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# Applying PESTEL Factors to Enhance Sustainable OHS E-Learning: A Theoretical Model for Adult and Continuing Education

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**Abstract:** The purpose of this paper is to apply Political, Economic, Social, Technical, Environmental and Legal (PESTEL) factors to e-learning in Higher Education Institutions (HEIs) with specific reference to sustainability and occupational health and safety (OHS). The use of Massive Open Online Courses (MOOCs) is also indicated. To this end, a theoretical model is proposed for adult and continuing education. The main constructs relating to ODeL and learning are explored through a systematic literature review and SCOPUS analysis. Applicable global directives, academic publications and other relevant documentation informed this analysis. Findings informed a proposed model for applying PESTEL factors to enhance sustainable OHS e-learning, indicating that such model should incorporate the focus areas of Open Distance e-learning (ODeL), the reimagined PESTEL factors, and a SWOT analysis to take cognisance of internal and external factors that can be helpful or harmful. These elements should inform the development of an OHS MOOC, specifically aimed at addressing the targets set in Sustainable Development Goal (SDG) 4, aimed at enhancing adult and continuing education. The research limitations include that this conceptual paper can be developed further by the application of the proposed theoretical model. This theoretical model should be tested and analysed further in a focused research project. The practical implications therefore lie in the proposed model being used to inform sustainable OHS e-learning in HEIs, aimed at achieving the goals and objectives of SDG 4. This paper makes a valuable contribution to the subject areas of OHS, sustainability, e-learning and PESTEL factors by providing a unique foundation to support sustainable OHS e-learning in HEIs for adult and continuing education, with specific reference to lifelong learning opportunities.

**Keywords:** PESTEL; safety; e-learning; adult learning; lifelong learning

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## Introduction

The absence of social interaction remains a major barrier in e-learning (Cherney et al., 2018; Graham, 2018; Khan et al., 2020; Mailizar et al., 2020; Suryawanshi & Venugopal, 2020). This conceptual paper is aimed at applying Political, Economic, Social, Technical, Environmental and Legal (PESTEL) factors to e-learning with specific reference to sustainability and occupational health and safety

(OHS). The use of Massive Open Online Courses (MOOCs) is also indicated. E-learning is part of the organisational strategy of many universities, with government and educational sectors realising the importance thereof (Baig et al., 2022; Dhawan, 2020; Graham, 2018; Mahdi & Wani, 2021; Prodanova, Gutiérrez, & Sánchez-Beato). With the global COVID-19 pandemic, the role of e-learning in formal and informal teaching has been emphasised (Aboagye et al., 2020; Shin & Kang, 2018). ODeL institutions provide students with an opportunity to learn wherever they are (Secreto & Pamulaklakin, 2015; Venturino & Hsu, 2022). It is important that virtual learning environments (VLEs) effectively support pedagogical principles (Krismadinata et al., 2020). To do so, learning activities should be designed to encourage and motivate students, to encourage active engagement in learning experiences, to share learning experiences with other students, and to allow opportunities for student reflection on learning (Graham, 2018; Kenzig, 2015; Rafiola et al., 2020; Neuwirth et al., 2021).

Blended learning is seen as one of the solutions to resolve human requirement weaknesses associated with e-learning systems (Hewett et al., 2019; Rasheed et al., 2020). Such a blended approach can be effectively utilised to address motivation and online socialisation weaknesses (Kantisa et al., 2020). The blended approach to learning involves e-tutoring instead of traditional tutoring, thus blending distance learning with face-to-face support (Ferrari & Triacca, 2020; Graham, 2018; Krismadinata et al., 2020). Research has found that e-learning is more effective for postgraduate students, due to such students already being independent learners (Sedio, 2022; Watts, 2017). Undergraduate students do require more interaction, thus implying a more blended approach to learning (Graham, 2018; Rieken et al., 2018). Undergraduate students indicate an interest in a blended approach to their learning, emphasising a desire for this to take place in a highly structured manner that is supported by tutorials (Morton et al., 2016). MOOC participants have indicated that they are engaged, high-quality learning experiences (Batchelor & Lautenbach, 2015; Goldberg et al., 2015). MOOCs are characterised by multiple pedagogic forms and intentions, with teachers still being relevant (Graham, 2018). MOOCs are also vital in making lifelong learning possible for working professionals (Batchelor & Lautenbach, 2015; Iloh, 2019).

Higher education forms the foundation for future leaders to engage in sustainable development. Curricula pedagogy and e-learning activities should therefore be customised to promote and encourage sustainable development (Marathe et al., 2020). Although research in sustainability is lacking in an African context, HEIs are at the forefront of addressing this deficiency and ensuring that developing countries promote sustainable development to a greater extent (Ulmer & Wydra, 2020). HEIs play a key role in the dissemination of information, knowledge and skills (Roos & Guenther, 2020). Almost every HEI makes use of technology to some extent. Blended and online learning, including MOOCs, can be used to promote the HEI in addition to contributing to the sustainability of educational endeavours (Rosenbusch, 2020; Wieser, 2020). Online course development should consider the needs of all stakeholders (students, lecturers, industry partners and the HEI) as well as available technology (Arbaugh, 2014). Open distance learning can be described as a pedagogy where the student and lecturer are separated by both time and space, which requires sufficient technological support and specially designed study materials aimed at enhancing accessibility for all (Muyinda et al., 2019; Oswal and Meloncon, 2014). Open distance learning (ODL) or open distance e-learning (ODeL) can support students in learning various subjects and provide new opportunities for learning that is contextualised, personalised and not hindered by the constraints associated with face-to-face learning (Crompton et al., 2017; Venturino & Hsu, 2022).

