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WHAT DRIVES WORKING ADULTS TO BE LIFELONG LEARNERS? DETERMINANTS

AND PATTERNS OF ADULT EDUCATION PARTICIPATION IN THE UNITED STATES

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WHAT DRIVES WORKING ADULTS TO BE LIFELONG LEARNERS? DETERMINANTS

AND PATTERNS OF ADULT EDUCATION PARTICIPATION IN THE UNITED STATES

A DISSERTATION APPROVED FOR THE
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BY THE COMMITTEE CONSISTING OF

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Dedication

To my parents, Ik Chang and In-sook Lee, and in memory of my maternal grandmother, Sun-ja Choi.

"In the vastness of space and the immensity of time, it is my joy to share a planet and an epoch with [you]." – Carl Sagan quotes from Cosmos.

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Abstract

With the recent shifts in the global economy, many scholars and policymakers are in broad agreement on the importance of lifelong learning practices in the occupational sphere. In response, there has been growing academic interest in adult education participation in which working adults acquire knowledge and skills to fulfill the ever-changing needs of the world of work. Many researchers have revealed that participating in adult education provides a wide array of benefits for individuals, organizations, and society. Yet, despite the increased research efforts, empirical findings are still inconclusive on what contextual factors most decisively or relatively importantly contribute to determining and patterning working adults' participation in adult education. In this context, this study is conducted to present a *holistic* picture of adult education participation. To that end, the purpose of this study is to re-examine the determinants and patterns of adult education participation of working adults by leveraging emerging analytic techniques to capture population-level insights on (1) *what* drives participation in adult education and (2) *how* discrete patterns in adult education participation emerge.

The data is drawn from the 2017 U.S. Program for the International Assessment of Adult Competencies (PIAAC). The total sample size was 1,283 respondents aged 25 to 65 years old who had work experience in the last 12 months. Outcome measures were formal adult education and training (AET), non-formal AET, and informal learning, all of which indicate three major *pillars* of adult education participation. The selected 19 independent variables represent working adults' individual-level (i.e., demographic information, human capital, and learning-related socio-psychological states) and work-related contexts. Through the random forest classifiers (RFCs) technique, one of the machine learning algorithms, this study identified important factors associated with participation in adult education. In addition, latent class analysis (LCA) was

applied to investigate discrete patterns of adult education participation among sub-groups of working adults that share similar profiles of individual-level and work-related characteristics.

According to the results obtained from RFCs models, first, skills proficiency and/or utilization appeared to be the far most critical influencers across every type of adult education participation. Second, education level and monthly income were the common salient predictors across types of adult education participation. Third, predictors explaining adult education participation somewhat varied depending on the types of adult education. By applying the LCA approach, this study identified four latent classes of working adults in adult education participation: (1) low-participation learners, (2) high-participation learners, (3) informal learners, and (4) structured learners. Moreover, the results demonstrated that the broader separation of working adults' participation in adult education itself was strongly affected by situational and institutional contexts, whereas individual preference or selection across types of adult education relies on personal demographics and human capital. Based on the findings, this study concluded with several discussions and implications for research, policy, and practice.

Keywords: *adult education participation*, *working adults*, *lifelong learners*, *random forest classifiers*, *latent class analysis*, *PIAAC*

CHAPTER ONE

Introduction

Growing Importance of Adult Education in the World of Work

Adult education has been increasingly considered a pivotal element for adults' career development and social mobility (Jarvis, 2010; Rainbird, 2010). Historically and traditionally, the underlying principle of adult education was primarily to provide adults the accessibility to formal courses at educational institutions to fulfill their academic needs (Smith & Ferrier, 2002). However, in 1996, the Education Ministers of the Organization for Economic Cooperation and Development (OECD) agreed to adopt a strategic policy framework that adult education includes all purposeful activities aiming at ameliorating the knowledge and skills of adults (OECD, 1996). In response, the landscape of adult education has been expanded and thereby has paved the way to encompass continued learning and economic values. Based on the widespread perception that education plays a vital role in facilitating human capital and economic prosperity, a particular accent of adult education is now focused on the world of work, re-education for the upgrading of skills and competencies, and work-to-school transitions (Smith & Ferrier, 2002). Aligning with the paradigm shift of lifelong learning (LLL), many scholarly works on adult education offer a new theoretical and conceptual lens; that is to say, the adult education system must embrace work-related perspectives and rationale (Chiţiba, 2012).

