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Personalized Learning Paths in Open Education Systems

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Abstract. The concept of education reflected in open education systems and their personalized learning paths is future-changing. Here, learners meet their personalized learning content according to their needs, interests, and learning speed. The idea is supported by technology, using adaptive learning platforms, data analytics, and open education resources, to make experiences flexible, learner-centred, and enhance access and engagement. The potential for personalized learning pathways is huge in open education systems, which should provide quality and low-cost education to very diverse populations. However, successful personalized learning faces challenges on infrastructure, data privacy, quality of content, and digital literacy. The personalized learning paths in open education can further allow for improved learning outcomes, scalability, and increased learner autonomy by tackling a number of challenges in the presentation of recommendations for their effective implementation. Personalized learning paths-aided by adaptive technologies and collaborative learning strategies-support more inclusive, flexible, and equitable education systems, especially in areas where access to traditional education systems is at a minimum.

Keywords: Personalized learning paths, open education systems, adaptive learning, data analytics, educational technology, scalability, digital literacy

1. Introduction

Education nowadays is no longer confined to the traditional classroom and textbooks. Technological advancement has cast a question mark on the traditional "one-size-fits-all" approach to teaching. The emergence of technology has created new avenues for transforming learning. Of the different approaches that have been highlighted and appreciated, personalized learning has been one strategy. Personalized learning, which involves education being offered based on individual needs, preferences, and learning styles of each student, is fast reshaping the educational landscape and enabling students to realize their full potential.

Personalized learning paths have become the cornerstone of modern education, especially within open education systems that emphasize accessibility and flexibility. These learning paths take into consideration the unique needs, goals, and abilities of individual learners and offer tailored educational experiences that promote deeper engagement and better outcomes. In a world where one-size-fits-all education is increasingly being regarded as anachronistic, personalized learning presents a different approach to meet diverse learners' needs, especially within open education frameworks that stress open and free learning opportunities (McKnight et al., 2016).
Open education systems, including MOOCs, OER, and open courseware, allow learners to access high-quality educational content without the constraints of traditional classroom settings (Miao 2015). These systems are inherently flexible, providing the perfect environment for personalized learning where learners can follow customized paths that align with their specific interests and pace of learning. Personalized learning paths are enabled by advancements in data analytics, machine learning, and adaptive technologies, which track learner progress and modify content to suit individual needs (Siemens, 2013).

Although the concept of personalized learning itself is far from new, its application to open education systems creates unparalleled potential to make

education more democratic. With support from learning management systems, adaptive learning platforms, and data-driven insights, these systems allow learners to take ownership of their learning process far more effectively (Bakia et al., 2012). This is in contrast to traditional models of education that tend to subject all learners to the same curriculum without considering learner variation or prior learning (Rose & Meyer, 2002).

In this regard, open education systems promise improved learner outcomes by providing more engaging, efficient, and relevant learning pathways. On the other hand, the adoption of such models has challenges such as ensuring data privacy, content quality, and scalability issues in large and diverse learner populations (Johnson et al., 2016). The paper examines the concept of personalized learning paths within open education systems, discussing the benefits, challenges, and technologies that enable them.

2. Concept of Personalized Learning Paths in Open Education Systems

The personalized learning concept has just lately emerged as one of the most important targets in the education system. In the history of personalized learning, long before now, John Dewey was the greatest advocate of putting the learner in the center in the early 20th century (Redding, 2016). It later started to take shape when some education reformers began to criticize the standardized approach to the industrialized education system and sought various methods to address student diversity (Redding, 2016). For instance, the Personalized System of Instruction proposed by Fred Keller in 1968, emphasizing student self-pacing, mastery-learning, and small-group tutoring, represents one of the first attempts at implementing personalized approaches to instruction and often is considered a precursor of PL (Keefe & Jenkins, 2008). While there are hints of more personalized approaches in a variety of areas, including special education, individualized instruction, and educational technology, the true premise of PL has remained fairly elusive at scale to date (Basham, Hall, Stahl, & Carter, 2017).

In the recent years, different education systems worldwide such as that of United Kingdom, United States, Finland, and Canada among others are adopting the usage of personalized learning techniques to increase the diversity of students alongside ensuring that all students undergo quality education, Peterson 2016.

