Cyber Security and Self-Learning Skills For Adults

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2025

Abstract

As the world today is experiencing a scientific renaissance among people, and a development in the field of communication and information technology in a way that has become the standard scientific and technical development for international competition to reach comprehensive development. The progress of the global technical field is keeping pace with the positive improvement of its various interactive advantages and applications in the field of education and knowledge industry. This research aimed to clarify the importance and role of effective cyber security in providing a safe learning environment capable of protecting the learner's personal data from unauthorized access, attacks, and damage, also aimed to enhance various self-learning skills for adults, including digital, cognitive, and other skills, with the aim of meeting the learner's own needs and qualifying the learner to deal with the variables of modern life.

Methods. The research relies in its methodology on the qualitative descriptive approach, which aims to describe the phenomenon that is the subject of the research through the writings and literature (such as: books, research, and scientific dissertations) available on the subject.

Keywords: cyber security, self-learning, self-learning skills for adults

ntroduction

In the digital era, cyber security is a critical concern for people, corporations, and governments. With the increased use of technology and digital devices, it is more necessary than ever to secure electronic devices, networks, and data against unwanted access, theft, and damage. With the advancement of technology, the cyber security action of protecting an organization, employees, and critical assets from cyber threats faces several challenges. (**Admass, et al., 2024**).

Egypt's Vision 2030, in achieving its strategic goals, relies on a crucial principle enhancing "Resilience and Adaptability". This means the system's capacity to effectively respond to abrupt international and regional shifts or unforeseen local developments; be they economic, political, social, or environmental. It involves anticipating swift and appropriate mechanisms to address issues and providing solutions that mitigate the adverse impacts of shocks or crises, ensuring the continuity of development and production. (**Egypt's Vision 2030,2023**)

Cyber-attacks can have catastrophic effects, such as financial loss, reputational harm, and even fatalities in industries with vital infrastructure, like healthcare and energy. Cyber security is used in small enterprises, government agencies, military groups, health care providers, educational institutions, energy suppliers, and transportation systems to protect personal data, secure vital infrastructures, and guarantee the confidentiality and integrity of sensitive information. (**Admass, et al.., 2024**).

Technological advancements have created new ways of disseminating knowledge that are more accessible and flexible in nature. Adults can use online learning platforms, mobile apps and digital resources to learn at any time and place they want, removing the geographical or time boundaries.Blended learning models that

include face-to-face teaching combined with online instruction can respond to different tastes and requirements of learners. (Edwards **et al., 2024**)

According to Knowles (1975), self-directed learning (SDL) is a significant concept in adult education. SDL refers to a process where individuals take the lead in identifying their learning needs, formulating goals, finding resources, selecting appropriate learning strategies ,and evaluating outcomes, either with or without assistance from others.   Programs for adult education should be learner-centered, by taking into account their personal needs, preferences and circumstances. The use of technology in adult education can improve its accessibility and involvement.

Digital literacy should be at the core of all adult education programs to make sure that learners have skills to not only operate but also apply any form of technology appropriately. Furthermore, access to digital tools and connectivity are important elements that ensure every student has an opportunity to gain from online educational resources. . (**Edwards, et al., 2024**)

The vulnerability of web applications to attacks by cyber criminals, who are known with names like [cyber] attackers, hackers and cyber criminals causes huge harms and losses to nations**,** organizations, groups and individuals alike. Some of the most popular web vulnerabilities are SQL injections, Cross site scripting (XSS) and Cross Site Request Forgery (CSRF).   It is reported that XSS presents 40% of attack attempts on web applications, compared to other web related attacks, such as SQLi and CSRF, among others (**Rodriguez et al., 2020).**

Cross-site scripting is when an attacker or hacker injects malicious codes or scripts into a server or on the client side to gain

access to critical and important information (**Kaur et al., 2023; Okusi, 2023**). Cross-site scripting attacks are of national and international concern, because of the threats and losses following the attacks. Essential and confidential data are compromised, stolen or destroyed, putting the nation or organization having the data in serious troubles. The United States of America suffers the devastating effects of cross-site scripting attacks too. (**Okusi, O. 2024**).

Significance of the study:

Cyber security is the practice of protecting computer systems, networks, and sensitive data from unauthorized access, attacks, and damage. It is a holistic approach that encompasses a wide array of measures aimed at ensuring the confidentiality, integrity, and availability of information. As organizations digitize their operations and store vast amounts of valuable data online, the need for robust cyber security measures becomes paramount. (**Pansara, R. R. 2022**).