More recently, therefore, work-related adult education participation, which indicates one of the core products of individuals and organizations, has become a central topic for many policymakers and practitioners over the past decades. Apparently, the underlying assumption is that work-related learning is closely related to the increased and sustainable economic growth of the country (Illeris, 2003; Tynjälä, 2008). The landscape of today's adult education is explained

by increased demand in labor market outcomes and employability (Coughlin et al., 2016); thus, work-related learning, which guarantees continuing knowledge and skills development of the workforce, is at the forefront of LLL policy across countries in conjunction with OECD's new initiative in 1996 (Knapper & Cropley, 2000). According to Knapper and Cropley (2000), the future of adult education relies heavily on a consensus between adult education providers and employers on how to reorganize the must-have skills of working adults and how to design platforms and policies facilitating a partnership between adult education programs and the business domain.

Today, with increasing demands for working adults who seek additional learning options and opportunities in and out of formal education systems, job-related adult education is regarded as an appropriate venue to fulfill their needs (Ross-Gordon et al., 2017). In fact, what lies beneath such an expanding landscape of adult education is the ramifications of demographic trends of the adult population and changed economic and workforce development patterns. Suffice it to say, the surge in demands for workforce productivity and the projected skills shortage of employees can lead working adults to pursue further learning engagement for their career and professional advancement. Concurrently, older adults' increased health and life expectancy, as well as their desire to work, will keep older workers in the workforce for much longer than before. Furthermore, the Baby Boomer generation's specific need for financial security will force them to engage in prolonged work beyond the traditional retirement age of 65 (Munnell et al., 2006).

In response, the rapid structural changes in economic environments and workforce populations have dramatically increased the necessity of working adults to strengthen their capabilities, acquire new competencies, and align their knowledge and skills to the emerging

economy, in order to avoid being unemployed or laid off (Chiţiba, 2012). More than ever before, profit-oriented industries and companies seek employees who are educated and skilled above average as the economy and job market have become denser and more competitive. In effect, current job openings are at an all-time high, and employers are struggling to find candidates equipped with the relevant skills they need (Smith & Ferrier, 2002). In addition, responding to the ever-changing ecosystem of contemporary business where the proportion of professional or career-oriented companies is increasing substantially, considerable numbers of firms demand larger numbers of candidates possessing upper levels of human capital and educational attainments. By 2024, fewer jobs will be available for adults without associate's or higher-level degrees (Hogan & Roberts, 2015), which reflects the fact that traditional higher education credentialing is no longer a promising prospect that decreases unemployment probability. This also implies that most adults are in need of strengthening their abilities consistently, even after their labor market entry. Particularly, working adults are often asked to pursue further degrees and certificates or acquire specialized job training at the workplace and beyond (Desjardins et al., 2006; Kazis et al., 2007; Röbken, 2009).

Adult Education Participation and Its Impacts

Learning takes place everywhere and at all times as individuals participate in educational activities and interactions throughout their lifetime (Billett, 2010). Much learning occurs through both formal and non-formal settings of the organization, community, and society at large; accordingly, the underlying principle of LLL becomes a primary source of strengthening human capital (Aspin & Chapman, 2007; Singh, 2015). From the LLL perspective, it is universally accepted that work is interconnected with one's continuous learning and development (Fergusson & van der Laan, 2021). With the recent shifts in the global economy, many scholars

and policymakers are in broad agreement on the importance of LLL practices in the occupational

sphere (Jarvis, 2006; Laal & Salamati, 2012). Given the increasing social problems and

economic costs associated with job displacement and mobility, knowledge and skills acquired in

public school systems are not sufficient to meet the job requirements of adults (Dibra et al.,

2014). Hence, more and more adults seek further educational opportunities to continue their

professional growth and sustain increased employability in today's competitive labor market

(Melacarne & Nicolaides, 2019). Especially for adults who are in the labor force, adult education

is one prominent avenue in which knowledge is acquired, and skills are upgraded for the ever-

changing needs of the world of work. Obviously, job-related adult education is an ongoing

practice occurring in all aspects of the work environment, as learning is a key part of one's work

life and is a salient component to maintaining the competitive edge within the organization

(Fergusson & van der Laan, 2021; Tynjälä, 2008).

