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# Open Distance Learning as a Catalyst for Enhancing Digital Literacy and Green Technology in Technical and Vocational Education and Training (TVET) in South Africa

Motlatsi Cletus Lehloka[1]

**Abstract**

*The aim of this paper is to investigate how Open Distance Learning (ODL) might improve digital literacy and support green technologies within the Technical and Vocational Education and Training (TVET) sector in South Africa. Case studies and interviews with teachers, students, and industry partners engaged in TVET programs were used in a qualitative approach. Thematic study of the data clarified how ODL affects digital literacy and the acceptance of green technologies. The results show that ODL greatly increases student access to instructional resources, hence promoting digital literacy. It helps to include green technologies within the course so that students have the necessary understanding for sustainable living. The study stresses the need of tools and ongoing assistance in order to enjoy these benefits. This paper shows how ODL may be a transforming instrument in the South African TVET sector. It underlines the need of digital competences and sustainability in vocational education, thereby providing fascinating data for legislators and educational institutions trying to increase the relevance and efficiency of TVET programs in a fast-changing technology environment.*

**Keywords:** *Digital literacy, green technology, TVET and 4IR..*

## Introduction

The modern scene of fast technology development in education calls for the change of paradigms of knowledge acquisition (Rodney, 2020). Technical and Vocational Education and Training (TVET) mostly depends on digital technologies and platforms to provide students the tools required for success in a fast-changing digital economy (Grech and Camilleri, 2020). Right at a turning point, South Africa is negotiating social challenges while committed to improving its educational system (Plagerson et al., 2019). Digital literacy and sustainable technology are mostly driven in the TVET sector by Open Distance Learning (ODL) (Njuki, 2023). This introduction attempts to clarify their complex interrelations and place ODL, digital literacy, and green technology within the South African context (Rzyankina, 2024). Rooted in the ideas of accessibility and flexibility, ODL lets students interact with instructional resources and materials anywhere, therefore overcoming geographical limitations (Netanda, 2020).

South Africa, where education quality is vastly different from other countries, finds this approach ideal (Madani, 2019). ODL enables people from diverse backgrounds to participate in vocational training and gain technical abilities by democratizing education and fostering inclusivity (Memon and Memon, 2025). The importance of ODL in enhancing educational outcomes cannot be overstated, especially in a country with alarmingly high rates of youth unemployment (Valiente et al., 2020). ODL offers a way for people to pick skills fit for the demands of the contemporary workforce by using digital platforms (Alenezi, 2023). A key component of the skill set of the twenty-first century, digital literacy is becoming more and more important for people negotiating the complexity of modern society (Chu et al., 2021). It covers a spectrum of skills, from the competent use of digital tools to the critical evaluation of online material to the capacity for effective communication in digital contexts (Caena and Redecker, 2019).

Digital literacy is not only a complementary ability in the framework of TVET; it is also necessary for the proper delivery of vocational training and the extension of skills needed for many sectors (Banga and te Velde, 2019). Including digital literacy into TVET courses is especially important since sectors rely on current technologies to generate demand for a workforce with digital literacy (Odondi et al., 2022). Moreover, the junction of digital literacy with green technologies offers a special chance to forward South

[1] University of South Africa, Department of Electrical and Smart Systems Engineering: lehlomc@unisa.ac.za

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African sustainable development (Amoah, 2024). The pressing demand for environmentally friendly technology, which includes various approaches to lessen negative impacts on the environment, is on the rise as a result of both climate change and resource scarcity (Nurhas et al., 2022). Including green technologies into TVET courses not only gets students ready for a sustainable living but also conforms to local, national, and international environmental protection laws (Pavlova, 2019).

ODL programs have to include green technologies if we are to increase the relevance and application of vocational education and ensure that students are ready to contribute to build a sustainable future (Li et al., 2023). South Africa's educational initiatives have to complement the Sustainable Development Goals (SDGs) as well as the National Development Plan (NDP) (Hendrickse, 2023). The NDP emphasizes the need of a qualified workforce ready to drive social and economic development (Matyana and Thusi, 2023). In this view, especially for poor populations, ODL serves as a strategic tool for enhancing access to education and training (Dwivedi et al., 2022). By means of ODL, South Africa may foster digital literacy and green technology, therefore tackling the skills gap that has historically impeded social justice and economic growth (Upadhyaya, 2024).