Technology and innovation evolved from being a rigid scientific term into a sophisticated and common approach for problem-solving across various development domains and daily activities, in order to cater to the needs of individuals and society, resulting in an abundance of information, enhanced communication methods, and greater efficiency in saving time and effort. (**Egypt's Vision 2030,2023**).

Egypt faces several challenges; the most significant ones include limited financial and moral incentives for scientific research and innovation, leading to brain drain and skill migration .The gap between development plans and research priorities, and the lack of effective mechanisms to link technology and innovation with productive sectors.Insufficient social and cultural awareness of

innovation, with a prevailing culture of replication and imitation that restricts creativity. **(Egypt's Vision 2030,2023**).

Both adult learning and education have been seen as fundamental elements of personal advancement and societal progress. Within the community development context, adult education is very important in building up individual skills, knowledge, and competencies thereby significantly contributing to overall welfare and growth of communities. Policymakers, educators and community leaders who understand how adult education plays a role in community development will be able to develop and implement programs that promote inclusive and sustainable growth better.

Adult education can promote social inclusion and economic enfranchisement as the UNESCO's Global Report on Adult Learning and Education (GRALE) shows. Adult education programs can significantly lower unemployment, raise earnings and improve overall economic situation in a society. This adult education fosters social cohesion by bringing together people from different backgrounds to share their experiences as well as understanding one another. For this reason, it is important to have such a social capital to ensure that there exist resilient and inclusive communities.

Aim of the study

The aim of this study is to:

Explore the vital role of cyber security and E-learning in developing skills of self-directed learning for adult learners through the following objectives:

1-How the interactive environment of the e-learning can help the adult learner to actively engage in self-directed learning?

2- What are impacts of new technology entrance on self-directed learning for adult learner?

3- What about adaptability of the adult learner in age of rapid development of technology?

Research questions:

1- Does virtual learning or E-learning posse positive effects on developing skills of self- directed learning of adult learners?

2- Is there a relationship between enhanced or empowered cyber security and increased effectiveness of self-directed learning skills for adult learners?

Methodology

The research is considered a theoretical library research and a type of descriptive qualitative research that aims to describe the phenomenon that is the subject of the research through writings and literature (such as: books, research and scientific dissertations available on the subject.

Review of Literature

Learning, Skill and Attitude Definition

According to the online edition of the American Heritage Dictionary of the English Language, learning has three main definitions. First, it can mean "the act, process, or experience of gaining knowledge or skill." Second, it can mean "knowledge or skill gained through schooling or study." Third, it can mean "Changes in behavior resulting from experience, especially changes due to conditioning." Knowledge is generally understood to mean facts, information, and concepts. Skill refers to know-how-that is, practical awareness of how to do something. Attitude is a general disposition or feeling, positive or negative, about something and is closely aligned to opinions and beliefs **(William Rothwell, 2020).**

Learning is a lifelong process. To continuously build a knowledge base, learners of all ages must extract information from their environments with and without explicit direction. Over the lifespan, most learning occurs outside the classroom. For example, U.S. students spend only 8903.3 h over 9 years completing primary and secondary education (**OECD, 2021**). From a lifelong learning Perspective, adults are more likely to spontaneously combine separate yet related episodes of new learning to derive novel factual information than children are (**Bauer et al., 2020).** Acquiring information and generating new knowledge across time from different resources (i.e. a broad interpretation of task switching) is challenging for both children and adults (**Dugan & Bauer, 2022; Esposito et al., 2021**).

Learning is something that individuals do on their own. It is a "pull" strategy. Learners pull knowledge, skills, and attitudes from others so that they can be successful. Learning refers to the acquisition of knowledge, skills, and attitudes. It may also include the acquisition of characteristics that go beyond mere knowledge, skills, and attitudes-such as values, ethics, behaviors, preferences, and much more. Learning occurs across the lifespan, and evidence even exists that learning can occur before birth (**William Rothwell, 2020**).