In the United Kingdom, PL was introduced as official government policy as early as 2004; it focused on how teaching can be adapted to meet students' individual needs Campbell et al., 2007. The U.K. Department for Education and Skills (DfES; 2004) defined five broad components of PL: assessment for learning, effective teaching and learning, flexible curriculum and choice, student-centred school organizations, and activities beyond the school (Sebba, Brown, Steward, Galton, & James, 2007). In the United States, the most recent federal education law-Every Student Succeeds Act of 2015 (ESSA)-advances the ideal of schools ensuring more learners have access to rigorous, personalized learning. ESSA regulations bring forth the need for state and local education agencies to design innovative learning environments tailored to meet the needs of individual students through the use of modern technology and flexible instructional practices aligned with the Universal Design for Learning framework (ESSA, 2015).

Personalized learning paths in open education systems are paths that cater to the needs, preferences, pace, and goals of every learner within an enabling framework of open and accessible educational resources. Technologies such as adaptive learning, data analytics, and AI in learning paths grant learners the potential to control their learning trajectories, hence flexibility, inclusivity, and learner-centredness of education. Open education systems allow access to high-quality learning materials for free or at low cost and thus offer ideal platforms for personalized learning paths. Personalized learning is a teaching ideology, a Finnish version of the internationally well-known concept of reversed or 'flipped' learning. It is a theoretical framework that describes how every learner can be dealt with at an individual level practically, whereas schools usually have large classes with diverse students. The key conditions of learning are considered in the model, which involves motivation of the student, accompanied by the feelings of autonomy, ability, and relevance of the learning.

The ever-increasing demand for education reform has urged an increasing number of schools to move toward PL systems (Basham, Hall, Carter, & Stahl, 2016; Bingham, Pane, Steiner, & Hamilton, 2016). Therefore, the proponents of PL have held views that students can achieve much more in learning and accomplishments than is possible if they receive tailored instruction and support to meet the individual needs of a given student, while leveraging the strengths of that same student (Jones & Casey, 2015). PL purports to break from and disrupt conventional structures of education for an equitable learning opportunity for all. However, its practice and study

remain in an infant state." Contemporary concept of PL arises out of convergence and advances at the cross section between educational research-learning science-data & computer sciences, & techno cycling innovation - Basham et al 2017 & Zhao, Tavangar McCarren, Rshaid & Tucker, 2016. From each of these fields, scholars have pursued research independently, collaboratively, and interdisciplinary on both the design and possible effects of PL. Continued research and new insights have also helped underpin the ability for systems that implement PL across a range of diverse student populations in a variety of settings to be developed and scaled (Basham et al., 2016; Walkington, 2013). For example, Basham et al. (2016), as learning researchers, reported that PL environments across an entire reform district supported better-than-expected outcomes in student growth. Other examples include interdisciplinary studies by researchers on the use of an adaptive mathematics tutoring application embedded in strategies and system features to support higher levels of PL and meet diverse needs of students (Arroyo et al., 2014). The results of the Arroyo et al. (2014) study showed that learning outcomes, motivation, and metacognitive skills were improved for participants who used the system.

While various modern educational initiatives and policies call for researchers from different fields to collaborate closely and conduct interdisciplinary research on PL (U.S. Department of Education, 2016), little understanding is shared across these fields of research. This thus leads to a sharper view of the features of current PL research across disciplines, yielding new and broader insights for each discipline by pushing the research forward in collaboration. For instance, while most research in education and learning sciences focuses on interaction among learning environments, educators, and students, research in computer science is focused on advanced learning technologies, data, or machine learning systems that provide foundational elements of these interactions (Basham et al., 2017).

The personalized learning model presupposes that a student, by employing practical means, owns the learning. It is a tool for increasing motivation in which one's commitment to learning will be much greater since the students themselves know much about their capabilities and motivation to learn. The foundation of all these things is an individual learning path combined with self-assessment.

The concept of individual learning is easy to practice when one class teacher is left with the same group in an academic year. Classes have several teachers, most specifically in major subjects, and usually large schools are always in deep and long-term learning strategies requires intimate co-operation of teachers.

