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REVIEW ARTICLE

Navigating open and distance learning trends, advantages, challenges and innovations for the future education - A systematic review

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Abstract

Open and Distance Learning (ODL) has revolutionized education by enhancing accessibility, flexibility and technology-driven learning methodologies. This study examines the trends, challenges and innovations in ODL through a bibliometric analysis of research published between 2002 and 2024. Using bibliometric techniques such as citation analysis, co-authorship analysis and keyword co-occurrence mapping, the study identifies key research trends and emerging themes in ODL. The findings indicate a steady increase in ODL research, with a notable rise in publications post-2020 due to the COVID-19 pandemic, which accelerated global adoption of digital learning. This study highlights the economic, social, psychological and infrastructural factors shaping ODL. Affordability and reduced travel costs make ODL financially viable, while strong social support systems enhance student motivation. Psychological aspects, including self-efficacy and adaptability, contribute to student success and robust digital infrastructure plays a crucial role in effective ODL implementation. Despite its advantages, ODL faces significant challenges, such as digital accessibility issues, high dropout rates and concerns over educational quality. To mitigate these challenges, institutions must enhance content delivery, foster student engagement and ensure equitable access to digital resources. Future research is expected to focus on integrating artificial intelligence, virtual reality and adaptive learning to enhance personalized education experiences. Maximize ODL's impact requires collaboration among educators, policymakers and technology developers to create inclusive and effective learning environments. By addressing existing barriers and leveraging emerging technologies, ODL can continue to shape the future of education globally.

Keywords

accessibility; challenges; motivational factors; open and distance learning

Introduction

Open and distance learning (ODL) refers to a teaching method where most or all instruction is delivered remotely, with the teacher and student in different locations. It also aims to enhance openness and flexibility in the curriculum, access and other key aspects (1). A blended education is an environment in which traditional face-to-face instruction is combined with online resources to enhance learning (2). Higher education institutions are being pushed to use ODL due to rapid technological advancements, which have transformed the way education is

delivered and accessed. Distance learning was once thought to be a way to meet the growing demand from students seeking to enrol in higher education, particularly from those who cannot attend classes full-time. To ensure continuity in education, recent shifts in demand have accelerated the transition from traditional face-to-face instruction to distance learning (3). In previous decades, distance learning primarily served working adults. However, in recent years, all students, whether full-time university students or distance learners, have participated in online learning. Teachers worldwide are increasingly experimenting with online learning systems as a practical teaching method (4). Advancements in digital communication facilitate technology-mediated participation and enhance synchronous online learning experiences (5). ODL offers an atmosphere where students can learn at their own speed without being constrained by time or place, giving them the freedom to choose their learning schedule (6). The higher education system in India has expanded significantly in recent decades, with a substantial increase in the number of universities, colleges and student enrolments. This growth has coincided with a rising trend of learning through open and distance modes. Improvements in Asia's distance learning system concerning equity, cost-effectiveness and accessibility (7, 8). However, ODL does not always lead to reduce per-student costs (9). People can gain knowledge, abilities and skills from it without having to leave their area of employment. Those who live in rural places with limited access to formal education can benefit from distance education. Distance learning is essential because individuals are confronted with numerous tasks they must complete (10). Distance learning settings have the power to increase student participation and interaction, which in turn can affect how optimistic and pessimistic students are when learning remotely (11). Effective ODL systems should foster personalized connections with learners (12).

Materials and Methods

A multidisciplinary literature review on ODL was conducted to ensure a comprehensive analysis. Bibliometric techniques were employed to examine scholarly research on ODL. Bibliometric analysis is a technique for assessing the advancement, caliber of scientific influence and research output on any topic. Recently, researchers in various fields have increasingly used this method. Recently, researchers in a variety of domains have been using it a lot. Literature reviews are not replaced by bibliometric analysis studies, but they do offer a crucial supplementary element. In addition to identifying author collaborations, keyword co-occurrence and citation networks, bibliometric analysis enables large-scale study evaluation through advanced visual mapping techniques. Finding patterns, gaps, intellectual structure, social networks and cognitive structure within a specific field of study is another use for the bibliometric analysis method. In addition, it helps assess the most significant papers, subjects, writers, institutions or publications within a field of study.