If learning is about mastering and applying useful knowledge, skills, and attitudes to achieve results, then it is central to organizational and individual success. Neither organizations nor individuals can adapt to change-or take full advantage of future opportunities-if they lack the requisite knowledge, skills, and attitudes. As a result, learning is a very important means to the end of performing. Learners must be more self-directed, with strong learning agility, because the teacher is no longer the active agent

while learners passively listen as it was in traditional classrooms. (**William Rothwell, 2020**)

Adult Learning and Education

Adult learning and education (ALE) is a core component of lifelong learning which has always been at the forefront for the betterment of life for adult citizens. By definition,UNESCO (2015) stated ALE includes all forms of learning by adults to enrich their personal development and capacities for their self-interest as well as that of their communities, organizations, and societies. From this definition, it can be seen that all forms of ALE have dual aims that are woven around the ability of adult learners engaged in ALE to seek self-improvement for their nation's development. (**Ajayi& E. A. 2022**).

There are certainly signs of a greater recognition of the importance and value of adult education and lifelong learning ALE today, though they are far from universal. To list a few: adults are living longer, generating more demand for learning throughout life in diverse settings and formats. New technologies, growing automation and shifting locations of production are influencing the skills needed by, and career trajectories of, workers in evolving labour markets. (**Benavot, et al., 2022**).

Lifelong learning involves personal aptitudes and dispositions (for example, a growth mindset), cognitive skills like problem-solving, metacognitive skills such the ability to self-assess, and affective factors (for example, motivation) (Punie, **et al., 2024**). Generally, one needs to be aware of what one should learn, decide how to learn it, source and use resources, self-assess, and have confidence in one's ability to engage in these acts.Developing these skills is seemingly at odds with typical educator-centered teaching approaches where educators decide what will be learned, how it will

be learned, and how learning will be assessed. (**Chamberland**, **et al., 2024).**

Self-direction entails determining goals, utilizing effective strategies for organization, encoding and repeating information, monitoring performance, requesting assistance when needed, having positive attitudes towards available skills and other similar processes (**Yoo, 2020**). A learner with self- direction is constantly planning, organizing, observing and evaluating (**Chau, Law & Tang, 2021**).**Brown et al. (2022)** found that online-only students had higher self-directed learning levels compared to blended learning students .Based on the findings of **Taş and Tortumlu (2021),** it may be stated that as individuals are motivated, they may express more self-direction skills. (**Altinpulluk, et al.,2023).**

Self- Directed Learning (SDL) competence is defined as "the ability to pursue SDL with success and efficiency: to proficiently direct one's own learning means and objectives in order to meet definable personal goals .Specifically, SDL competence has been identified as a fundamental competence for adults living in our modern world: SDL competence is especially important for employees to manage rapidly and constantly changing work condition. (**Morris et al.,2021**)

scholars have pointed out how fundamentally important SDL competence is for an adult across the course of their life: Tough's seminal work highlighted how SDL is commonplace employed in everyday life: as a process through which work- or life-centered problems are solved. Self- Directed Learning (SDL) is a learning process in which learners take primary responsibility to direct their learning means and objectives in order to meet their learning goals. The process concerns both self-management and self-monitoring of learning tasks, which have been referred to as macro- and micro-level

aspects of SDL, respectively .From a macro-level perspective, SDL often does not involve learners learning alone in isolation. **(Morris et al.,2021).**

Furthermore, scholarly models of self- directed learning (SDL) commonly emphasize three further dimensions: personality characteristics of persons that are likely to affect their tendency and propensity toward SDL, factors within the person's context that might influence the likelihood of whether self- directed learning (SDL) is carried out and, the cognitive aspect of SDL–considering how meaning is made during the SDL process. **(Morris et al.,2021).**

Education and lifelong learning are understood to be drivers of broad social, political, economic and environmental transformation. The fact that promoting "lifelong learning opportunities for all" (**SDG 4; UN 2015**) has been adopted as an official international development priority is unprecedented. If ALE is an essential means of capacity building, then the need for such capacities is acute in many under-resourced settings. Effective capacity building through ALE can significantly contribute to SDG progress. And yet, ALE continues to play the role of an "invisible friend" for the SDGs (**Benavot 2018**).

Adult learning and education must look very different a generation from now. As our economies and societies change, adult education will need to extend far beyond lifelong learning for labour market purposes. Opportunities for career change and reskilling need to connect to a broader reform of all education systems that emphasizes the creation of multiple, flexible pathways. Like education in all domains, rather than being reactive or adaptive (whether to change in labour markets, technology, or the environment), adult education needs to be re-conceptualized around learning that is truly transformative (**UNESCO 2021b, pp. 114–115**).