The traditional model has nowadays been displaced in the dynamic landscape of professional growth, where standardized programs in training prevail over personalized learning. Personalized Learning Paths, which align individual professional growth with tailored learning needs, have gained significant attention according to the Institute of Data, 2023. These learning paths provide a structured approach to training, considering the particular needs, preferences, and goals of each learner beyond the one-size-fits-all model. It helps the employees reach their full potential while contributing to professional growth through customized learning experiences. Individualized learning is one thing that one can simply not afford to overlook in any training program. This is because the talent, knowledge base, and experience of each individual are different due to which the strategy of learning has to be prepared on an individualistic basis. In addition, by customizing the training to suit individual needs, an organization automatically improves participation, motivation, and the rate of retention and application of that information. Moreover, personalized learning allows learners to become owners of their professional growth by instilling in them the concept of lifelong learning. This will allow the learners some ownership of their lives in planning for themselves; thus, being more participative and committed toward personal development.

Traditionally, professional development has been conducted in a one-size-fits-all manner, with all employees taking the same courses irrespective of their roles, capabilities, or objectives. The Differentiated Instruction theory, proposed by Dr. Carol Ann Tomlinson (Tomlinson, 1999), recognized that every group has a different learning need; therefore, professional development should consider these needs. Personal Learning Paths take this a step further by considering the individual needs of each person along the path of development.

The development of an efficient learning path requires a look at distinct learning needs and differentiating every individual. These can be judged through self-assessment, performance appraisal, or interviews, where one gets to understand the strengths, weaknesses, and preferences of the learner. In that way, understanding these aspects enables organizations to configure training programs toward what every learner exactly wants. Such personalization would imply choosing relevant

content, appropriate instruction method, and offering feedback and support. Besides, personalized learning should allow the learners to set their objectives and decide at what sequence they cover learning tasks in order for them to progress with their learning in their own speed and to make concentration on whatever is most helpful to their job and career goals. Continuous monitoring and feedback are what make personalized learning successful. This article discusses personalized learning for professional development, its key elements, and the enormous advantages that are derivable from such learning.

Key Concepts Behind Personalized Learning Paths include:

Individualized Learning Journey: Personalized learning paths focus on adapting the content, structure, and pace of learning to each learner's specific needs. This includes accommodating different learning styles, abilities, and prior knowledge, ensuring that learners engage with content in a way that suits them best. For example, a learner struggling with a particular concept might be provided with additional resources or alternative explanations, while someone who has mastered a topic could be advanced to more challenging content.

Learner Autonomy: One of the central elements of personalized learning paths is the autonomy granted to the learner. In open education systems, learners are typically offered more control over when, where, and how they engage with learning materials. This autonomy allows them to pursue areas of interest, set personal goals, and learn at their own pace. Learners can select from a range of resources (e.g., videos, articles, quizzes) and choose the sequence in which they engage with them, fostering a more self-directed learning environment.

Data-Driven Customization: A personalized learning path is often powered by data. In open education systems, learner progress is tracked, and data analytics are used to understand each learner's strengths, weaknesses, and preferences. This data helps inform the adaptation of learning experiences. For instance, platforms might use learner interaction data (such as quiz results or time spent on topics) to suggest personalized resources or adjust the difficulty level of subsequent content.

Adaptive Learning Technologies: Adaptive learning platforms, powered by machine learning algorithms, can automatically adjust the learning experience based on real-time performance. These systems provide dynamic feedback to learners and adapt content delivery according to individual progress. For example, if a learner answers multiple questions correctly, the system may increase the difficulty of the tasks, while providing remedial content for learners who are struggling.

Open Educational Resources (OER): Open education systems often rely on OER, which are freely accessible and openly licensed materials that can be used, adapted, and shared. Personalized learning paths within open education leverage OER to allow learners to explore subjects and topics in more depth, with resources that can be adapted to their specific needs. OER can include textbooks, videos, simulations, and assessments, all of which can be curated into personalized learning experiences.

3. Nigeria as a Case Study: Personalized Learning Paths in Open Education Systems

Nigeria, the most populous country in Africa with a fast-growing digital landscape, creates an interesting case study for implementation in open education through personalized learning paths. The general education system of the country is seriously suffering from various challenges like overcrowded classrooms, a lack of resources, and wide disparities in educational opportunities between urban and rural areas. That said, Nigeria is also trying to embrace digital technologies as means of addressing these issues to improve learning outcomes. This is especially true in terms of personalized learning paths within open education systems, which may well revolutionize the way learning happens across Nigeria, by catering to learners with very diverse learning needs.

