconsistent regulations, despite initiatives like the East Africa training curriculum [6] [12]. South Africa and Kenya are progressing towards incorporating e-learning in their

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training strategies, with Kenya enhancing its Technical and Vocational Education and Training (TVET) with ILO support [13] [14]. On the other hand, Tanzania continues to rely on traditional classroom-based instruction for its bus driver training program. Introducing e-learning in Tanzania could significantly improve driver training, align it with international standards, and improve road safety.

1.1 Driver education in Tanzania

The commercial transportation industry faces a significant challenge of road accidents resulting in injuries and deaths **[7].** According to statistics from the World Health Organization (WHO), despite having only 60% of the world's vehicles, low- and middle-income countries account for 92% of road traffic deaths, with a staggering 1.19 million fatalities globally each year **[15]**. The European Agency for Safety and Health at Work also reports that professional drivers have a high risk of death in road traffic accidents, with 85% caused by human errors (United Nations Conference on Trade and Development **[16].**

In East Africa include Tanzania, factors such as inadequate training, inattentiveness, drunk driving, drug use, over speeding, wrong overtaking, poor knowledge of traffic rules, and physical disability contribute to road accidents **[17] [18]** . Commercial drivers are at a higher risk of such crashes due to driving long distances, over speeding, fatigue, weather conditions, and road curvature **[19] [20]**. However, research shows that there is a severe shortage of professionally skilled commercial drivers in East Africa, with only 38% of transport operators having undergone a professional course in transport **[21].** The lack of qualified drivers is further compounded by the prevalence of unsafe driving practices, such as driving under the influence of alcohol or drugs and engaging in illegal activities while on duty **[21]**. To mitigate this issue, a structured practical driving training program that includes awareness of potential hazards and avoidance measures, training facilities, and qualified trainers for commercial drivers is required **[22] [23]**.

While driver education is widely seen as a way to improve road safety, Akbari et al. [**24]** suggest it has not reduced crashes, injuries, or deaths. However, their study's lack of impact could be due to the teaching methods or course content not working, mismatches in how adults learn best, or the programs not targeting the specific risky driving behaviours that cause the most accidents. China's driver training overhaul 2013 addressed road safety concerns with stricter training (mandatory hours, attendance tracking) and a more arduous 4-subject exam. The new system emphasizes traffic knowledge and practical skills, including simulator tests, on-road manoeuvres, and safe driving awareness to reduce road accidents **[25]**. In 2015, the National Institute of Transport (NIT) in Tanzania implemented a commercial driver curriculum for buses and trucks **[21]**. In 2016, the program expanded into a standardized Professional Driver Training program across East Africa, including Kenya and Uganda **[26].** The initiative is supported by organizations such as GIZ and Transaid and is funded by BMZ, DFID, and NORAD. The training covers traffic laws, mechanics, and customer care, with varying durations across different countries. The current training program for commercial drivers in Tanzania heavily relies on traditional classroom instruction.

However, online services are gradually being incorporated into driver training through institutions like the Tanzania Revenue Authority (TRA), NIT, and Land Transport Regulatory Authority LATRA **[18]**. The effectiveness of online technology in commercial driver training has been demonstrated in developed countries such as Europe and the United States, leading to improvements in road safety **[27] [28]**.

1.2 Driver education worldwide

Driver education programs are continuously evolving, and it is crucial to scientifically evaluate their effectiveness before widespread adoption **[27] [29]**. Several studies have shown that training programs can help drivers acquire the skills and knowledge to prevent traffic crashes caused by fatigue, distraction, and reckless driving **[28]**. For example, the European Union (EU), the United States (US), and Canada have implemented successful training programs to improve commercial driver behaviour [24] **[30]**. Even in Africa, initiatives like South Africa's FleetWatch showcase the value of comprehensive driver training, which integrates practical learning with ongoing assessments **[13] [14]**. In recent years, there has been a shift towards more comprehensive training methods, including uses user-friendly online tools and optimized Learning Management System (LMS) with simulations and quizzes, enhancing learning and safety **[31]**.
A LMS can benefit truck and bus drivers by providing specialized training modules covering driving techniques, safety protocols, and regulatory compliance tailored to their needs. For instance, logistics companies in the US and UK utilize LMS to train their global workforce of drivers on safety protocols and operational efficiency **[30] [32]**.