Technology should be introduced in such a way as to allow students to benefit from an enhanced learning experience aimed at lifelong learning (Iloh, 2019; Makina, 2020). The learning environment should be pre-designed to bridge the physical distance gap between students and lecturers by implementing communication-rich, interactive and flexible online tools (O'Connor & Domingo, 2017; Watts, 2017). The use of technology allows for more challenging demonstrations of mastery, specifically aimed at facilitating learning at more advanced levels such as postgraduate studies. Technology can be effectively utilised to teach higher order comprehension and address authentic understanding and in-depth integration of knowledge (Oswal & Meloncon, 2014; Rieken et al., 2018). Student satisfaction and perceived learning is influenced by the type of technology utilised to facilitate student engagement and interaction at HEIs (Stickney et al., 2019; Watson & Sutton, 2012). Student support in an ODeL environment comprises all activities and elements designed to assist in the learning process (Secreto & Pamulaklakin, 2015). Student support forms the foundation of student success since it facilitates the achievement of their learning goals. This aspect should be supported by excellent academic content and sufficient technological support (Muyinda et al., 2019; Secreto & Pamulaklakin, 2015). A lack of suitable student support systems leads to a situation where a high number of students deregister (Bawa, 2016;

Secreto & Pamulaklakin, 2015). Professional competency frequently requires upskilling or re-skilling. One of the reasons presented for this need of continuing education is directly linked to advances in technology. Continuing education includes both informal (in the workplace) as well as formal education. Today's digital age provides flexible opportunities for lifelong learning in adult education (Curran et al., 2019).

## Systematic literature review

This study employed a systematic content analysis of existing literature on Open Distance e-Learning (ODeL). The primary aim was to identify and synthesise the most frequently used key terms in prior ODeL research, thereby providing insight into thematic emphases in the field. The SCOPUS database was selected as the data source due to its wide coverage of peer-reviewed literature in the fields of education. A structured search was conducted using the keywords *"ODeL"* and *"Learning"*. The search was limited to publications relevant to higher education, in order to ensure contextual appropriateness to the focus of this study. The search initially yielded 65 publications, of which 48 were retained after applying relevance screening. Exclusion criteria included studies that referenced learning in unrelated fields (e.g., corporate training or primary/secondary education), or those where ODeL was mentioned tangentially rather than substantively.

From the selected publications, the authors extracted all keywords as specified by the original researchers. This process yielded a total of 157 distinct keywords. To enhance analytic clarity, these keywords were grouped into clusters based on semantic and conceptual similarity. Figure 1 presents the consolidated key terms and highlights those most frequently recurring in the literature. Prominent terms included *access, quality assurance, postgraduate supervision, usability, learner management system, testing and assessment, curriculum development,* and *ICT*. The three most frequently cited terms across the dataset were *ODeL, e-learning,* and *access*.