The Reimagining our futures together report advocates for a multidimensional view of adult learning and education (ALE) – empowering, critical and transformative – which takes responsibility for shaping a just, peaceful and sustainable world: Adult learning and education play multiple roles. It helps people find their way through a range of problems and increases competencies and agency. It enables people to take more responsibility for their future.

Furthermore, ALE helps adults understand and critique changing paradigms and power relationships and take steps towards shaping a just and sustainable world. A futures orientation should define adult education, as much as education at all moments, as an education entangled with life. Adults are responsible for the world in which they live as well as the world of the future. Responsibility to the future cannot be simply passed on to the next generations. A shared ethic of intergenerational solidarity is needed (**UNESCO 2021b, p. 115**).

Digitisation, Digitalization, Digital transformation in adult education

In the context of education, **Titus (2018), Olatunde-Aiyedun, Eyiolorunse-Aiyedun, and Ogunode (2021)** conceptualize digitalization as the process of transitioning traditional teaching and learning materials to online platforms, including educational apps, multimedia resources, online courses, online assessments, and web seminars/conferences or workshops, for electronic delivery within educational institutions.

Digitalization in adult education has revolutionized the educational process, enabling learning and teaching to occur conveniently for both learners and facilitators, regardless of time and location. It enhances accessibility to the internet, increases the flexibility of study, fosters diverse interactions between teachers and

students, facilitates online testing, improves the ability to cater to special needs, and makes online learning content more readily available. Furthermore, it promotes adaptability and personalization within the learning experience. (**GOGARAM, A. Z. ,2025).**

Digital Transformation

Digital transformation refers to relying on digital technologies in delivering public and private services and commercial operations ,subsequently replacing paper –based transactions with electronic ones. This shift enhances the efficiency of service provision and improves production process and transaction governance. (**Egypt's Vision 2030,2023**)
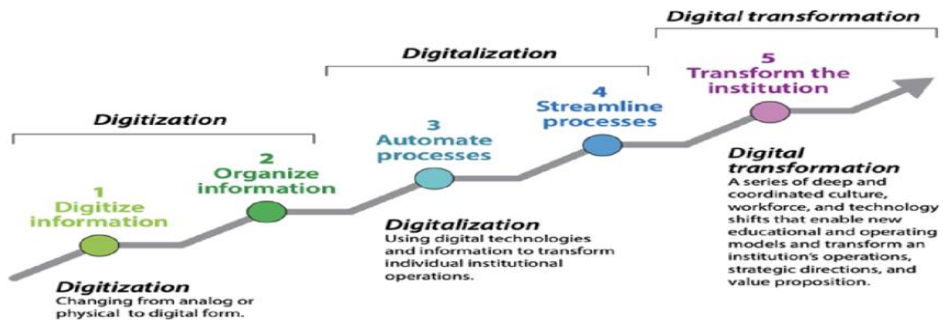
Landscape of Digital Transformation and Adult Learning

A.   Digitisation Impact on Adult Education

Topics such as cyber security or artificial intelligence (AI) have become more socially important, and teaching them to the population is part of adult education (**Daugherty & Dark,2021).** Because knowledge about online safety, data privacy and protection against cyber threats is important to protect oneself and one's organizations from cyber-attacks and data breaches. (**Julia Rott et al.,2024**). Digitisation has enabled the development of adaptive learning technologies that use data analytics to provide learners with

customized learning experiences based on their individual learning styles, needs, and preferences (**Li et al., 2022**).

One of the primary objectives of cyber security is to safeguard against cyber threats that can have severe consequences. These threats include, but are not limited to, data breaches, ransom ware attacks, phishing attempts, and denial-of-service attacks. The fallout from such incidents extends beyond financial losses to encompass damage to an organization's reputation, loss of customer trust, and potential legal ramifications. (**Pansara et al., 2022).**

Digitization has transformed opportunities for self-directed learning in informal, non-formal, and formal educational settings. Digital technologies facilitate easy access to information, which facilitates self-directed learning; however, the increasing volume of available information necessitates additional learner skill in information literacy—part of being **a competent self-directed learner** in order to navigate information in a meaningful way (**Kara, 2022**)

The ongoing digital transformation has reshaped adult education, providing new learning tools, expanding accessibility and requiring continuous adaptation to technological advances .As technology continues to evolve, it will be important for adult educators to stay up-to-date with the latest digital tools and strategies to effectively support adult learners in a rapidly changing world. (**Julia Rott et al.,2024).**