Recent research suggests that the education provided to commercial drivers may need to be enhanced to meet the demand for operating Advanced Driver Assistance Systems (ADAS) and future Automated Vehicles (AVs) **[33]**. Safe operation of these technologies requires a specific skill set, including understanding system limitations and high-level cognitive abilities **[8].** This is similar to the practice in the aviation and maritime industries, where ongoing training is crucial for optimal performance **[33].** Like pilots and maritime crews, ADAS users will likely need continuous education to adapt to advancing technology and ensure safe operation **[29]** .

In developed countries, professional commercial drivers must undergo periodic training before renewing their driver's license. For instance, in the EU, professional drivers must undergo mandatory training for 35 hours each five years **[11]**. Digital tools such as online training modules incorporated with LMS and Artificial Intelligence (AI) powered virtual reality simulations can significantly enhance these training programs **[32].** For instance, the United Kingdom (UK) Driver and Vehicle Standards Agency offers practice tests where

drivers watch videos and click on the screen when they see a developing hazard [8]. Another study suggests video-based training may be more effective, particularly for females, in reducing cognitive load and improving ADAS use [34]. However, developing countries like Tanzania lack enough modern training programmes for commercial drivers. This is mainly due to insufficient funding, outdated facilities, and lax enforcement. As a result, there is a heavy reliance on minimal formal education and extensive on-the-job training, resulting in a workforce that needs more skills and experiences higher accident rates. Additionally, current programs only use classroom and practical methods. Finding innovative solutions to transform driver education in these regions is essential.

1.3 Study focusses and contributions

Based on the literature review above, an e-learning (blended) curriculum, which combines traditional classroom learning with e-learning technology and assessment, could be interesting for commercial driver training in Tanzania. However, this area has yet to be extensively explored in Tanzania. Therefore, this study explores the potential use of e-learning to enhance traffic knowledge and awareness among commercial drivers in Tanzania. This study aims to assess the training methods for commercial bus drivers in Tanzania and create an e-learning framework with optimum LMS to improve road safety. The goals are to modernize driver training, raise safety standards, and establish a scalable e-learning model specific to Tanzania. The study will focus on evaluating the effectiveness of current training in teaching road safety and understanding stakeholders' views on digital learning. Ultimately, the aim is to develop a well-structured e-learning platform for educating professional bus drivers.

2. Methods

2.1 Document analysis

The research examined the East African Community (EAC) Standardized Driver Training Curriculum for bus drivers. The theoretical and practical aspects were analysed, including the curriculum's objectives, content, structure, delivery methods, and assessment techniques. Additionally, procedures for renewing a commercial driver's license were checked and how they integrate with training programs. The priority on road safety for commercial drivers by national regulations and the EAC curriculum were also considered.

Literature on the guidance and legislation of training programs for commercial drivers was investigated, focusing on the feasibility of online or eLearning platforms and LMS for bus and truck drivers. This involved searching on platforms such as Elsevier using keywords like "guidance and legislation for commercial drivers" and "professional drivers." The study covered resources from various continents, organizations, and specific countries, including national websites, to identify suitable content for an online and LMS for bus driver training programs in Tanzania.

The validity and credibility of this secondary research are maintained through reputable sources. Key sources include documents from the International Road Transport Association (IRU) and the European Union (EU), both well-regarded authorities in the field. Additional sources from government websites and reputable academic studies further enhance the credibility of the research. All documents were publicly accessible, ensuring transparency and ease of verification.