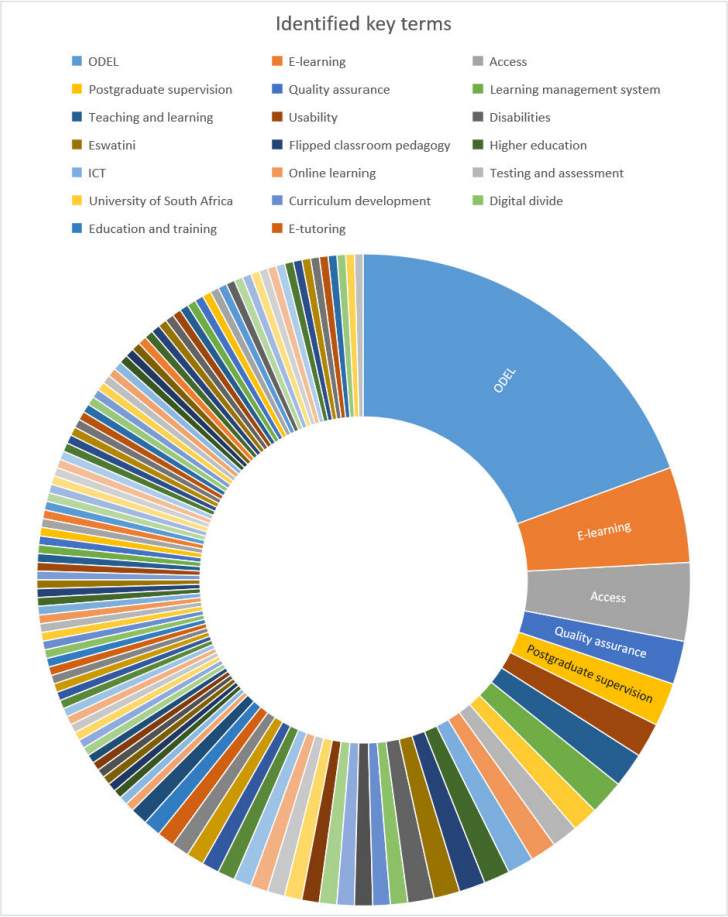


**Figure 1.** Identified key terms.
Source: Authors' own composition.

To interpret the relevance of these recurring terms, the Person–Process–Context (PPC) Model of self-directed learning proposed by Curran et al. (2019) was applied. This model posits that learning is shaped by the interplay of three categories of factors: Person factors (such as individual responsibility, initiative, and sense of obligation); Context factors (including digital connectivity, institutional policies, and digital literacy supports); as well as Process factors, which encompass triggers for learning, information credibility, and challenges such as information overload.

The research conducted on ODeL as per Figure 1 supports the observations published by Scott and Nichols (2017) that recent higher education research regarding learning analytics is an interdisciplinary field that helps in ensuring equitable access, increased efficiency and personalised curricula. Students, lecturers and content development are also highlighted in the findings of Kebritchi et al. (2017). Student challenges include learner expectations as well as readiness and participation, while lecturer issues include changing teaching roles, transitioning from face-to-face to online teaching, time management, as well as teaching styles (Conceição, 2006; Kebritchi et al., 2017; Kenzig, 2015). Content issues have been identified as content development, integration of multimedia in course content, instructional strategies and considerations regarding content development for online courses (Kebritchi et al., 2017). The key components of virtual learning design should therefore focus on an online presence, integrating real-world examples into study material, appropriate assessment practices and course interaction contributing to the motivation and involvement of students (O'Connor & Domingo, 2017). Access, quality and cost of ODeL tuition should be considered in the design of online courses. Technology is used to address these aspects simultaneously by allowing for wider access, improved quality and reduced tuition costs (Gous & Roberts, 2014; Muyinda et al., 2019; O'Connor & Domingo, 2016; Rosenbusch, 2020). Properly designed ODeL courses provide a unique opportunity for HEIs to ensure accessibility for all students, including those with disabilities. It facilitates learning opportunities for previously disadvantaged and adult students, as it is fundamentally and humanistically grounded to overcome disparities and unequal opportunities (Iloh, 2019; Oswal & Meloncon, 2014; Rosenbusch, 2020; Mahdi & Wani, 2021). Sustainability in HEIs is still primarily rooted in a Western vantage point, with little research being conducted with specific reference to the African context. In an African context, language barriers and cultural differences impede the successful implementation of Africanisation (Adam, 2020; Ulmer & Wydra, 2020, p. 18).

Sustainable Development Goal (SDG) four aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations [UN], 2015), with specific reference to target 4.3 that focuses on access to quality technical, vocational and tertiary education (Nketsia et al., 2020; SDG-Education 2030, n.d.). This target includes, but is not limited to, university education. Providing lifelong learning opportunities for adults is therefore a mandate of HEIs and can be achieved through the implementation of e-learning courses such as MOOCs which provides educational opportunities to students who would otherwise not have access (Albelbisi et al., 2023; Rosenbusch, 2020; SDG-Education 2030, n.d.). This is closely related to target 4.4, which aims to increase the number of people who have relevant skills for employment and entrepreneurship. Target 4.4 specifically mentions increasing the number of adults with vocational skills. Target 4.7 mentions that knowledge and skills needed to promote sustainable development should be addressed through education, including an appreciation of cultural diversity (Elfert, 2019; SDG-Education 2030, n.d.). OHS, as a vocational skill, fulfils a vital role in addressing all three of these SDG 4 targets by providing the opportunity for adults to acquire skills needed for employment, decent jobs, entrepreneurship, as well as sustainable development and the ability to appreciate cultural diversity. E-learning and MOOCs address the access aspect of SDG4 by facilitating an increase in learning opportunities that is both inclusive and effective (Miller, 2020). Pierce (2018) concludes that the achievement of SDG 4 will assist and promote the achievement of the other SDGs by ensuring that people, including adult learners, are provided with education that is inclusive and equitable, thus providing and promoting lifelong learning opportunities. Other SDGs that are influenced by adult and continuing education (especially in OHS) include reducing poverty, enhancing good health and wellbeing, decent work, and workplaces as well as economic growth (Cooray, 2009; SDG-Education 2030, n.d.).