Furthermore, underlining the need of digital transformation in education is the COVID-19 epidemic (Mhlanga et al., 2022). Many educational institutions were driven to turn to online and remote learning models when conventional classroom-based learning was disrupted (Yusuf and Taiye, 2021). This shift underlined the difficulties with digital inequalities as well as the possibilities of ODL to support continuity in education (Czerniewicz and Carvalho, 2022). The epidemic has acted as a spur for reevaluation of educational delivery and pushed participants to investigate creative ideas using technology to improve learning results (Ahmed and Opoku, 2022). In this regard, the combination of digital literacy and green technology inside ODL systems becomes even more relevant since it prepares students to negotiate the complexity of a post-pandemic society (Cegielski, 2023). Examining how ODL might be a catalyst for improving digital literacy and green technologies in TVET requires one to take into account the body of current studies on these subjects (Mngomezulu).

Numerous studies have examined the impact of OLD on educational equity and access, highlighting its potential to mitigate disparities in conventional educational institutions (Conto et al., 2021). Research indicates the necessity of digital literacy in enhancing job advancement and employability, particularly in technology-driven sectors (Ebom-Jebose, 2025). Focusing on the convergence of digital literacy and green technology, scholars have highlighted the importance of educational programs that foster sustainable habits and environmental awareness, as well as the significance of these activities (Lo, 2024). ODL has great potential to improve digital literacy and green technologies, although some obstacles remain (Maphosa and Bhebhe, 2019).

Effective ODL deployment is greatly hampered by problems including the digital divide, poor infrastructure, and restricted access to dependable internet connection (West, 2015). Moreover, a crucial factor still is the necessity of ongoing professional development for teachers in using digital tools and including green technologies into courses (Daniela et al., 2018). Collaboratively removing obstacles is essential if leaders from various organizations, including government, academia, and business, are to create a climate that is favorable to open and distance learning (Kezar, 2006). Basically, by increasing digital literacy and green technologies, ODL is a game-changing instrument in TVET that solves social and educational concerns in South Africa (Avento and Louw, 2020). ODL is becoming more and more vital in arming students with the tools they need to succeed in a fast-changing environment by advocating sustainability, diversity, and accessibility (Mtombeni, 2020). Combining ODL's method of strategic implementation with a focus on digital literacy and green technology will help to produce a workforce ready to confront the challenges of the twenty-first century as South Africa negotiates her road towards a more equitable and sustainable future (Ramdass and Masithulela, 2016).

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## Literature Review

Recently under criticism for its approach to technology, online learning, and digital literacy is the South African TVET system (Huang and Mayisela, 2024). By allowing students to access course materials and teachers from anywhere, ODL helps to remove geographic restrictions (Ghosh, 2012). ODL has greatly enhanced the access to education in neglected rural parts of South Africa (Letseka and Pitsoe, 2012). Among the main policy concerns of the South African government nowadays are ODL. For this reason, the 2012 main Development Plan stresses the need of inclusive educational institutions (Legotlo, 2014). This guarantees, in turn, that ODL is seen by people as a technique capable of somewhat lowering educational disparity (Makhanya et al., 2013). ODL's utilization of innovative technology and pedagogical techniques yields better educational accessibility and quality (Iqbal and Ahmad, 2010).

ODL's natural adaptability lets one customize it to fit different students' requirements and preferences, therefore fostering a special learning environment (Sharma, 2024). The increasing need for practical skills and abilities highlights even more the advantages of TVET's flexibility (Kasim et al., 2018). Digital literacy is the capacity of one to engage and communicate successfully in a digital context (Morgan et al., 2022). Regarding TVET, students must be able to make good use of technology if they are to succeed in employment of today (Denhere and Moloi, 2021). As educators who are teaching students to satisfy the demands of contemporary companies, TVET courses ought to include digital literacy (Lee et al., 2022). Studies conducted among TVET students reveal that ODL greatly increases digital literacy (Raban and Mayisela, 2024).