2.2 Survey and interview

This research extends a master's thesis conducted by Magoti [12] in Dar es Salaam, Tanzania. Data for this study were gathered through an online survey using Qualtrics, a platform provided by Hasselt University, and semi-structured interviews. The survey was conducted over three weeks, from February 7th to February 28th, 2021. Each of the 153 participants who completed the survey spent an average of 5 minutes on it. Participants from NIT, VETA, road safety NGOs, and bus drivers in Dar es Salaam collaborated with LATRA, the regulatory authority overseeing commercial transportation safety in Tanzania. The participants completed the survey voluntarily, without any financial compensation or incentives.

Semi-structured interviews were conducted to assess the readiness for eLearning and its effect on bus driver training at the NIT. The participants were drawn from various organizations: five officials from NIT, one from the LATRA, and one from the Union of Tanzanian Women Lawyers (UMAWATA), all located in Dar es Salaam, Tanzania. These interviews occurred between 8:30 AM and 9:10 AM East Africa Time. On average, discussions with NIT and LATRA representatives lasted 40 minutes, while the conversation with the UMAWATA officer was around 30 minutes. Follow-up discussions highlighted LATRA's initiation of a new driver certification process in 2023. This new process includes online registration and computer-based tests for commercial drivers, which aims to make the license renewal and certification process more efficient. Moreover, 20 participants were in the pilot test of the eLearning training, which involved one trainer from NIT, one officer from LATRA, and 18 bus drivers on the defensive driving module. Ethical approval was received by the Tanzania Commission for Science and Technology (COSTECH) under reference number 2023-898-NA-2023-975.

2.3 Data analysis

The study involves an analysis of the strengths, weaknesses, opportunities, and threats (SWOT) of the EAC of Passenger Service vehicle driver curriculum and document analysis to investigate the international approaches. Surveys and interviews were conducted with NIT, VETA, and LATRA. The data was analysed using SSPS Version 29, focusing on descriptive statistics, handling multiple responses, and

showing how different categories, like people's backgrounds and views on e-learning, are connected. The study also used chi-square tests to determine what makes e-learning appealing to people and to see its effects on knowledge enhancement, skill improvement, attitudes towards road safety, and its role in reducing road accidents. For an interview, the study used NVivo version 15, a computer program that helps organise and understand interview information. First, what was said in the interviews was typed and put into NVivo. Then, the main points were picked out. With more examination, these points were grouped into themes like how e-learning is growing, what people think about it, how courses are designed, how comfortable people are with technology, pressure from jobs, and the advantages of studying online. Ultimately, these themes were brought together to show the valuable insights from the study clearly.

3. Results

3.1 The SWOT Analysis of EAC Passenger Service vehicle driver curriculum

The curriculum review found it well-structured with a precise aim to improve driver competency and overall transport efficiency in the EAC [12] [35]. It covers essential areas like safe driving, vehicle maintenance, and regulations. The EAC's standardized driver training program for passenger vehicles shows promise in boosting driver competency and regional transport efficiency. It tackles critical areas like safe driving and regulations with a balanced theory and practical training mix. However, a closer look reveals a need for more detailed practical assessments, addressing language barriers, and incorporating training on new vehicle technologies.

A SWOT analysis (see Figure 1) offers a deeper dive into these strengths, weaknesses, opportunities, and threats. Overall, the program presents a positive step for the EAC, but refinements can maximize its impact on road safety and transport efficiency. This is a list, note the hanging indent. This is a list, note the hanging indent. This is a list, note the hanging indent. This is a list, note the hanging indent. This is a list, note the hanging indent. This is a list, note the hanging indent.

3.2 Document analyses to investigate International Approaches to E-Learning Commercial Driver Training

This research examined the use of e-learning in commercial driver training programs from different countries (see Table 1).

The study aimed to analyse these international models to identify best practices that could be applied to the specific context of Tanzania.