This study was designed following established bibliometric analysis methodologies. Publications were analyzed using descriptive bibliometric methodologies based on the year, type, language and Web of Science (WoS) indexes. Evaluative bibliometric techniques included citation analysis (by journal and publication), co-authorship analysis (by institution and country), keyword co-occurrence analysis and co-citation analysis.

Data collection

Numerous databases are accessible for bibliometric research and data retrieval. Among these databases, WoS (Web of Science), Scopus, Google Scholar, PubMed and MEDLINE are the most crucial. The database used in this study was selected for its reputation as a reliable source of bibliographic data and its extensive collection of high-quality scholarly publications. Among the important phrases used in the research-focused search string for data collection were “open learning”, “distance education”, “distance learning”, “open education”, “trends in ODL” and “future aspects.” The search term was constructed as TS = ((“open education” OR “open learning” OR “distance learning” OR “distance education”) AND (“trends in ODL”) AND (“future aspects”)), where TS refers to the Web of Science Topic Search field tag, which retrieves records based on keywords found in titles, abstracts and author keywords. Fig. 1 illustrates the criteria applied for document retrieval and filtering.

The study follows specific inclusion and exclusion criteria to ensure relevance and quality. Articles published prior to 2000 are not included in the study; only those published between 2000 and 2024 included. Agricultural and biological sciences, multidisciplinary studies, social sciences and computer science are among the topics under consideration for inclusion. Medicine, biochemistry, genetics and molecular biology, pharmacology, toxicology and pharmaceutics, energy, veterinary sciences, immunology and microbiology, engineering, earth and planetary sciences, psychology, chemical engineering and the arts and humanities are among the disciplines that are not included. Regarding document type, only articles are included, while reviews, conference papers, notes and retracted papers are excluded. The language criterion limits inclusion to English-language publications, excluding works in Portuguese, Spanish, Chinese and German. Only journal articles are considered as the source type, with conference proceedings, trade journals and book series being excluded. Additionally, only studies in the final publication stage are included. In terms of open access, all open-access articles are included, while those categorized as Gold, Green, Hybrid Gold, or Bronze open access are excluded.

Examination of data

Bibliometric analytic approaches were employed to analyse the data for this study. Stated differently, publications were analyzed using descriptive bibliometric methodologies according to year, type, language and WoS indexes. The study employed bibliometric techniques, including co-authorship analysis (by institution and country), keyword co-occurrence analysis, co-citation analysis (by source) and citation analysis (by journal, publication and country).

For this study, descriptive findings were shown using Microsoft Office Excel, while evaluation results were shown using R Studio and VOS Viewer software (13, 14). This study utilized established bibliometric techniques for importing and analysing bibliographic data, including citation count and h-