The government of Nigeria, among other bodies, has begun embracing open education systems to help solve some of the lapses in Nigeria's education. With the establishment of programs such as the National Open University of Nigeria and the creation of Massive Open Online Courses, access to education has increased, especially for non-traditional learners. Being Nigeria's first and largest open and distance learning institution, NOUN has played an important role in the provision of accessible educational opportunities for students around the country with much flexibility (Ajadi et al., 2008).

MOOCs, especially those on platforms like Coursera, edX, and Nigeria's own Tuteria, have gained popularity over the last couple of years, especially among urban and tech-savvy populations. Many of these platforms are designed to incorporate adaptive learning technologies that can support personalized learning experiences, making them well-suited for Nigeria's diverse learner base. Further, the emergence of local platforms such as the Nigeria-based online learning platform, Ulesson, developing mobile-app-based customized learning content exemplifies

technology acting in harness to not only solve problems within the educational sphere but also give independence to learners.

Nigeria's increasing internet penetration, coupled with the growth of mobile technology, has laid the groundwork for the widespread adoption of personalized learning. According to the Nigerian Communications Commission (NCC), Nigeria has over 200 million mobile phone subscribers, with mobile internet access expanding rapidly, especially in urban areas (NCC, 2020). These technological advancements have enabled learners across the country to access online education, even in remote areas, where traditional educational infrastructure may be lacking.

With increased acceptance for data analytics, AI, and machine learning within Nigeria's education, it could lead to higher heights of access and quality through open education systems and personalized learning paths. Platforms such as Khan Academy and Duolingo, among others, have contents that blend into the features of adaptive learning. It is a feature with huge potential benefits in Nigeria's context. Meanwhile, some Nigerian ed-tech startups, like Andela and Tuteria, are considering personalized learning tools so as to enhance the learning experience for students at different levels and disciplines.

4. The Need for Personalized Learning Paths in Nigeria

Critical challenges facing Nigeria's educational system include a lack of access to quality education, inadequate qualified teachers, and poor infrastructure. UNESCO estimates that approximately 10.5 million children in Nigeria are out of school, the largest number in the world (UNESCO, 2020). The country's education system also suffers from a high teacher-student ratio, with some classrooms containing over 100 students, which undermines individualized instruction (Okebukola, 2016). Considering these challenges, personalized learning pathways can be an alternative approach to making learning more effective, scalable, and accessible.

Open education systems may take care of the gap that exists between each particular learner's needs and the reality created by a classroom, which mostly includes just one size-one approach, by personalizing learning. Allowing for the individual rhythm of learning at the same time fosters more inclusion and participation, and this can have a greater value in contexts where the majority of methods adopted are simply inappropriate for a portion of students (Santos et al., 2020).

4.1 Benefits of Personalized Learning Paths for Nigeria

Before one gets down to selecting whether personalized learning is the best strategy for online courses and programs, it is good to weigh its benefits and drawbacks. Let us look into some of the major benefits.

(i) Increased Access to Education: Personalized learning paths in open education systems can increase access to education by overcoming geographical and infrastructural barriers. Using mobile devices and access to the internet, learners in remote or underserved areas can now access high-quality, self-paced educational content that is tailored to their needs.

(ii) Better Learning Outcomes: By providing content suitable for individual learning speeds and needs, personalized learning can certainly help learners master concepts more effectively. This is very important in a setting like Nigeria, where students have to contend with huge class sizes and a lack of attention from teachers in conventional classrooms.

(iii) Affordability: Open education systems, especially the MOOC and OER, can reduce financial burdens on students by providing free or low costs for educational resources. Personalized learning, enabled by this system, may help students to concentrate their efforts upon those dimensions where they have low achievement, reducing the time and money wasted because of sections not needed.

(iv) Competence Building among Workforce: By encouraging tailored learning paths, each learner can learn courses that fall directly into career or professional development opportunities, thus becoming endowed with prospective employable labour market skills. Indeed, in those countries where high unemployment is identified to pose huge difficulties-namely Nigeria-personalised learning can help such youth acquire vital technical and vocational capacity amongst contemporary the workforce. World Bank, 2019.

4.2 Challenges and Limitations

Despite the potential benefits of personalized learning, several challenges hinder its full implementation in Nigerian open education systems:

(i) Cultural and Social Factors: In some communities, especially in Nigeria, much preference is still shown for traditional, classroom-based learning. Some learners may resist personalized learning approaches which are out of their usual

formats or may lack the necessary skills to navigate a digital platform efficiently (Ribadu & Usman, 2021).