Figure 1: SWOT analysis of reviewed curriculum of EAC Passenger vehicles driver training programme

Table 1 International Approaches to E-Learning for Commercial Driver Training

Location	Guidance/ Legislation	Focus	Literature source
UK	Driver Certificate of Professional Competence (DCPC) program	Risk perception, defensive driving, eco- friendly driving, customer service	[9] [10] [11] [36]
ASIA	Online logistics training/remove barrier for CPC	Supplemental online modules for Driver Commercial drivers	[29] [37] [38]
EU	Driving License Directive revision and Driver CPC course (eDCPC)	New mobility challenges, digital tools, legal requirements, safety protocols, vehicle maintenance, health considerations, vulnerable road users	[27] [39] [40] [41]

Africa	Study on commercial driver's training and compliance	Lack of training in areas like Trafficking in Persons and emerging technologies. Potential opportunity for online refresher courses.	[12] [13] [24] [26] [42]
Australia	Guidance and legislation for professional driver training	Foundational knowledge via online training with LMS, practical skills through in-person instruction methods.	[10][43] [44] **[45]**
Canada	National Safety Code	Comprehensive online training for professional drivers with topics like defensive driving, risk detections, customers care with optimized LMS	[19] [46]

3.2 Survey results

3.2.1 Demographic characteristics

Regarding occupation status, 55.6% identified as bus drivers, 8.5% as trainers, and 35.9% fell into the 'other' category. Regarding holding a bus driving license, 74.5% reported having one, while 25.5% did not. Regarding driving experience, 9.8% had less than one year of experience, 13.1% had one to two years, 19.6% had three to five years, and 13.7% had more than five years of experience, with a notable 43.8% of data missing in this category. Among the respondents, 62.1% were bus drivers, 8.5% were trainers, and 29.4% were students familiar with driver training. The survey revealed a diverse educational background among the participants, with 37.2% being university graduates, 32.3% having completed secondary school or lower, and 25.5% being college-educated. The respondents were involved in operating different types of buses: 32.6% long-distance, 28.4% BRT, 25.3% transit (daladala), and 13.7% school buses, representing a wide range in the industry.

3.2.2 Summary of Driving Training and Related Opinions

Table 2 below summarises survey results on the drivers' observations based on the driving schools attended, the procedures applied to renew driving licenses, and the perceived benefits of assessing bus drivers to streamline for eLearning. Age groups categorize the data: less than 25 years, 25 to 34 years, and greater than 35 years. The total number of respondents for each category is also provided. In terms of adherence to traffic laws, 64.9% of drivers consistently comply, attending training before license renewal, while 35.1% comply only by periodically remitting the license fee.

Table 2: Survey Results by Age Group and Total Respondents

Item	Age <25	25 - 34	>35	Total
Opinion on Driving training theory				
35 hours	5	22	8	35
40 hours	0	8	5	13
72 hours	3	9	3	15
Opinion on practical training				
17 hours	1	3	0	4
20 hours	3	10	5	18
28 hours	2	9	4	15
Driving school attendance				
National Institute of Transport (NIT)	6	46	18	70
Vocational Educational and Training Authority (VETA)	4	22	11	37
Both NIT and VETA	7	28	21	56
Procedure applied to renew the driving licence				
After successful completion of bus driver training at NIT	3	18	5	26
Sit the official Traffic driving test	0	7	2	9
Paid for renewed license fee without bus driver training	4	14	10	28
All the above	2	6	3	11
Benefit of assessing the bus drivers				
Increased professionalism	0	13	7	20
Observes unique personal qualities	7	29	15	51
Identify the ways they learn best	6	21	14	41
Strengthen their skills and health	10	22	16	48
Increased road safety	5	18	6	29

3.2.3 Awareness, opinion toward usage of online tool and training module for LMS

According to the survey data, 66% of respondents are familiar with E-learning training methods, while 34% are not. Regarding opinions on using E-learning for professional bus driver training, responses vary: 31.4% are highly willing to adopt it, 24.8% show moderate willingness, and 11% feel unable to embrace E-learning. When it comes to preferred devices for accessing E- learning content, the majority choose smartphones 39.4%, followed by computers 23.1% and desktops 16.3%. Additional details about the module (see Figure 2).