## OHS education

The absence of social interaction remains a major barrier in e-learning (Cherney et al., 2018; Graham, 2018). Students attend university as much for social interaction as for the educational benefits of subject knowledge and learning (Graham, 2018; Suryawanshi & Venugopal, 2020). A sense of distance can negatively affect learning

(Cherney et al., 2018). Therefore, e-learning should be constructed in such a way as to allow for social interaction, which might imply a blended approach to teaching. E-learning can enhance social skills and interaction through the introduction of new perspectives, knowledge and tools, and tasks requiring students to apply conflicting social values (Cherney et al., 2018; Liwång, 2020). Optimal learning requires student engagement to be successful. The presence of collaboration and community contributes to deeper student learning and engagement (Arbaugh, 2014; Cherney et al., 2018; Smallwood & Brunner, 2017; Virtue, 2017). Occupational health and safety (OHS) online course management should allow lecturers to emphasise diverse cultural backgrounds, taking cognisance of the challenges associated with student participation in online classrooms (Shin & Kang, 2018). The prior experience and frames of reference of students will differ, and additional online support should be offered to assist with academic writing style and referencing in particular (Virtue, 2017). This is especially true for those students with a low proficiency in English (Shin & Kang, 2018) as a second or third language, as is the case with many South African students.

Lecturers need to play an active role in allowing and facilitating student participation in work performed during a module or e-learning course (Liwång, 2020). It should be noted that research has found that the role of the teacher or tutor remains of vital importance despite the change in mode of operation in an e-learning environment (Graham, 2018). HEI lecturers spend a significant amount of time dealing with email as part of their interaction with students as part of teaching and tutoring (Graham, 2018). This regular interaction can be an opportunity to enhance the social skills of students in an online environment. The attributes of good online lecturers comprise the 4Es: expertise (extensive knowledge of the subject area); exposition (the ability to explain and deliver theoretical concepts in an online learning environment); enthusiasm (for the subject and successfully conveying this enthusiasm online); and empathy (with the students and their learning experiences). The attributes of good online lecturers culminate in value-added learning (VAL) and should therefore be developed (Graham, 2018). Effective e-learning practices provide an encouraging platform for interaction between lecturers and students. Mutually beneficial interaction and cooperation between students should be facilitated by the lecturer. Active learning techniques should be utilised regardless of the communication method used to conduct discussions. Prompt feedback and preparing students to manage their time wisely are essential for course success and student learning. Expectations should be communicated to students while respecting diverse talents and accommodating multiple learning methods (Watson & Sutton, 2012). Lecturers should promote functional communication, display empathy, provide timely feedback, engage in active listening practices and communicate clear and consistent expectations to students (Campbell et al., 2020; Watson & Sutton, 2012).

Social sustainability skills can be enhanced by implementing applicable methods for assessing values, contextual understanding, realistic task execution, decision-making and personal reflection (Liwång, 2020). With specific reference to the field of OHS and OHS education, a combination of suitable tools and perspectives, contextual knowledge and a relevant frame of reference enhances students' sustainability skills (Liwång, 2020). Students should be encouraged to practically apply theoretical knowledge despite the challenges presented by an online learning environment. Class participants should interact with fellow students to enhance the process of learning, making use of technology and applicable online tasks and activities (Shin & Kang, 2018). Analysis of face-to-face and ODL indicates limitations and advantages for both these methods of learning and teaching. It is therefore suggested that a blended approach to learning in higher education be followed in this digital age (Ghemawat, 2017). Even though technology-enhanced learning (TEL) does have its place, it does not mean that it should be used if the only motivation to do so is financial in nature. Technology should be used to enhance the learning experience of students whilst not removing the human element (Graham, 2018). In the context of OHS teaching specifically, blended learning could address the challenges presented by the more practical aspects that students are required to master to achieve the learning outcomes set out by OHS courses (Graham, 2018; Ferrari & Triacca, 2020). The stages of blended learning comprise access and motivation; online socialisation; information exchange; knowledge construction; and development (Graham, 2018). Conditions should thus support success, planning, implementation and improvement of the blended learning experience (Krismadinata et al., 2020; Arbaugh, 2014). Additionally, adult learning impacts communities and plays a key role in promoting lifelong learning opportunities that address key global challenges. Adult education contributes to the development and sustainability of urban areas and communities, aligning with the broader goals of sustainable development and societal progress (Adedokun et al., 2020).

## PESTEL and SWOT analysis in OHS e-learning

Traditionally, the acronym "PESTEL" is used for political, economic, social, technological, environmental and legal or regulatory factors (Nagy-Molnár & Lendvay, 2018). Political factors relate to political stability and funding, while economic factors include inflation, sustainability and unemployment. Social factors relate to population growth, demographics, age distribution and employment, while technological factors include technological maturity, access to technology and affordability. Environmental factors relate to climate and weather, business ethics and sustainability, while legal or regulatory factors relate to labour laws, including OHS directives. A PESTEL analysis provides an opportunity for HEIs to identify the potential threats in their surrounding environment and identify ways in which these threats can be turned around into opportunities (Hernandez et al., 2015). Integrating the investigation of PESTEL factors with a SWOT analysis (strengths, weaknesses, opportunities, threats), as a familiar and easy-to-use technique that provides insight into exactly how the threats identified in the PESTEL environment can be converted to opportunities, could be useful in ODeL (Piercy & Giles, 1989). One should capitalise on strengths and opportunities and address weaknesses and threats in order to achieve ODeL objectives (Leiber et al., 2018).