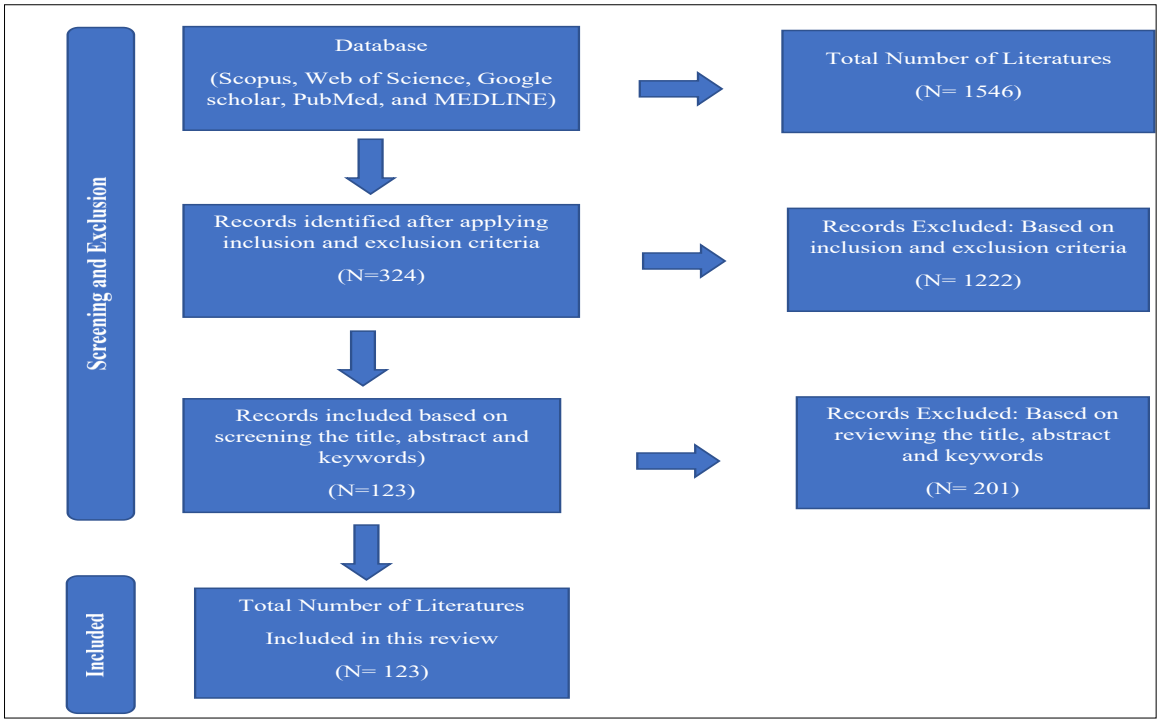

Fig. 1. PRISMA flowchart outlining the inclusion and exclusion process.

index assessment (15). An algorithm called "visualization of similarities" is built into VOS viewer, a tool developed by van Eck and Waltman (16), to illustrate the connections between items. These components include authors, journals, nations, keywords and other bibliographic data gleaned from scientific databases (17). To generate bibliographic information, databases such as Dimensions, Lens, Scopus and Web of Science, along with reference management programs like EndNote, RefWorks and RLS, can be used (18, 19).

Results

Detailed results

Publications by year of distribution : Fig. 2 displays how the articles in the study were distributed by year of publication within the study's parameters. The majority of research on ODL was conducted between 2002 and 2024, showing a general increase in publication output over time. Pascarella and Terenzini (20) conducted the first study on this study. There were no notable leaps in the era of linear growth that lasted from 2002 to 2024. There was limited study from 2002 and 2010, indicating that ODL received not much academic attention. Between 2011 and 2017, the number of publications increased moderately with occasional variations, indicating a progressive rise in academic interest, potentially due to technical developments and the increasing number of online learning platforms. A large increase in research output has been noted from 2018, with the biggest peak occurring in 2024. This sharp increase is most likely due to the global trend toward online education, especially during the COVID-19 epidemic, which stimulated research, inventions and discussions about ODL's benefits, difficulties and future directions. The number of publications peaked in 2024, with a total of 20 studies published, reflecting heightened research interest in ODL.

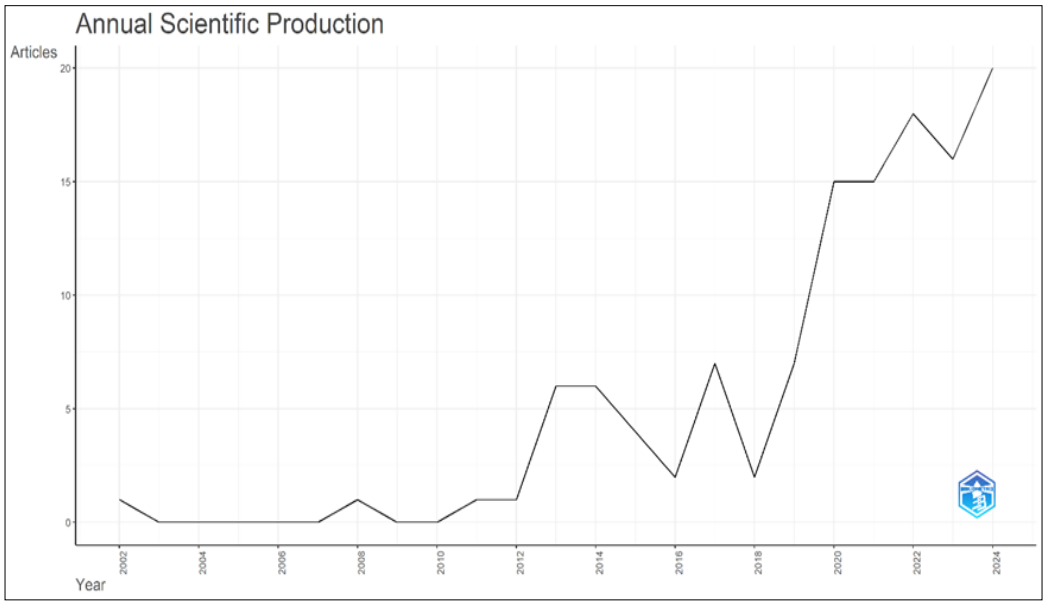

Fig. 2. Publication by year of distribution.