Moreover, chi-square tests reveal significant associations supporting the study's key findings. Stakeholders show high awareness and acceptance of e-learning methods, with a strong consensus on its use in professional bus driver training and positive attitudes towards its potential to improve road safety ($\chi^2 = 120.47$, df = 5, $p < .001$). E-learning significantly enhances drivers' knowledge and practices ($\chi^2 = 67.33$, df = 1, $p < .00$) and highlights the importance of training before license renewal ($\chi^2 = 41.02$, df = 1, $p < .001$). There is substantial support for the adequacy of training components and the perception of professional driver training's role in improving traffic safety ($\chi^2 = 236.42$, df = 2, $p < .001$). Furthermore, data strongly support that e-learning can reduce road accidents, demonstrated by the significant association between eco-driving practices and reduced fuel consumption ($\chi^2 = 63.15$, df = 4, $p < .001$) and the belief that e-learning enhances road safety measures ($\chi^2 = 159.14$, df = 5, $p < .001$).

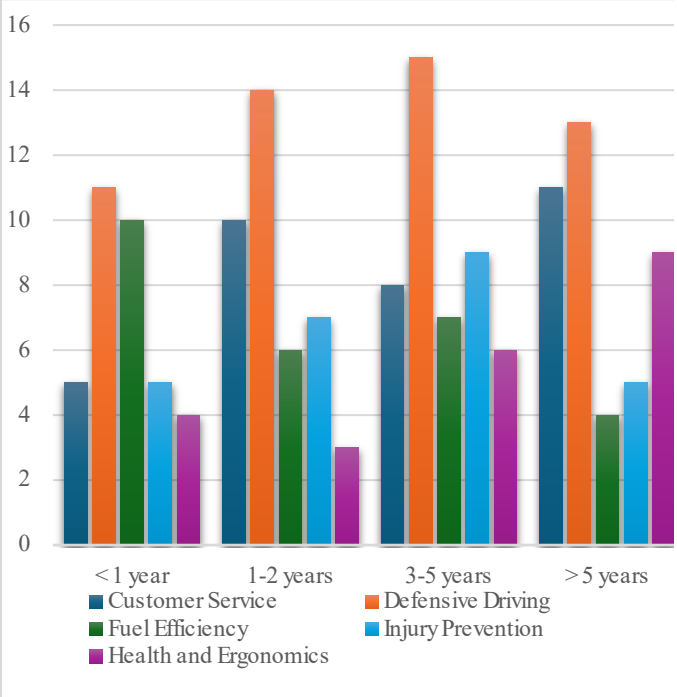

Figure 2: Preferred Training module by Driving Experience

3.3 Interview results

In interviews, UWAMATA's chairman and drivers supported the adoption of eLearning. They emphasized initiating a pilot study and specialized instructor training aligned with NIT and LATRA recommendations. LATRA emphasized the importance of professional training for drivers whose licenses expired in 2019, advocating for a periodic training curriculum to enhance road safety. They noted the efficacy of digital processes, including computer-based tests and online registration, which bolstered road safety through a vehicle tracking system monitored by LATRA. Safety efforts are supported by video clips on various social media platforms. In 2023, 7,580 drivers were registered, with only 2,769 of them examined and only 1,613 passing the driver certification at LATRA. Additionally, drivers who failed the driving examination for commercial vehicle qualification, including buses and trucks, were suggested to return to driving schools such as NIT and VETA for refresher courses, which are not currently available.

LATRA's data report describes commercial vehicle drivers' challenges when applying for computer-based exams. Within this report it is mentioned: "Many lack adequate preparation and have not yet had refresher courses if their initial training was long ago. High pressure from employers to take the exam adds to their stress. Additionally, there is fear and discomfort with using ICT facilities for the examination. Many drivers are unaware of the exam's importance, and the fear of failing further exacerbates their anxiety". This highlights the importance of eLearning, which, when integrated with an optimized LMS, can be highly beneficial for commercial drivers by monitoring their performance before and after exams.