Political and economic factors are external drivers for the expansion of e-learning, whilst the advantages of e-learning over face-to-face learning are a factor of contention. Legal factors imply a moral element as it embodies ethical and moral principles in the context of wider learning (Graham, 2018). It is suggested that PESTEL in e-learning should stand for Pedagogical, Education, Social, Technical, Educational Environment, and Legal factors (Graham, 2018). The order of PESTEL factors in e-learning remains relevant. Pedagogy is deemed the most important, with education being an overlapping factor (Krismadinata et al., 2020). The importance of pedagogy in e-learning or Massive Open Online Courses (MOOCs) lies in its significant impact on learning outcomes, student engagement, and the overall effectiveness of online education (Pickering & Swinnerton, 2018). Effective pedagogy is crucial in promoting meaningful learning experiences, fostering critical thinking skills, and ensuring the transfer of knowledge in digital learning environments (Frijters et al., 2008). Pedagogy in e-learning plays a vital role in addressing key global challenges, enhancing the quality of education, and contributing to sustainable development goals (Pretorius et al., 2021).

Social factors are next in line, and human issues remain important, with learning still being regarded as an inherently social activity (Graham, 2018; Ferrari & Triacca, 2020). Additionally, from a social factor perspective, age-related changes in the higher education environment act as a barrier to the adoption of e-learning (Bai et al., 2020). Social factors such as gender, motivation, satisfaction and age also impact student engagement and completion of online courses (Leal et al., 2019). However, the education level and background of students were not indicated as a determining factor of online course completion (Goldberg et al., 2015; Meaney & Fikes, 2023; Zhang et al., 2019). This creates an opportunity for e-learning to contribute to education levels and create a level playing field for students regardless of their educational background. Technology and environmental factors appear to carry less weight, but are still important (Graham, 2018). Research indicates that problems with technology, such as equipment, negatively impact the acceptance of e-learning options (Bai et al., 2020). However, Steffens (2015) highlights the importance of technology in MOOCs and enhancing MOOC learning experiences. MOOCs promote lifelong learning and expand educational opportunities through digital technology.

Based on the stated information, it is proposed that a model for applying PESTEL factors to enhance sustainable OHS e-learning be developed.

## Proposed model for applying pestel factors to enhance sustainable OHS e-learning

As indicated in Figure 2, a proposed model for applying PESTEL factors to enhance sustainable OHS e-learning should incorporate the focus areas of ODeL learning (Kebritchi et al., 2017), the reimagined PESTEL factors (Graham, 2018), and a SWOT analysis (Leiber et al., 2018) to take cognisance of internal and external factors that can be helpful or harmful. These elements should inform the development of an OHS MOOC, specifically aimed at addressing the targets set in SDG 4 (Pierce, 2018; Venturino & Hsu, 2022).