B. Enhancing Information-Seeking Behavior

Critically, in the absence of explicit direction, learning is self-motivated. That is, rather than by outside forces (e.g., teacher or researcher), the successful learner self-initiates and self-motivates acquisition of information. Learners of all ages must rely on their own self-motivated initiation of knowledge base expansion, followed

by self-termination of information-seeking behavior. Self-motivated and directed learning is not a continuous process with which all learners are constantly willing to engage. Instead, it is an intentional action that must be actively self-initiated and self-maintained to desired completion. **(Dugan & Bauer, 2022; Esposito et al., 2021)**

Under self-motivated and directed learning conditions, it is often not clear from the outset how many and in what order tasks need to be attended to in order to effectively satisfy a self-identified "knowledgeitch." The learner must expend effort evaluating resources, squeezing all possible information from them, and then shifting attention to identifying, evaluating, and extracting information from a new resource. Task switching in a broad sense may be particularly important under self-motivated and directed conditions because <u>learning often occurs serially across time and context</u>. (**Dugan & Bauer, 2022; Esposito et al., 2021**).

Self-Efficacy in Self-Directed Learning

Learners must feel confident, demonstrating high beliefs in self-efficacy, to invest the appropriate amount of effort and generate their own feedback in relation to task switching across educational resources embedded in self-motivated and directed learning opportunities. If a learner cannot confidently identify where their attention is best allocated during learning, they also may not be able to extract enough adequate information from different tasks or resources to serve their goal, their overall comprehension and ultimate learning outcomes may suffer. Without self-initiated information-seeking behavior, knowledge structures would remain painfully static, and tragically uniform.

<u>Online learning platforms</u>

Online learning platforms allow learners to access educational content from anywhere, at any time, as long as they have an Internet

connection. A further benefit is that the content can be worked on at their own pace. Digitisation has also made it possible to personalize the learning experience for individual learners (**Li et al., 2021**). Basic digital literacy skills, which include basic computer skills, internet navigation, and online communication, are essential for functioning in the digital age and are the foundation for more advanced digital skills. Lifelong learning requires autonomy, self-efficacy, problem-solving, resilience and reflective skills (**L. M. Blaschke, 2021**).

Online learning refers to teaching and learning processes that are provided through the Internet. It includes a wide range of applications to access educational materials, as well as to facilitate teacher-student interaction (**Keshavarz et al., 2022**). The advantages of such courses include the possibility of independent learning and the availability of resources and information at all times (**Bagheri-Nesami et al., 2021**).Today, in the digital age, one of the main attributes that learners need to have is the skill to learn in new digital environments. For this reason, teachers must be familiar with digital-age teaching techniques to manage and lead online classes (**Kohan et al., 2021; Goldberg & Lannoye-Hall, 2023**).

Self-directed learning is compatible with new technologies,enabling the development of online educational platforms with videos, games, simulators, augmented reality, and virtual reality, offering flexibility and independence to students, and a strong predictor of readiness for online learning (**Luu, 2022; Herrera & Valenzuela, 2019; Prihastiwi, Prastuti & Eva, 2021**).In SDL, students take responsibility for diagnosing their learning needs, setting goals, selecting materials and strategies, and evaluating outcomes (**Knowles, 1975**)(**Velásquez, et al.,2024**)

C. <u>Online learners</u>

Online learners, who have the opportunity to learn whenever and wherever they desire, must assume the responsibilities of planning, controlling and evaluating their own learning processes (**Karataş & Arpacı, 2021**).Self-directed learning, which is also related to learners' motivations, is an important concept for online learning environments **(Misra & Mazelfi, 2021).** Learners who are able to organize their learning processes in an online learning environment where <u>learners are physically separated from instructors and other learners may achieve richer learning outcomes</u> **(Deraman et al., 2021**).

William Rothwell, 2020 In flipped classrooms, <u>synchronous learning experiences</u> focus on higher-order issues such as problem finding idea generation, brainstorming, and critical discussions. Asynchronous learning experiences focus on providing background information. Learners interact in both synchronous and asynchronous formats, and learner engagement is more actively encouraged than in traditional residential classrooms. As online learning in higher education becomes more <u>Micro-learning</u>.

Micro-learning is a broad term that refers to any effort to organize learning experiences into small (bite-sized) bits of information. It should not be confused with mobile (m) learning, which Learning is encouraged by presenting learners with: short text or print passages, pictures, short videos, audio files, short quizzes, a simple game .In short, any effort that occurs in a brief timespan can be a micro-learning experience.