3.4. Development of eLearning modules

The eLearning modules were created using best practices identified through literature reviews, surveys, and stakeholder interviews. Based on this information, six modules for Tanzania's professional bus driver training program were developed, including Traffic Rules, Defensive Driving, Injury Prevention, Fuel-Efficient Driving, Health and Ergonomics, and Customer Service. Each module is designed for 40 to 60-minute sessions to understand each area thoroughly. The proposed pilot eLearning modules for bus drivers can be seen in Figure 3 and Table 3 below. The updated training includes interactive elements such as quizzes, simulations, and hands-on activities to improve understanding of concepts (Table 3). This enhanced program is developed based on survey feedback and follows the European CIECA-RUE model [11] [12]. It incorporates multimedia tools to make learning more practical and engaging, and course progress is monitored through the LMS to elevate driving and safety standards in Tanzania.

Table 3 Summary of E-Learning Training Framework for Professional bus driver

Module	Objective	Content	Assessment
Traffic Rules	Understand traffic laws and regulations	Traffic laws, road signs, speed limits	Quizzes, road sign exercises
Defensive Driver Training	Prevent accidents through defensive driving	Defensive driving principles, hazard avoidance, safe distances	Simulations, judgement tests
Injury Prevention	Prevent injuries for drivers and passengers	Ergonomics, lifting techniques, seat belts	Videos, practical exercises
Fuel-Efficient Driving	Reduce fuel consumption and costs	Efficient driving, vehicle maintenance	Fuel tracking, eco-driving simulations
Health and Ergonomics	Promote driver health and well-being	Health check-ups, nutrition, stress management	Wellness activities, health quizzes
Customer Service	Improve passenger interactions	Communication skills, handling difficult passengers	Role-playing, feedback analysis

3.5 The proposed LMS layout for professional driver training programme

A new driving training system is being developed for use in Tanzania. Its features include interactive learning options and easy access to different driving techniques. The aim is to improve the way driving knowledge is shared and learned. This system also seeks to bring more openness to the training process for instructors and drivers, especially when renewing licenses is time. This should help reduce corruption and make driving safer.
A trial was run using free learning management software to test this idea. This trial showed that instructors could quickly set up the system, create detailed courses, and control who accessed these courses. Instructor(s) were also able to give feedback on assignments and quizzes efficiently. It was found that the courses could be accessed on a wide range of devices, such as smartphones, tablets, and laptops, or even in traditional classroom settings at driving schools. The 20 driver participants volunteered to be trained in one module on defending driving, which involved texts, pictures, and short videos that were easy to access and get feedback from the trainer and trainee. 80% of the participants completed the course and got good marks (see Figure 3).