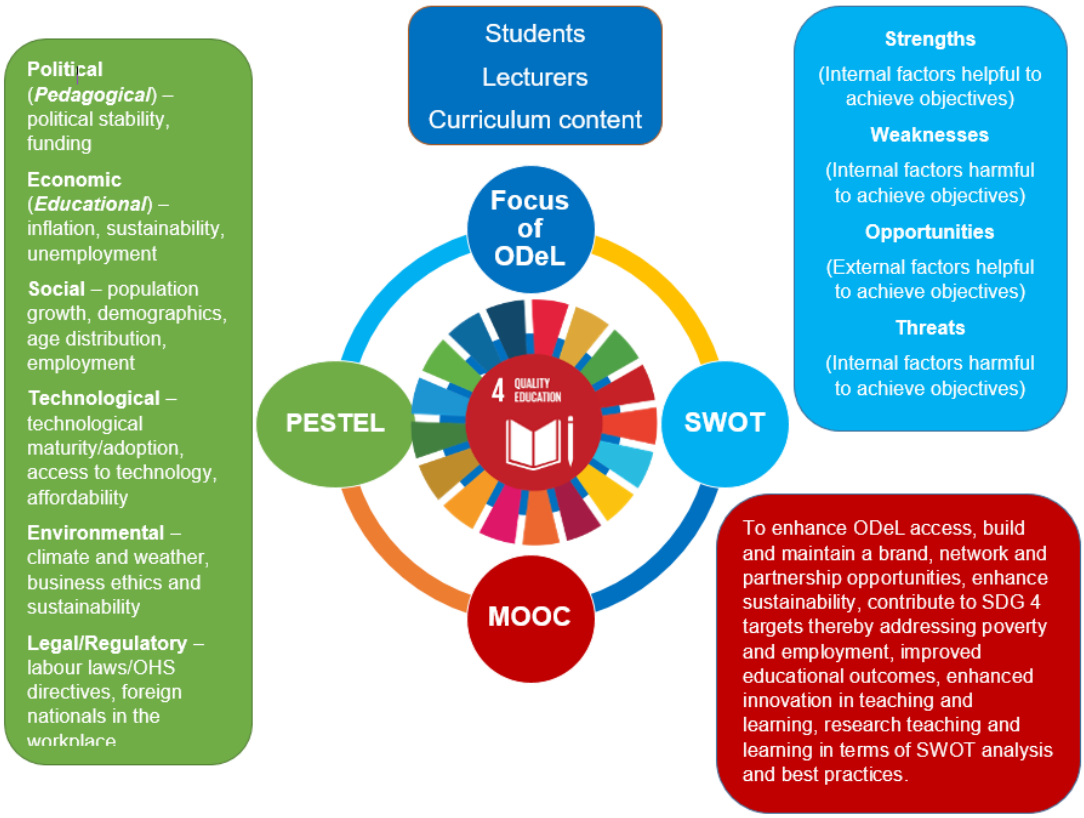


**Figure 2.** Proposed model for applying PESTEL factors to enhance sustainable OHS e-learning for adults and continuing education.

Ultimately, an OHS MOOC, informed by this proposed model will aim to enhance ODeL access, build and maintain a brand, network and partnership opportunities, enhance sustainability, contribute to SDG 4 targets thereby addressing poverty and employment, improve educational outcomes, enhance innovation in teaching and learning, and research teaching and learning in terms of SWOT analysis and best practices. These aims of the proposed model for applying PESTEL factors to enhance sustainable OHS e-learning for adults in continuing education are expanded on and explained in the next paragraphs.

1. *Enhance ODeL access*: A MOOC focused on OHS e-learning can leverage the PESTEL framework to identify and mitigate barriers to ODeL access through technological advancements to support learners in remote or underprivileged areas. Additionally, content can be adapted for mobile access and improved access for differently-abled or disabled individuals. The creation of inclusive learning environments that cater to diverse learning styles and needs could involve the integration of multilingual support and culturally relevant materials to broaden access.
2. *Build and maintain a brand, network and partnership opportunities*: An OHS e-learning MOOC can contribute to establishing a strong brand identity for the higher education institutions involved, emphasising their commitment to OHS education and training. Part of establishing this brand identity is the incorporation of marketing strategies and leveraging of social media to increase visibility. By fostering networking and partnerships with industry, government and non-governmental organisations, the relevance of the MOOC is enhanced by improving its applicability to real-world settings. Additionally, such networking and partnerships could provide internships, job placements and applicable, real-life case studies for students.
3. *Enhance sustainability*: Sustainable practices can be incorporated into the operations and curriculum of the MOOC by aligning with environmental and social governance principles. This includes digital sustainability, reducing the carbon footprint of course presentation, through digital education and teaching the principles of sustainability in the course content. In terms of the sustainability of the MOOC itself, it is important to address the financial and operational structures within which the course will be presented.

This creates an opportunity to introduce innovative funding models, cost-reduction strategies and scalability.

4. *Contribute to SDG 4r targets thereby addressing poverty and employment*: In addition to addressing sustainability in general, the introduction of an OHS e-learning MOOC can directly contribute to achieving SDG 4 (quality education) by improving accessible, affordable, quality education and training in OHS. Education serves as a pathway out of poverty and into employment which contributes to the broader economic impact of OHS education. Additionally, OHS education's economic impact includes a reduction in workplace accidents and diseases, improved productivity and contribution to economic growth by reducing the direct and indirect economic costs of OHS incidents.
5. *Improve educational outcomes*: From a pedagogical perspective, the introduction of an OHS e-learning MOOC contributes to the implementation of various innovative practices such as adaptive learning technologies, gamification and interactive simulations to enhance engagement and outcomes. As with all teaching activities, the implementation of robust assessment mechanisms that incorporate timely, constructive feedback can enhance and improve educational outcomes. Data analytics collected in the process of presenting an OHS e-learning MOOC can be used to personalise learning and identify areas of improvement for individual students.
6. *Enhance innovation in teaching and learning*: Additional innovations in teaching and learning focus on the role of artificial intelligence, virtual reality and blockchain, as examples of emerging technologies in teaching. Utilising emerging technologies has the potential to create immersive and interactive learning experiences. However, this creates a need for the continuous development of educators to ensure that they have the necessary skills and tools to innovate within digital learning environments.
7. *Research teaching and learning in terms of SWOT analysis and best practices*: Educators can address continuous improvement and strategic planning by conducting a SWOT analysis to identify the strengths, weaknesses, opportunities and threats relating to teaching and learning in the MOOC context. This creates an opportunity to compile and disseminate best practices in OHS e-learning, based on research, experience and analysis.

## SWOT analysis for teaching and learning in OHS e-learning

This section provides examples of how educators can conduct a SWOT analysis to identify the strengths, weaknesses, opportunities and threats relating to teaching and learning in the MOOC context (Figure 3) and specifically an OHS e-learning context (Figure 4).