Digital micro-learning, is <u>a less formal competency development tool</u> that aims to fill knowledge gaps identified by the staff themselves through self-assessment, known as <u>personalized learning</u>. Digital micro-learning provides brief learning modules (seconds to minutes to conduct) on demand via digital means (e g,

computers, mobile telephones, or tablets) that are highly specific to the individual's learning context and environment. Digital micro-learning aims to increase flexibility in organizations' competency development compared to standard and more formal methods, which are often delivered broadly through written course literature and lectures **(Richardson et al., (2023).**

Micro-learning focuses on specific learning outcomes and can also be used as part of formal training when short summaries are adopted by trainees. Accessibility issues are much less common in micro -learning pieces, allowing the learner to experience such sessions from any device they prefer.In fact, mobile compatibility is one of the most important aspects of micro-learning design to address and is again extremely helpful for adult learners. Micro-learning creates more interaction. Micro-learning courses are easier to implement and require less time because the nature of these parts is modular. It can also be conveniently used as part of a larger e-Learning courses for adults. **(KAYALAR, F. 2022)**.

D. Characteristics Of Adult Learning In Online Communities Of Practice

According to **Guan and Frenkel (2018),** adult learners obtain important information by transforming past experiences and reshaping them to solve a new problem. Likewise, **Cocquyt et al. (2019)**, point out that adult learning mainly occurs while reflecting on an action that is learners act on prior experience to discover new knowledge. Adult learners seek to be actively involved in the learning process and to directly apply their gained experiences in a practical problem **(Kleinke & Lin, 2020),** engaging in the learning process when they perceive information presented in a real-life situation **(Velardi et al., 2020).**

The following hinder adults' engagement in online communities of practice (OCOPs): (a) ageing, (b) tiredness, (c) directed rather than independent learning, (d) learning new technology, (e) lack of personal evaluation, (f) prior experience to any new learning activity and (g) diverse experiences. Meanwhile, the following facilitators may improve engagement: (a) competition elements, (b) freedom to choose the content and method of learning, (c) interactive learning settings (d) motivation, (e) self-regulation, (f) flexibility of learning at a time and environment of choice, (g) diverse experiences and (h) engaging in learning design. The results showed that adult learners are independent ,self- directed, experience- centered and problem- centered, self-motivated and goal- oriented ,with the main prospect of achieving a relevant professional outcome**. (Abedini, et al., 2021)**

In recent years, e-learning systems have been increasingly influencing both classroom and campus-based teaching, but more primarily, such systems are leading to new models or designs for teaching and teach (**Mirmoghtadaie et al,.2023**). With an increase in official and non-official educational opportunities in electronic learning environments, there is much debate over virtual self- directed learning (**Goh & Sandars, 2020**). Self-direction in virtual learning plays an important role in the success of virtual learners. On the other hand, the flexibility of virtual environments in terms of time, place, and speed of learning increases the possibility that virtual learners accept responsibility for their learning experiences (**Kara, 2022**).

The concept of SDL is defined by Knowles as "a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating

learning outcomes" (**Knowles, 1975,p. 18**). Learning is largely influenced by cultural and social factors. Hence, it is necessary to study SDL in different cultures. (**Mirmoghtadaie, et al., 2023).**

E. Artificial Intelligence (AI) In Education

Artificial Intelligence (**AI**)driven educational tools can adapt to individual learning styles and paces, offering tailored content and assessments that meet the specific needs of each learner .This level of personalization was previously unattainable in traditional and even early online learning environments. AI can support educators by automating administrative tasks and providing insights through data analytics, allowing them to focus more on teaching and student interaction. (**Holmes et al., 2019**).

AI holds significant promise for the sustainable development of distance learning in continuing adult education. By enhancing engagement, personalization, and accessibility, AI can transform educational experiences and outcomes for adult learners. (**Edwards-Fapohunda, et al., 2024).** The need for digital skills is also gaining urgency in other arenas. Both now and over the longer term, people without foundational digital skills may struggle to advance in their careers, or have difficulty holding on to their existing jobs as their roles evolve to demand greater digital fluency. (**Bergson-Shilcock& A2020**).