Analytical results

Analysis of citation (source, country and publication) : Citation analysis research has received a lot of interest in recent years. These studies focus on author productivity, publishing use and literature aging citation analysis to identify the most cited research, countries and publications in an area leading to the construction of library collections (21). The VOS viewer software displays statistics on publication and citation counts, as well as total connection.

Analysis of bibliographic coupling between publications and most cited studies: Each link has a positive numerical value that indicates its strength, per the VOS viewer documentation. The cumulative strength of a researcher's co-authorship relationships with other researchers is expressed by the total link strength characteristic (22). Each node represents a publication or author. Larger nodes, such as Masalimova (23) and Rad (24), indicate higher citation impact within the network. Node-to-node connections draw attention to links like co-authorship or co-citation and their density indicates how frequently or strongly these associations occur. Various hues denote clusters, which are a subject or thematic grouping within the field. For instance, a cluster's closely related nodes indicate a common area of study or cooperation. The research evolution throughout time is depicted by the temporal gradient, which runs from blue (2014) to yellow-green (2024) with more recent papers contributing to emerging trends.

Country-specific bibliographic coupling analysis

A bibliographic coupling analysis was conducted using the criteria of (i) at least two publications from a country and (ii) publications with a minimum of 10 citations. These criteria were used to generate a network map of countries contributing to research on this topic. Nine countries met these criteria and were analysed for their bibliographic connections. The study yielded linkages, 3 clusters, with a total link strength of 298. Fig. 3 displays the linkages between countries' bibliographic couplings. Based on publication count and link strength, the top three contributing countries were South Africa (link strength = 123), China (131) and Malaysia (117).

Co-occurrence of keyword analysis

Keyword co-occurrence analysis identifies relationships between concepts by examining words or themes that frequently appear together in keywords or abstracts (25). Title, abstracts, or keywords can all serve as the basis for common keyword analysis (26). Instead of titles and abstracts the most popular keywords were chosen in this analysis. Using "author keywords", "all keywords" and "index keywords". In this study, co-occurrence analysis was performed using VOS viewer. Of the 12 terms extracted from the author keywords in 123 documents, 6 keywords appeared at least five times. The analysis produced 44 linkages, 4 clusters and a total link strength of 92. In Fig. 4 the network structure illustrating the connections among the keywords is displayed. Fig. 4(a) presents a hierarchical arrangement of the most popular keywords by year of publication, displaying the results of layer visualization. The image additionally illustrates those ideas like "distance learning", "e-learning", "covid-19", "online learning", "open and distance learning" and "ODL", are frequently used. It was observed that between 2019 and 2020. These ideas were preferred over common phrases such as "distance education", "open and distance learning", "ODL" and "distance learning". Following 2021, the keywords have evolved into ideas like "online learning", "blended learning" and "covid-19", "massive open online course-MOOC". From 123 documents 32 terms were extracted from all keyword sections, obtained from the literature search. There were more than 15 keywords that appeared at least 10 times. As a result, 31 linkages, 3 clusters and a total link strength of 164. Fig. 4(b) shows the network structure illustrating the connections among the keywords displayed. Out of 123 records, 21 terms that came from the literature search were taken out of the index keywords section, 15 terms that appeared at least five times were found. Following the study, 190 linkages, 3 clusters and a total link strength of 810 were found. Fig. 4(c) displays the network topology that demonstrates the connections among the keywords.