Participating in ODL programs, for example, students demonstrated higher proficiency in digital abilities including seeking information online, working with others online, and using digital tools to solve problems (Manichander, 2020). Moreover, ODL is not time-sensitive, so students might engage in self-directed learning, which boosts their confidence and independence by means of technology (Maphalala et al., 2025). Green technology is the idea of inventions meant to support environmental protection and sustainability (Zhang and Li, 2020). Including green technologies into TVET courses is crucial for equipping students to help to meet Sustainable Development Targets (SDGs) (Legusov et al., 2022). As a signatory to the SDGs, South Africa has given the shift to a green economy top priority, hence sustainable practices must be included into technical and vocational education (Josopu, 2023). The need of arming TVET students with green technology knowledge and abilities (Manyati et al., 2024). The researchers contend that by giving access to current materials and sustainability-oriented training courses, ODL may help to speed this process (Sarpong et al., 2022). Moreover, ODL can raise knowledge of environmental problems and inspire among students' responsible behavior, therefore complementing the more general goals of the South African government to build a sustainable society (Department of Higher Education and Training, 2019). ODL, digital literacy, and green technology taken together offer a special chance to improve TVET's efficacy in South Africa (Mbatha, 2024).

While introducing students to green technology, ODL provides a means for delivering digital literacy training (Barrie et al., 2021). In the framework of the Fourth Industrial Revolution (4IR), when technology developments are transforming sectors and calling for a workforce that is both technologically savvy and ecologically concerned, this synergy is especially pertinent (Oosthuizen, 2022). In ODL's all-encompassing classroom, green technologies and digital literacy may coexist (Isaacs, 2023). ODL has the ability, to provide students access to a wide range of materials, including webinars, interactive platforms emphasizing on acquiring digital skills and environmental habits (Richard and Musa). By using this unified strategy, ODL aims to better educate TVET graduates to fit the demands of the modern work scene (Zwezwe, 2022).

ODL may help to improve digital literacy and support green technologies within TVET, although various obstacles still exist. Still a major obstacle is dependability of internet access, especially in rural places (Nthutang, 2021). The digital gap accentuates already existing disparities, therefore restricting chances for underprivileged people to interact with ODL successfully (M´endez-Dom´ınguez et al., 2023). Teachers engaged in ODL also require constant professional development to make sure they are ready to provide high-quality education combining digital literacy and green technologies (Brenya, 2024). Maximizing the

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effect of ODL on TVET results in South Africa depends on overcoming these obstacles (Madimabe, 2020). ODL might act as a catalyst for improving digital literacy and advancing green technologies inside TVET in South Africa (Nyembe, 2022). ODL can provide students with the required abilities to flourish in a fast-changing digital environment and help to contribute to sustainable development by offering flexible and easily available learning chances (Quinn et al., 2019). Realizing ODL's full potential in this environment, nevertheless, depends on resolving issues with access and instructor readiness (Mudau and Van Wyk, 2021).

## Methodology

This paper uses an exclusive-methods approach to examine how ODL may improve digital literacy and support green technologies within the TVET sector in South Africa. To give a complete knowledge of the phenomena under study, the research design employs qualitative approach. This method is very useful in investigating complicated educational events as it allows the data sources to support conclusions and improve the validity of the outcomes (Hatch, 2023). Teachers, students, and managers engaged in some of the TVET institutions in South Africa make up the target group for this study. Public, private, and community-based colleges as well as other areas and kinds of TVET schools were guaranteed representation via a stratified random selection method.

A systematic questionnaire was created to evaluate participants' opinions on ODL's efficiency in improving digital literacy and supporting green technologies for the quantitative component. Three elements comprised the questionnaire:

- Demographic data,
- Digital literacy evaluation, and
- opinions regarding green technology incorporation.

While the perceptions segment used a Likert scale to evaluate attitudes about ODL and green technology, the digital literacy assessment had items testing participants' ability in several digital abilities. To guarantee dependability and clarity, the questionnaire was first evaluated on forty people. After the pilot test, required changes were done, and the last version was sent electronically to the chosen participants via email and online survey systems.