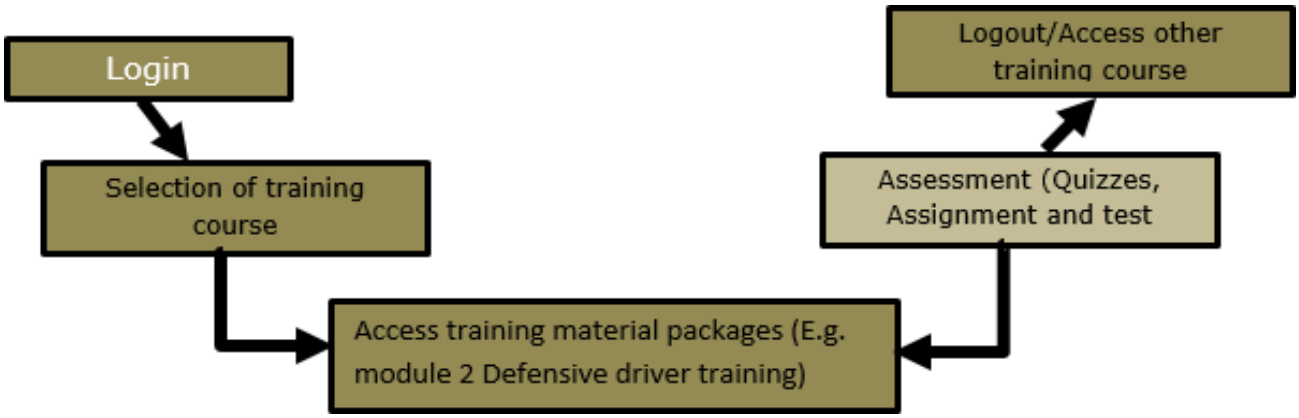

Figure 3: The structure of proposed the prototype of eLearning

4. Discussion

4.1 Driver education in Tanzania

This study aimed to create a new approach to learning that increases awareness of road safety among professional bus drivers. It involved evaluating the current curriculum and exploring the potential of an eLearning platform for commercial driver training. The document analysis describes the current professional bus driver training in Tanzania, highlighting several ongoing issues that need attention. These issues are consistent with global studies that have identified similar challenges. For instance, a study in India by Nilekani, **[47]** pointed out that bus driver training programs need more practical elements. Similar concerns were raised in research from Iran and China by Taravatmanesh et al. **[48]** and Zhang et al. **[49]**, respectively, where bus drivers had poor safety-related knowledge and skills. In African countries, including Tanzania Nigeria and South Africa **[6] [12] [23] [50]** commercial drivers need more awareness about the requirements for obtaining a driver's license. This issue is exacerbated by weak enforcement of regulations, highlighting a widespread need for improvements in driver training programs and regulatory practices to enhance road safety.

The current curriculum for commercial bus drivers in Tanzania has effectively improved road safety skills and knowledge **[12] [22] [47] [51]**. This competency-based curriculum sets minimum standards for drivers of large commercial vehicles, including freight and passenger transport. However, some areas need improvement, such as more detailed practical assessments, addressing language barriers, and incorporating training on new vehicle technologies. A SWOT analysis of the EAC Curriculum has identified these strengths and weaknesses. While the program is a positive step, refining it could further enhance its impact on road safety and efficiency.
Best practices in professional bus driver training worldwide, particularly in Canada and Sweden, show that comprehensive training programs are essential for safety and efficiency. Canadian programs typically last 12 weeks, while Swedish ones last for 10 weeks. According to studies by Akbari et al., **[24]** and Elvebakk et al. **[11]** these programs blend classroom learning with hands-on practice, among others. The European Directive 2003/59/EC also outlines the need for 35 hours of periodic training for commercial drivers, including theory and practice **[6] [27]**. There is a growing recommendation for Tanzania to adopt a client-centred approach to bus driver training. This would mean including relevant training content and offering flexible hours for theoretical and practical lessons, similar to what is seen in developed countries such as alternative training methods such eLearning. This approach, supported by researchers Ji-Hyland & Allen **[10]** could significantly enhance road safety and fuel economy in Tanzania, as pointed out by Runyoro et al. **[52]**.

4.2 Survey and Interview insights

The study provided a deep understanding of people's thoughts and feelings about eLearning by using surveys and semi structured interview. Everyone involved, like drivers, instructors, and policymakers, was positive and supportive of using eLearning methods. This optimistic view is backed up by findings from a study in Malaysia by Harith and others in 2019, which found that online learning significantly helps improve drivers' knowledge and skills. A survey showed that many participants know about eLearning and are open to using it for job training. This shows that eLearning could be successful and famous **[10] [34]**. However, the survey also found that people have different driving experiences and education levels. eLearning programs must be customized to fit everyone's learning speed and knowledge. The recommended modules should be accessible via smartphones, tablets, and laptops, which aligns with most respondents' preference for smartphone-based training for professional drivers (Loizides, 2019).