Professionals can position themselves for success by embracing change and honing new AI skills. Therefore, educators should teach the appropriate use of AI tools. People need to learn to use AI tools just like they would any other advanced technology. The rapid pace of AI tool development and adoption creates challenges and opportunities for educators. Generative AI produces novel work that makes academic integrity enforcement challenging. Educators must adapt to the changing technological landscape not only to guard

against cheating, but to improve learning outcomes. (**Marquardson, J. 2024**).

Sustainable Development in Education

The concept of sustainable development in education involves creating systems that are not only effective in delivering quality education but also equitable and inclusive, ensuring that all individuals have access to learning opportunities throughout their lives (**UNESCO, 2019**). This aligns with the United Nations' Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Sustainable development in education emphasizes the need for lifelong learning, which is particularly relevant in the context of adult education. (**Edwards-Fapohunda, et al., 2024**).

However, digitalization also presents challenges that can impede effective learning delivery. These issues include inadequate funding, insufficient digital facilities, unreliable power supply, poor internet connectivity, the high cost of digital facilities, a lack of digital skills, a lack of professionalism, implementation challenges, resistance to change, and systemic corruption. These emerging issues pose significant obstacles to achieving sustainable development in adult education. .(**GOGARAM, A. Z. (2025))**.

Research from the Urban Institute suggests that technology and digital literacy training are a crucial component of support for any community college students taking online courses. (**Amanda Briggs, et al., 2020**) However, researchers also caution that technology should not be "the tail wagging the dog," and urge stakeholders to start with learners' needs and goals in mind so that adoption of digital technology is a goal driven rather a product-driven approach. (**Bergson-Shilcock& A2020**)

Although, adult education has been associated with many positive results, it still remains a complex process of community development. The limited resources and financial constraints have constrained the growth and survival of adult training programs.The majority of these programs are financially constricted thus limiting their reach to wider audiences and inability to offer full services. Furthermore, lack of basic infrastructure that includes learning centers and technological devices has hindered adult learning from being effective. (**Edwards-Fapohunda, M. O. (2024)).**

Fostering digital competence in adult education has emerged as a critical requirement in an era where digital revolution is redefining the boundaries of information distribution and connectedness. This journey through the complexities of digital competency, global understanding, and sustainable development has shown the revolutionary potential that exists at their crossroads. Adult learners' capacity to harness digital technologies and critically engage with digital information becomes increasingly important as they traverse a complex and linked environment. (Motorga**, M. E. (2023)**.

o **Study Results:**

- In the digital era, cyber security is a critical concern for people, corporations, and governments. It is more necessary than ever to secure electronic devices, networks, and data against unwanted access, theft, and damage.

- virtual learning or E-learning posse positive effects on developing skills of self- directed learning of adult learners and enhances the learning practices, develops different skills of the individual learner and encourage creativity and innovation.

- There is a relationship between enhanced or empowered cyber security and increased effectiveness of self-directed learning skills for adult learners.

- Egypt's Vision 2030, a crucial principle enhancing of "Resilience and Adaptability". This means the system's capacity to effectively respond to abrupt international and regional shifts or unforeseen local developments; be they economic, political, social, or environmental.

- Learning is a lifelong process. To continuously build a knowledge base, learners of all ages must extract information from their environments with and without explicit direction.

- Generally, one needs to be aware of what one should learn, decide how to learn it, source and use resources, self-assess, and have confidence in one's ability to engage in these acts.

- Adults can use online learning platforms, mobile apps and digital resources to learn at any time and place they want, removing the geographical or time boundaries.

- Both adult learning and education have been seen as fundamental elements of personal advancement and societal progress.

- Adult education serves as an umbrella term for all educational programs or services designed for adults within formal, non-formal, and informal sectors of society.(**GOGARAM, A. Z. (2025)).**

- According to Knowles (1975), self-directed learning (SDL) is a significant concept in adult education.

- Digital literacy should be at the core of all adult education programs to make sure that learners have skills to not only operate but also apply any form of technology appropriately.

- Adult learning and education (ALE) is a core component of lifelong learning which has always been at the forefront for the betterment of life for adult citizens.

- A learner with self- direction is constantly planning, organizing, observing and evaluating (**Chau, Law & Tang, 2021**).

- Self- Directed Learning (SDL) competence is defined as "the ability to pursue SDL with success and efficiency: to proficiently direct one's own learning means and objectives in order to meet definable personal goals.

- Adult learning and education must look very different a generation from now.

- Digitisation has enabled the development of adaptive learning technologies that use data analytics to provide learners with customized learning experiences based on their individual learning styles, needs, and preferences (**Li et al., 2022**).