Semi-structured interviews with a purposeful sample of teachers and managers from the chosen TVET colleges complemented the qualitative results. The interview process was meant to investigate participants' experiences and viewpoints on the use of ODL, the difficulties encountered, and the supposed influence on digital literacy and green technologies education. Application of the six-stage framework to the qualitative data allowed for theme analysis. Familiarizing oneself with the data, creating first codes, looking for themes, defining and labeling themes, and then creating the final report comprised this procedure. The theme study sought to spot important trends and ideas on ODL's contribution to increasing digital literacy and green technologies in TVET. The results were validated by member checking, which let participants examine and offer comments on the themes found.

Although this study seeks to shed important light on how ODL could improve digital literacy and green technologies in TVET, certain constraints have to be admitted. the results of this study could not be applicable to every TVET institution in South Africa given the particular setting of the selected ones. The study is to help to clarify efficient pedagogical practices that can improve educational achievements in this important area by using qualitative data.

## Results

The study sought to establish how ODL would improve digital literacy and green technologies within TVET in South Africa. Three key themes:

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- The influence of ODL on digital literacy,
- The incorporation of green technology in TVET curriculum, and
- The general efficacy of ODL as a pedagogical strategy in developing skills relevant to the changing labor market-formulate the findings.

ODL seems to have a notable favorable effect on TVET students' degrees of digital literacy. Based on the qualitative data collected, most respondents demonstrated that using ODL platforms directly enhanced their digital abilities. Essential in today's digital economy, students noted their growing mastery in using instructional software, online research tools, and collaboration platforms.

Furthermore, the qualitative study of student comments showed that ODL created a flexible learning environment whereby students could acquaint themselves with several digital tools at their own speed. One student said, for example, "the online modules enabled me to explore different software applications without the pressure of a traditional classroom setting". As students were free to search for extra tools and materials that matched their study, this adaptability seems to have encouraged a deeper involvement with digital technology. Teachers also pointed out that ODL helped to include digital literacy instruction into the syllabus. Emphasizing the value of digital skills in current vocational training, most teachers said they included digital literacy elements into their courses. Along with improving their technical abilities, this integration helped students to be ready for a workforce depending more and more on digital competences. The results also highlight how ODL projects are driving increasing focus on green technologies inside TVET curricula. The study underlined how ODL systems helped organizations to efficiently obtain and spread current knowledge on sustainable technology and practices.

ODL allowed course materials to quickly include freshly developed green technology concepts, according to interviews with curriculum developers. "With ODL, we can quickly update our courses to include the latest advancements in renewable energy and sustainable practices, ensuring our students are equipped with relevant knowledge", one designer of a curriculum said. In a subject that is always evolving dependent on environmental problems and technological developments, this adaptability is quite crucial. With most students saying they were more aware of sustainable technologies and their applications in many areas, students showed excitement for the green technology course offered by ODL. Virtual labs and webinars among other interactive online tools let students interact with ideas in a real-world setting, therefore fostering a better understanding of green technology. Another main focus of the research was the general efficiency of ODL as a training instrument in improving abilities appropriate for the changing labor environment. The results reveal that ODL not only improved digital literacy and understanding of green technology but also made TVET graduates mor employable. Amazingly, the companies surveyed indicated that they valued people with strong knowledge of digital capability and sustainable practices.

ODL helped students acquire important soft skills, like the capacity to manage their time effectively, study on their own, and collaborate to solve challenges. Students said that ODL's framework encouraged them to participate more actively in their own education, therefore strengthening their marketable abilities. One company says candidates have to be ready to work with and adjust to new technology. Companies really want these qualities, and ODL graduates seem to have them. The findings of this study show that ODL is a great tool for improving digital literacy and incorporating green technologies into South African TVET. The results imply that ODL not only gives pupils necessary skills but also gets them ready for a time when digital competences and sustainable practices will be top priority. ODL therefore is an essential part of the continuous evolution of TVET as it helps to match educational results with the needs of a workforce changing fast.