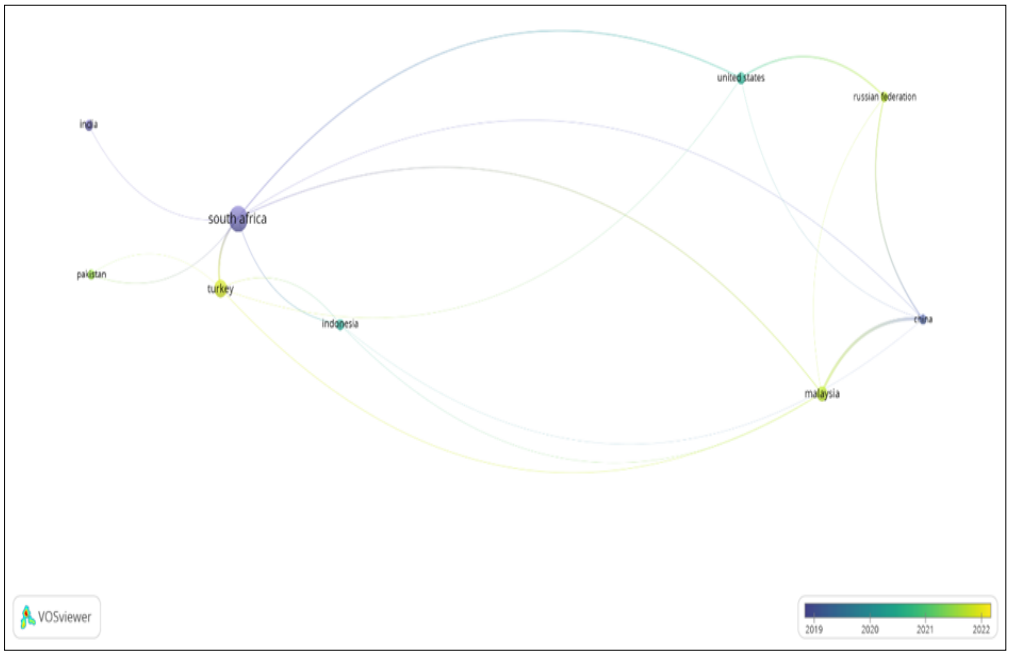

Fig. 3. Bibliographic coupling links of countries.