- The successful learner self-initiates and self-motivates acquisition of information.

- Learners of all ages must rely on their own self-motivated initiation of knowledge base expansion, followed by self-termination of information-seeking behavior.

- Lifelong learning requires autonomy, self-efficacy, problem-solving, resilience and reflective skills.

- Within the community development context, adult education is very important in building up individual skills, knowledge, and competencies thereby significantly contributing to overall welfare and growth of communities.

- Digital micro-learning, is <u>a less formal competency development tool</u> that aims to increase flexibility in organizations' competency development compared to standard and more formal methods.

- Adult learning mainly occurs while reflecting on an action that is learners act on prior experience to discover new knowledge.

- Artificial Intelligence (**AI**)driven educational tools can adapt to individual learning styles and paces, offering tailored content and assessments that meet the specific needs of each learner.

- Sustainable development in education involves creating systems that are not only effective in delivering quality education but also equitable and inclusive, ensuring that all individuals have access to learning opportunities throughout their lives (**UNESCO, 2019**).

- <u>Adoption of digital technology is a goal driven rather a product-driven approach.</u>

- Technology in learning and education is as a complementary part not replacing of traditional learning resources.

- Responsible use of technology and AI applications (tools), so we can provide added value to technology and to society.

Study Recommendations and Suggestions

Based on the findings of this paper, some recommendations must be put to place to manage the challenges of adult learners in their learning and educational practices:

- Adopting the principles of readiness and adaptation to change in all systems and levels of adult learning and education.

- Establishing and developing infrastructure and equipping it with the last and most advanced technologies (e. g ... AI driven technology) and providing it with strong designs through strong

cyber security that confronts various cyber-attacks , data privacy protection issues whether for individuals or educational institutions.

- Transferring and exchanging experiences by facilitating scholarships and missions from one country to another in a way that serves the adult learner and develops the educational institution.

- Encouraging scientific research and urging researchers to attend high quality scientific conferences and seminars to achieve constructive participation and to allow transfer and exchange of new opinions, experiences, ideas and expand knowledge base regarding the adult education sector and to benefit from experts in adult learning and education.

- Training(or digital training) and supporting professionals in the adult education sector ,especially educators or instructors and learners ,on how to use technology ethically, safely ,healthily and correctly ensuring high quality and healthy learning and educational outcomes.

- Identifying technical ,administrative ,tactical and organizational gaps , errors and risks in adult learning and education(ALE) and moving towards finding solutions to them through risk management ,analyzing the problems and their root causes analysis or working to mitigate the severity and effects of these problems ,so that they do not deviate from the path of educational goals from their desired paths and basic purpose.

- Continuously reviewing the educational content(online ,0ffline content) and its suitability (or relevance) to quality standards, and working to develop it in a way that is compatible with individual or learners styles, needs, and personal characteristics(personalization of adult learner experience),

administration of both learning and education context and environment.

- Using a variety of exposure methods to the educational content may lead to a high- skillful adult learner with different experiences and development of self-learning skills for adults as critical thinking skills, communication skills, decision making skills, self-responsibility, and self-assessment and prioritizing and setting goals according to a carefully planned time frame.

- It is necessary for adult curriculum designers and developers to integrate basic terms and concepts of new trends of communication and information technology, its benefits, potential risks, and how to manage accordingly all should be included in adult education and learning curricula .

- Professional and effective use of the electronic learning(E-Learning) platforms (both ,online and offline) and the **artificial intelligence (AI)applications** such as:

  o   Intelligent tutoring systems

  o   Adaptive learning environments

  o   Expert systems

  o   Virtual reality

  o   Augmented reality

  o   Internet of things(IOT)

  o   Chabot

- Fostering a culture of creativity and development.

- Engaging the online adult learners in regular communication with each other (peers) and with their instructors to foster a well –rounded learning experiences.

- Supporting cooperation and partnership between institutions and sectors at the local ,international and global levels, especially adult education ,communication and information technology (CIT) and scientific research and training sectors, to discuss important and prominent issues ,study and analyze their elements and to suggest solutions or opportunities or improvements(studying the challenges and the opportunities) in adult learning and education (ALE).

- Continuous and effective assessment, monitoring ,planning, diagnosis, analysis, and evaluation of learning and education outcomes and adopting findings of prior evaluation in adult learning and education(ALT).

- Regulations and laws supporting adult education.

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