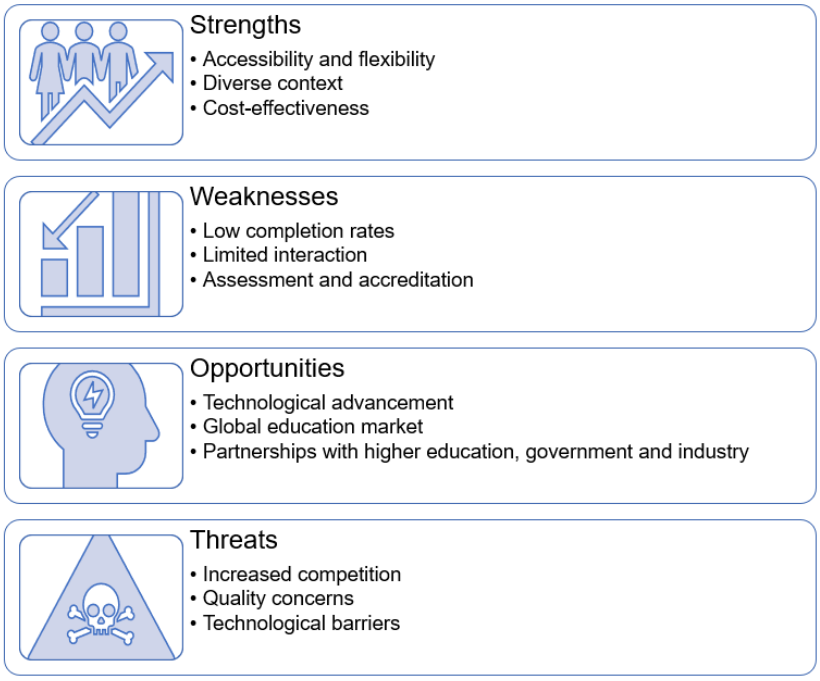


**Figure 3.** SWOT analysis for MOOC teaching and learning.

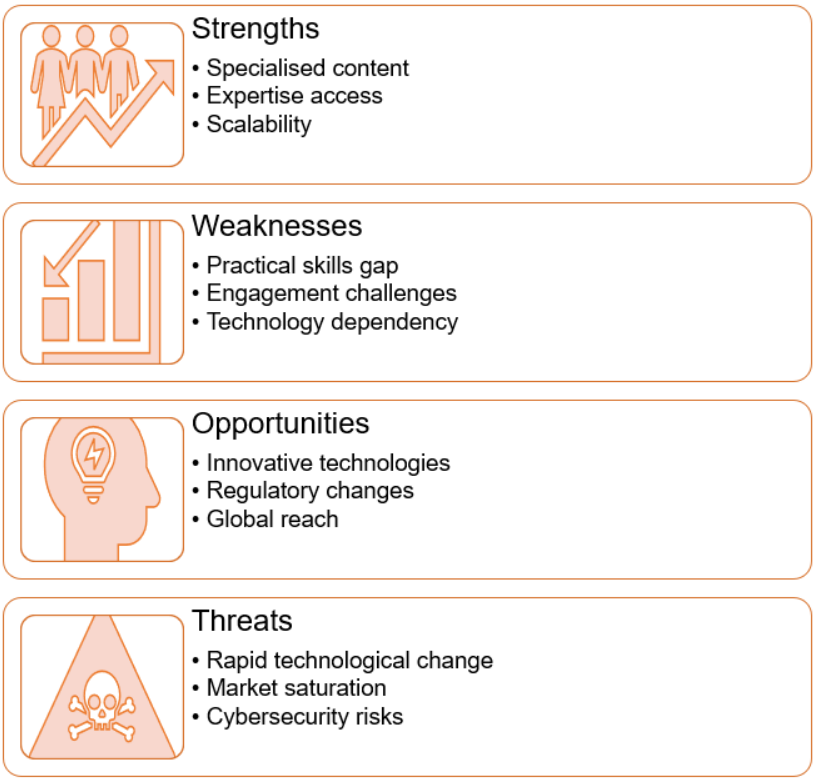


**Figure 4.** SWOT analysis for teaching and learning in the Occupational Health and Safety (OHS) e-learning context.

Within the context of MOOCs in general, internal strengths and weaknesses and external opportunities and threats can be highlighted. Strengths include that MOOCs offer widespread access to education, enabling learners from various backgrounds and locations to engage with content at their own pace. MOOCs have gained attention as a technology-enhanced learning approach in higher education, providing educational opportunities to a massive number of learners globally to attend free online courses through their accessibility and flexibility (Yousef et al., 2014). MOOCs also provide diverse content across disciplines, catering to diverse interests and career goals (Bozkurt et al., 2017). Finally, MOOCs are often presented at a low cost or for free, which contributes to making higher education more affordable (Fan et al., 2022). Unfortunately, some weaknesses are applicable, including the relatively low engagement and completion rates on MOOCs. This could be attributed to the self-motivation and self-discipline required to complete distance learning courses (Schuwer et al. 2015). This is exacerbated by the limited interaction with educators and peers, impacting on learning effectiveness and student satisfaction (Dwyer et al., 2022). It is also difficult to provide meaningful assessments and assessment feedback when MOOCs are scaled (Daradoumis et al., 2013). Finally, the certification and accreditation of MOOCs impact the perceived value of these courses (Milligan & Littlejohn, 2016).