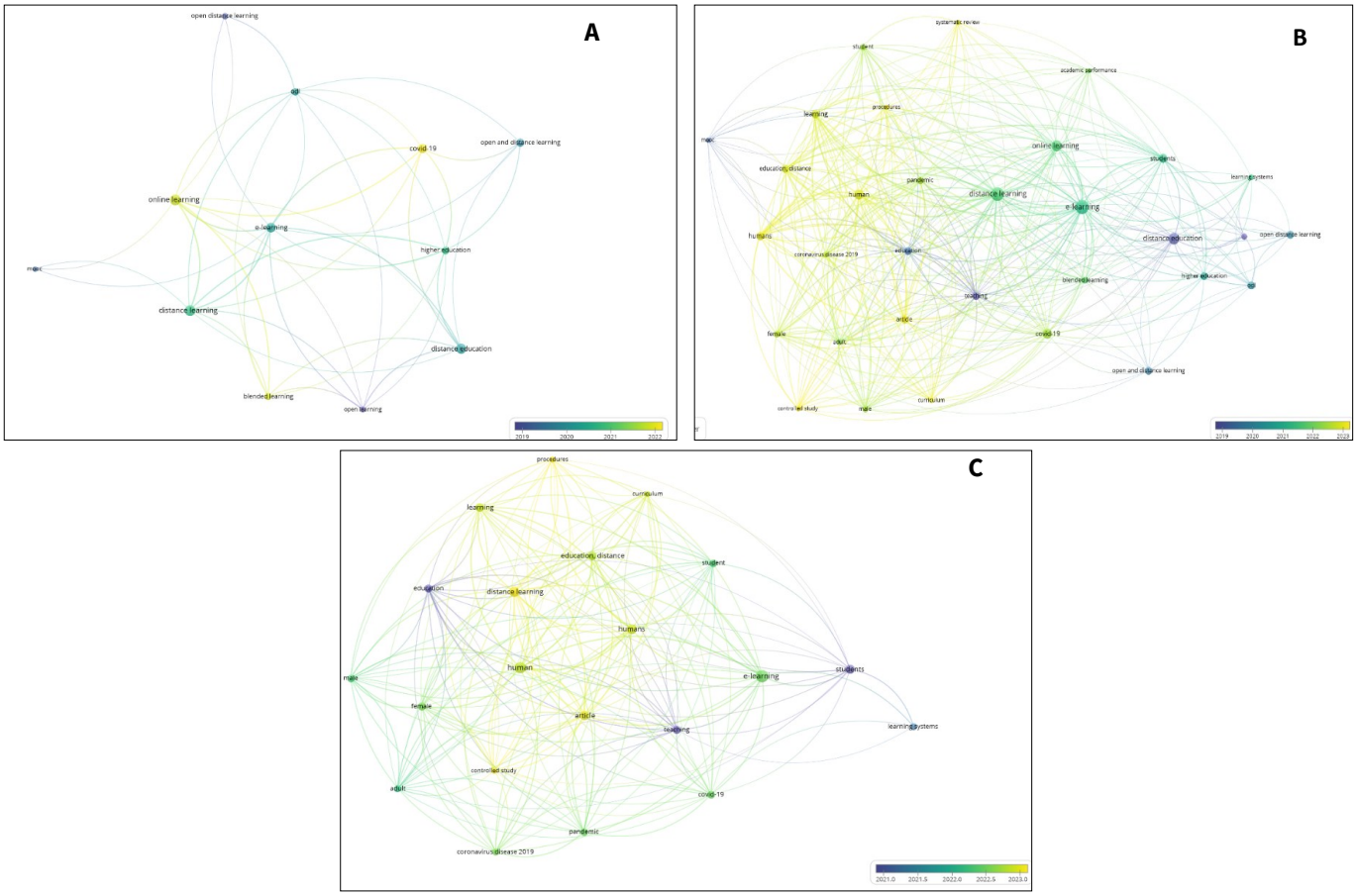

Fig. 4. (a) Layer diagram of the most frequently used author keyword terms; (b) Layer map of the most frequently used all keyword terms; (c) Layer diagram of the most frequently used index keyword terms

Discussion

By embracing the idea of global accessibility, ODL institutions aim to reach millions of individuals by offering educational opportunities that transcend time and location. These organizations have been legitimately criticized for their efficacy. Although they can significantly affect people's lives and society. The strikingly low completion rates of ODL schools worldwide are at the core of these concerns (27). The dissemination of successful scientific and technology education is increasingly recognized through ODL (28). ODL's recent global expansion and appeal are attributed to its flexibility, which include flexibility for students who want to study and work at the same time. ODL is also an effective tool for increasing access to education among underprivileged social groups, particularly students who face barriers due to geographical distance, lack of internet access, family responsibilities, or financial constraints (29).

Factors influencing ODL

Various factors influence the effectiveness and adoption of ODL. Economic factors play a significant role as cost-effectiveness is a key advantage. Online education reduces commuting and accommodation expenses, making it more accessible to a broader audience (30). App-based learning enhances cost efficiency by minimizing material and travel costs (31). Flexible online programs enable students to balance work and education, thereby promoting financial stability and lifelong learning (32). Additionally, the affordability of digital resources and the elimination of physical infrastructure costs contribute to the overall cost-effectiveness of ODL (33). These financial benefits make ODL an attractive option for students seeking budget-friendly educational opportunities.

Social factors also significantly enhance persistence and motivation in ODL. Family and organizational support play a crucial role in sustaining student engagement and reducing dropout rates (30, 32). Social distancing requirements during the COVID-19 pandemic accelerated the adoption of distance learning, showcasing its adaptability to societal needs (31). Peer interaction and collaborative learning foster engagement and motivation, highlighting the importance of social participation (34). Additionally, supportive cultural norms and encouragement from family members positively influence student engagement and persistence (33). Social acceptance and a sense of community within virtual classrooms further contribute to a positive learning environment.

Psychological factors such as self-efficacy, self-motivation and autonomy are critical motivators in ODL. High self-efficacy and self-determination enhance student satisfaction and persistence (30, 32). Technological self-efficacy significantly influences student satisfaction and perceived ease of use, making the learning experience more enjoyable (31). Intrinsic motivation, including the desire for self-improvement and curiosity, positively impacts participation in online learning (33). Positive attitudes towards ODL and adaptability to virtual learning environments contribute to higher motivation and reduced stress (35). Personalized feedback and encouragement from instructors also enhance students' confidence and psychological well-being.

Environmental and infrastructural factors are crucial in enhancing the effectiveness of ODL. Reliable technical infrastructure, including internet access and digital devices, ensures effective participation and uninterrupted learning experiences (32, 34). Technical support and user-friendly digital

platforms contribute to student satisfaction and retention (30). Improved internet connectivity and advanced digital infrastructure provide seamless access to educational resources, enabling effective learning (35, 36). Additionally, access to digital devices and technological advancements empower students to participate actively in virtual classrooms (33). These infrastructural advantages facilitate a conducive and interactive learning environment.