## Discussion

ODL gives South Africa a special opportunity to promote digital literacy and adopt environmentally friendly technology. It adopted the TVET paradigm. This speech underlines the several ways in which ODL may

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achieve these objectives, including its ability to reduce contemporary educational inequalities and promote the acceptance of sustainability by means of its impact. South Africa has a unique opportunity to increase digital literacy and the adoption of sustainable technologies through the integration of ODL within the TVET curriculum. This article outlines some of the various ways ODL might help with environmental protection goals, sustainable behaviour promotion, and bridging existing learning gaps. For students, improving digital literacy is absolutely necessary; ODL in TVET helps them to reach that aim. In the modern digital scene, one needs to be competent in digital technology and negotiate it skillfully.

Apply sustainable practices to reach national targets for environmental protection and economic growth. One clear advantage of ODL in TVET is its capacity to satisfy a need of students to improve their digital literacy. Modern, dynamic digital terrain depends on effective use and navigation of digital technology. ODL systems give students access to a wealth of materials so they may acquire fundamental knowledge in digital communication, information technology, and online teamwork. Given the ongoing differences in access to technology and educational resources in South Africa, this is especially important there. Institutions may democratize access to high-quality education by using ODL, therefore promoting an inclusive atmosphere that prepares students for the competences needed in the modern workforce. ODL's participation in environmentally friendly technology initiatives highlights the need of sustainability in learning environments. As businesses search for creative environmentally friendly solutions, TVET courses become more and more important in the green technology industries. To further this link, ODL offers sustainable living courses, renewable energy, and customized and easy resource management tools. To students, concrete examples, interesting tools, and realistic exercises show the advantages of sustainable technology. Apart from improving their competency, this greatly influences their views on sustainability and creativity.

Furthermore, the application of ODL in TVET might motivate cooperation among government agencies, business companies, and academic institutions. ODL projects may guarantee that courses stay relevant and comply with business demands by means of partnership. Such cooperation may also help to share resources and best practices, thereby improving the general standard of vocational education. Moreover, the participation of business partners in the creation of ODL materials guarantees that students possess the competencies companies want, therefore enabling more seamless transitions into the employment. Still, the effective use of ODL in TVET presents some difficulties. Problems including poor infrastructure, restricted internet connection in remote locations, and different degrees of digital literacy among teachers and students have to be addressed. Policymakers and educational leaders have to provide infrastructure and training top priority so that ODL may be used as a tool to improve education rather than wasted. Moreover, encouraging a culture of ongoing professional development for teachers guarantees their ability to provide high-quality online learning.

In the scene of South African TVET, ODL offers great promise as a transforming tool. By means of increasing digital literacy and promoting green technologies, ODL may equip students with essential skills, therefore supporting more general objectives of economic development and environmental sustainability. Knowing this calls for cooperation among all the participants to address current issues and provide an instructional environment fit for the twenty-first century. ODL is an essential tool moving advancing South Africa towards a more fair and sustainable future.

## Conclusions

Under the context of TVET in South Africa, this paper has investigated the major contribution of ODL in improving digital literacy and supporting green technologies. The results reveal that ODL is a transforming agent addressing the urgent demands of a fast-changing employment environment and environmental issues as well as an educational tool. Including digital literacy into TVET by ODL would help students acquire the required skills to succeed in a technically driven economy. Businesses depend more and more on digital tools and platforms, so negotiating such becomes rather important. The study underlines that ODL provides flexible and conveniently available learning possibilities, thereby allowing a wide spectrum

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of students even those residing in far-off areas to gain necessary digital skills. Bridging the digital divide that once excluded some people in South Africa depends on this inclusiveness.

The study stresses the need to include green technologies within TVET courses. Demand for qualified experts in sustainable technology is rising as the world faces realities of environmental damage and climate change. ODL allows students interact with innovative ideas promoting sustainability by helping green technology to be widely distributed. Encouragement of environmental stewardship not only gets students ready for the job market of today but also gives them the ability to help to create a better future. Moreover, the results underline the need of strong support systems to go with ODL initiatives. Good OLD implementation in TVET calls for costs in infrastructure, learner support services, and teacher development initiatives. First of all, companies should create thorough plans ensuring that teachers and students are ready to negotiate the obstacles of online learning environments main relevance. Furthermore, helping to build a coherent strategy to raise green technology knowledge and digital literacy will be government, educational institutions, and industry participants working together

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