(ii) Infrastructure and Internet Connectivity: With the expansion of the internet, most rural areas still suffer from the problem of having either an unreliable or slow connection. The high cost of mobile data also limits the extent to which learners can afford to access personalized learning resources online. The infrastructure needed to support personalized learning, such as well-trained educators, digital learning platforms, and the technical support to maintain these platforms, is still inadequate in many parts of Nigeria. This gap poses a significant barrier to the widespread adoption of personalized learning models (Uwaifo, 2020).

(iii) Digital Literacy: Unsatisfactory digital literacy on the part of students and teachers stands out as an obstacle toward effectively implementing personalized learning. This may involve most educators lacking the requisite skills in embedding technology in pedagogic practices while students are often found incapable of holding a computer mouse and/or cannot be entrusted to apply basic digital competencies that online platforms call for (Adomi, 2012). While access to mobile phones and the internet has increased in Nigeria, there is still a great digital divide between urban and rural areas regarding this access, hence affecting access to online learning platforms. In addition, students in the rural setting do not have reliable means of accessing the internet or using devices to engage with personalized learning tools effectively (Adebayo, 2020).

(iv) Content Quality and Localization: Most open education resources are created with a global audience in mind, not really culturally relevant or appropriate for the Nigerian learners. For that reason, developing high-quality, locally relevant content in local contexts and languages is vital in ensuring effectiveness in personalized learning.

(v) Data Privacy and Security: The use of data analytics and AI for personalization of learning paths raises serious concerns about data privacy and security. Protecting learners' personal information against misuse is key to retaining trust in digital education platforms.

5. Conclusion

Personalized learning paths in open education systems hold great potential to transform education in Nigeria. Technology, data analytics, and adaptive learning platforms are capable of facilitating personalized learning that addresses issues of access, quality, and equity in Nigerian education. Simultaneously, such systems have a number of barriers to implementation: infrastructure, digital literacy, content localization, and data security. With further investments in both technological infrastructure and capacity building, individualized learning routes may hold the key to the future of education in Nigeria. It will require a multi-media approach, which means investment in technology, training educators, assuring the quality of content, and attention to data privacy and security in implementing personalized learning paths within open education systems. If policymakers, educational institutions, and technology providers focus on these few recommendations, the learning environment can become more inclusive, flexible, and effective to meet the needs of all learners, especially in areas with very limited access to education. Together, this opens ways that personalized learning pathways could dramatically reshape the educational landscape and help learners around the world unlock their full potential.

6. Recommendations

For the implementation of personalized learning paths in open education systems, a number of recommendations are of paramount importance in guaranteeing success, inclusivity, scalability, and quality. These recommendations are in relation to the main challenges faced by educators and learners from technological, pedagogical, and infrastructural standpoints.

(i) Improve Technological Infrastructure: Truly, robust technological infrastructure is a pre-condition for successful personalized learning paths. Governments, schools, and organizations need to ensure that development and expansion of reliable internet access are a priority, especially within communities that remain under-resourced.

(ii) Ensure Data Privacy and Security: Personal learning requires a great deal of data created by a learner in order to track progress and tailor content; therefore, the security and privacy of data are of prime importance.

(iii) Generate Culturally Relevant and High-Quality Content: Pertinent, high-quality content is at the core of the effectiveness in personalized learning. It has to be consonant with learners' cultural backgrounds and interests and meet the serious educational requirements of the institutions in question.

(iv) Digital literacy development should be encouraged, together with teacher training: For the implementation of personalized learning paths, success requires that students and educators alike have the necessary digital literacy to navigate and use the technology effectively.

(v) Ensure Scalability and Flexibility: For personalized learning paths to prove their worth for large and diverse populations, they must be scalable and flexible enough to support different learning styles, speeds, and contexts.

(vi) Encourage Collaborative Learning: Even though personalized learning paths put the main focus on the individual's learning, collaboration can still serve to foster social interaction and deepen understanding.

(vii) Mechanisms for Ongoing Monitoring and Feedback: If personalized learning paths are to remain efficient and relevant to the learners, timely feedback is in order and the monitoring of progress must be constant.

(viii) Accessibility: Personalised learning pathways should be inclusive, catering to a wide range of learners from various walks of life, different socio-economic backgrounds, students with disabilities, and having different learning needs.

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