Difficulties in ODL

Despite its advantages, students transitioning to higher education through distance learning face several challenges, as illustrated in Fig. 5. One of the most major issues in ODL is the reliance on technology to deliver education. Poor internet connectivity, power interruptions and restricted access to high-quality gadgets like laptops or tablets are challenges that many students experience. Inconsistent technical support, software compatibility issues and cybersecurity concerns all add to the difficulties that students have when participating in online classes, submitting assignments, or accessing digital learning resources (37). Furthermore, mental health issues are common among distance learners, since a lack of social interaction and direct involvement with peers and instructors can result in stress, worry and feelings of isolation (38). The lack of a structured setting, excessive screen time and difficulty maintaining a work-life balance all contribute to burnout and the lack of access to counselling or mental health support services worsens the problem (39). Another significant obstacle is time management, since many students find it difficult to balance their education with work, family obligations and other commitments. Without a set schedule or face-to-face reminders, students can procrastinate, miss deadlines and develop ineffective study techniques, all of which would have an adverse effect on their academic achievement (40).

In addition, self-control and drive are essential for success in ODL, yet many students struggle to maintain their interest in the subject without peer contact or close coaching. Lack of participation in class can lead to a decrease in motivation and dedication to learning (41). Since online learning frequently depends on asynchronous communication, limited contact and communication difficulties also make learning more difficult. Lack of networking possibilities, teachers' slow answers and challenges voicing issues via online forums can all have a detrimental effect on student learning results (42, 43). Additionally, students frequently find it difficult to adjust to digital exam forms, experience technological difficulties during examinations and worry about academic integrity in online assessments, making assessment challenges in ODL extremely challenging. The absence of in-person supervision makes it difficult for educators to monitor student progress, ensure fair grading and stop plagiarism and cheating (44). For a more successful and interesting distant learning experience, addressing these issues calls for advancements in technology infrastructure, improved mental health assistance, organized learning frameworks, improved communication channels and creative evaluation techniques.

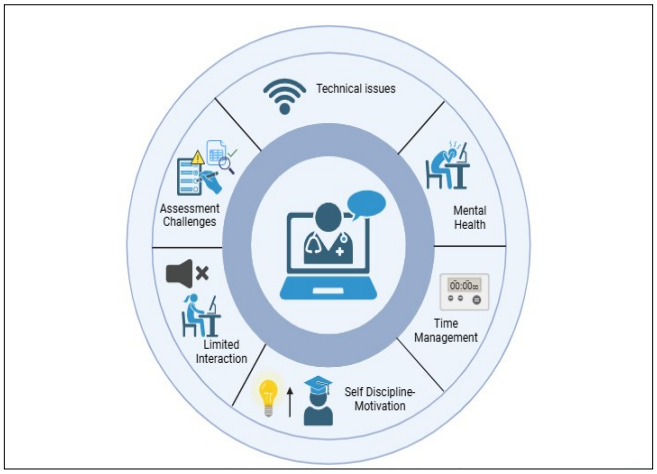

Fig. 5. Challenges faced by the students in open and distance learning.

Conclusion

This study highlights the growing role of ODL in expanding educational opportunities. The increasing adoption of ODL, especially after 2020, has been driven by technological advancements and the demand for flexible learning models. While ODL offers advantages such as accessibility and cost-effectiveness, it also presents challenges, including digital inequality, student dropout rates and concerns about learning quality. Addressing these challenges requires improved digital infrastructure, effective teaching strategies and enhanced student support systems. In the future, the evolution of ODL will be shaped by innovations like artificial intelligence, virtual reality and adaptive learning technologies. Future research should focus on improving personalized learning experiences, ensuring equitable access to digital education and enhancing student engagement. Collaboration between educational institutions, policymakers and technology developers will be essential in making ODL a more inclusive, efficient and sustainable mode of education.

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Authors' contributions

MP conceptualized, formulated the manuscript and analysed the data. PB guided the research by formulating the research concept and approved the final manuscript. SL contributed by developing the ideas, reviewed the manuscript and helped in procuring research grants. NS helped in summarizing and revising the manuscript. KMS helped in summarizing and statistical analysis of data.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

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