Opportunities present themselves through emerging technologies such as artificial intelligence, virtual reality and artificial reality to enhance interactivity and personalisation in MOOCs (Bonk et al., 2018). MOOCs can also be presented on a global platform, without being limited to the confines of a single institution or country (Ruipérez-Valiente et al., 2019). Finally, MOOCs present an opportunity for collaboration between universities, government and industry. These collaborations can enhance the credibility of a MOOC by providing formal accreditation and pathways to employment (Aliu & Aigbavboa, 2021). A major threat to MOOCs is the increase and intensification of competition within the MOOC space, resulting in a constant need for innovation to remain relevant (Schuwer et al., 2015). Other threats lies in the fact that MOOCs may not be accredited and are presented at a low cost creates quality concerns that affect institutional reputation and learner trust (Kundu & Bej, 2020). Access to the required technology and internet connectivity is an ongoing problem for students in some regions of the world (Aboagye et al., 2020).

In addition to the internal strengths and weaknesses and external opportunities and threats present in MOOC teaching and learning, additional factors can be identified specifically for OHS e-learning (Figure 4). Strengths

include the specialised context of tailored OHS courses that can be applied to meet specific industry needs, enhancing workplace safety and compliance (Zondo, 2021). Additionally, e-learning platforms enable access to top OHS experts and materials, regardless of the geographic location of students (O'Doherty et al., 2018). Digital platforms also allow for the accommodation of a large number of participants, making it easier for employers to train their entire organisation. Weaknesses incorporate the unfortunate situation that there could be a practical skills gap in OHS e-learning. OHS often requires hands-on training that is challenging to replicate online (Donelan et al., 2018). Maintaining learner engagement in an online environment presents difficulties (Chatterjee, 2020). The successful completion of OHS e-learning courses relies heavily on the student's access to and familiarity with technology (Hamdan et al., 2021).

Opportunities lie in the incorporation of various technologies that can assist in simulating real-world OHS scenarios, improving practical training online (). The evolving nature of workplace safety regulations drives the need for updates and continuous OHS training, ensuring a persistent market for this type of training (Stankova et al., 2021). OHS training presented on e-learning platforms can readily be tailored to different languages and regional regulations. Keeping e-learning content and platforms updated with the latest technologies and content can be costly and time-consuming, which is one of the threats to be noted (Elghibari et al., 2017). It is also important to note that market saturation is a real risk as more providers enter the OHS e-learning space (Börger et al., 2023). Finally, online platforms are susceptible to data breaches and other cybersecurity risks, which can compromise learner information and trust (Triplett, 2023).

Internal weaknesses and external threats can impact the delivery of OHS courses online. However, the internal strengths and external opportunities present an opportunity to address these challenges and provide targeted and effective OHS education opportunities.

## Managerial implications and conclusion

An OHS MOOC can be used to test specific interactions between different aspects of OHS education with specific reference to enhancing sustainability (Liwång, 2020; O'Connor & Domingo, 2017). It is important to investigate how students apply knowledge in a real-world setting, with a specific focus on how they apply sustainability practices in their workplace and daily lives. The applicability of OHS management and social sustainability in other core courses can also be investigated. Research conducted relating to an OHS MOOC should focus on student learning and not the device utilised to facilitate enhanced student learning experiences in an ODeL setting (Crompton *et al*., 2020; Secreto & Pamulaklakin, 2015). In the development of an OHS MOOC, education institutions should be mindful that the course, in terms of structure, resources required and availability, creates a supplementary method of education without exacerbating the digital divide (). It is important to emphasise that safety management is not a constraint, but rather a value-creating aspect for enhanced sustainability (Liwång, 2020). A combination of theory and practice should be employed to encourage students to reflect on sustainable OHS in professional practice (Liwång, 2020). The success of any e-learning venture lies in the nature of the impact it has on students and stakeholders who, in turn influence their immediate environments (Pittaway & Hannon, 2008; Radha et al., 2020).

To address the challenges in online education, lecturers should be provided with professional development opportunities, learners should be trained, and technical support needs to be available to assist with content development (Kebritchi et al., 2017; Korthagen, 2017). This paper is essentially based on and supported by the researchers' understanding of the current evidence base of sustainable OHS e-learning in HEIs and PESTEL factors that could influence it (Pittaway & Hannon, 2008). Additional research on the successful implementation of a MOOC to address the SDG 4 targets should be conducted whilst informing a continuous improvement cycle of OHS e-learning (O'Connor & Domingo, 2017). Online presentation of course content is not the only goal of implementing an OHS MOOC. The skill to properly master the content should be taught with specific reference to addressing challenges, such as reading competence, in the South African context (Gous & Roberts, 2014).

### Declarations

**Interdisciplinary Scope:** This systematic literature analysis adopts an interdisciplinary scope by integrating insights from political, economic, social, technical, environmental and legal (PESTEL) factors to e-learning in Higher Education Institutions (HEIs) with specific reference to sustainability

and occupational health and safety (OHS). The use of Massive Open Online Courses (MOOCs) is also indicated. To this end, a theoretical model is proposed for adult and continuing education.

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