An interactive platform, suggested by Elvebakk et al., **[11] [53]** would promote active engagement through embedded assignments, quizzes, and tests. This platform could also adopt gamification techniques, which have been found beneficial according to previous studies **[24]** and the Ex-post evaluation report by European Commission, . Preventing Road Accidents and Injuries for the Safety of Employees (PRAISE) in 2011 portrayed the bus driver training methods include online training **[43]**. These elements, aimed at motivating bus drivers internally, have been supported by various European research, including the PRAISE report the EU's legislative framework concerning professional driver training **[27] [30]**. These documents recommend eLearning tools for long-distance driver training. Additionally, efforts in Europe and the USA have identified the importance of safe driving, the social environment's influence, and integrating smartphones into driving safety as key to altering drivers' behaviours, according to Murtaza et al. **[33]** and Peer et al. **[54]** .

The interviewees discussed how eLearning could make roads safer by improving professional bus driver's training. Officials from LATRA said regular training for renewing a driver's license and using digital methods and computer tests could help with road safety**[33] [44] [54]**. However, there were some problems mentioned. Some drivers feel pressure from their jobs and need to be more comfortable using technology **[34] [50]**. This highlights the need for special programs like basic tech training and continuous support to help drivers feel more confident using digital **tools [27] [53]**.

4.3 Trial of the LMS Prototype

The trial of the LMS prototype involved 20 participants, including one trainer from NIT, one trainer from LATRA and 18 bus drivers who tested the module on defensive driving. This module featured accessible texts, pictures, and short videos. Trainers and trainees found it easy to use and effective for providing feedback. The trial showed high completion rates, with 80% of participants completing the course and achieving high marks. This aligns with experiences from studies in Australia and Canada, where eLearning modules combined with practical skills training have shown significant improvements in driver competency and road safety **[13] [30] [33]**. Also, adding game elements to learning, as shown by Akbari et al. **[24]** can make trainees more eager to learn about safety on the road.

4.4 Implications and Recommendations

Adding eLearning to Tanzania's bus driver training can make driving safer and improve the transport system. A study found much support for eLearning. However, challenges like technology issues and pressures from employers need to be solved. Using intelligent digital tools and keeping the training content fresh and relevant can help Tanzania upgrade its driver education. This can lead to safer roads and more efficient transport. Participants like the idea of eLearning. Early tests with an eLearning platform and analysis showed that a well-planned eLearning program could improve the current training. It is essential to keep talking with everyone involved, monitor progress, and update the eLearning content to keep it helpful for bus drivers. This way, road safety and transport efficiency can get better over time.

4.5 Limitations of study and future study

The study on eLearning for bus drivers in Tanzania is a big step but has some limits. It only looked at a few drivers from Dar es Salaam because of the COVID-19 pandemic, limiting the generalizability of the findings. Future studies should expand to include drivers from various regions across Tanzania to gain a more comprehensive understanding of eLearning adoption. Additionally, the study did not fully explore cultural perceptions of online learning among drivers, which is crucial for successful implementation.
Future studies should expand beyond Dar es Salaam to include drivers from various regions in Tanzania, providing a broader perspective on eLearning adoption. Research should focus on drivers aged 25-50, assessing their willingness, attitudes, and digital literacy through surveys and focus groups. A detailed implementation plan is needed to address adoption challenges, accessibility, and learning module design. Engaging key stakeholders such as LATRA, traffic authorities, and fleet companies will be crucial. Additionally, integrating GPS tracking into eLearning and raising awareness among fleet operators about its benefits can enhance driver competence, road safety, and operational efficiency.

5. Conclusion

Introducing eLearning could significantly improve driving education in Tanzania by making roads safer and drivers

more knowledgeable. Research found that online courses are better than traditional classes, leading to fewer accidents. Countries using eLearning noticed that drivers improved at spotting dangers, had better attitudes, and drove more eco-friendly. This method not only helps reduce accidents but is also beneficial for driving schools and companies by allowing for better feedback and ensuring rules are followed.

Feedback on eLearning has been positive, indicating it could fill current training gaps effectively. A successful online program needs continuous updates and input from everyone involved to ensure it meets drivers' needs. This effort will lead to safer roads and more efficient transportation in Tanzania.

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Competing interests

The authors declare no conflict of interest.

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