Broadly speaking, learning practices pertaining to the matter of vocation are the most

frequently reported form of educational pursuit among the adult population (Ross-Gordon et al.,

2017). Moreover, in many countries, employment-related education is the dominant form of

adult education (Desjardins, 2020). In response, over the past few decades, there has been

growing interest in research and practice concerning job-related adult education and its benefits

to employees and organizations. In the discourse of educational experiences of adults who are in

the workforce and/or those who seek initial employment or re-employment, two different but

equivalent concepts have been widely acknowledged and extensively studied: *adult education

and training* (AET) and *workplace learning* (WL).

AET, which is used interchangeably with the term LLL, refers to forms of learning that

contribute to the accumulation of knowledge and skills by both formal and non-formal means

throughout an adult's life course (Desjardins, 2015; Rubenson, 2011). It is noteworthy that AET is often seen as a continuous process that encourages and empowers adults to learn and develop human potential – the compatible goal of LLL (Longworth & Davies, 1996). AET has been studied from the perspective of human capital theory: adults' participation in AET is largely influenced by the social environment to which the individual belongs (i.e., socioeconomic status); accordingly, it is known to be associated with income and educational attainments (Darkenwald & Merriam, 1982). Research evidence indicates that adult education participation tends to increase the likelihood of securing greater employment opportunities and enhanced human capital, such as appropriate job-related knowledge and skills (European Centre for the Development of Vocational Training [CEDEFOP], 2016; Schuller & Desjardins, 2010). Notably, unlike and in addition to the previous perspectives, most recent studies have shown that AET participation and its benefits are more likely associated with the dynamics of personal, institutional, and socio-contextual influences (Kim & Park, 2022; Thongmak, 2021). According to Punksungka et al. (2021), job-related AET provides a wide range of benefits for individuals, firms, and society. Individuals who received positive returns by participating in job-related AET, in turn, serve as an important asset to enhance the competitiveness of national economies (Gherardi, 2006).

WL and its related topics have received more attention from human resource development (HRD) and organizational development studies. Over the past few decades, there has been a growing interest in research concerning what WL is and how it can be interconnected with human resource interventions. By definition, WL refers to the accumulation of knowledge and skills mostly through informal sources that take place during work-related interactions (Cacciattolo, 2015). That is, the concept of WL practices limitedly encompasses intentionally

designed educational programs that may lead to official qualifications; instead, it is heavily

dependent on informal activities that are less structured and incorporated into social networks

and everyday practices in the workplace (Eraut, 2004; Marsick & Watkins, 1990). According to

Fenwick (2008b), WL occurs through the dynamics and relations between 'individual actors' and

'collectives'; therefore, it is expected to promise enhanced learning for both individual

employees and the organization as a whole (Doornbos et al., 2008; Fenwick, 2008a). Not

surprisingly, considerable literature offers abundant evidence that WL plays a crucial role in

organizational performance improvement, is an indispensable component for change, and is

often an overarching goal of HRD itself (Watkins & Marsick, 2014).

     According to the empirical findings, participation in job-related AET and WL has a

positive impact on increased employment stability and reduced unemployment risks at the

individual level (Fouarge et al., 2013; Froehlich et al., 2014; Marsick & Watkins, 1999). In

addition to obtaining human capital, which in turn enhances economic benefits (Keeley, 2007),

providing AET opportunities that may secure a skilled workforce became one of the central

concerns of employers and the government (Desjardins, 2020). Similarly, informal learning at

the workplace functions as a vehicle for generating employees' social capital, such as interaction

and task interdependency, that yields positive organizational outcomes (Han et al., 2019;

Nakamura & Yorks, 2011). At the organizational level, the organization's learning strategies and

interventions unleash the supply of a competent workforce (Lee & Desjardins, 2019).

Responding to the critical role of job-related AET and WL in organizational effectiveness

(Bierema & Eraut, 2004; CEDEFOP, 2015; Svensson et al., 2004), increased investment in AET

and human capital notion reflects the emerging awareness of the association between learning-

oriented HRD practices of the organization and its core strategic plan (Garavan et al., 2002; Park

& Jacobs, 2011). Furthermore, in a broader sense, work-related educational activities undertaken by employees, groups, and organizations tend to contribute to permanent changes in work processes and organizational culture (Simons et al., 2003). As such, working adults' participation in job-related AET and WL has been paid considerable attention and has become a key topic in adult education and HRD literature.

Purpose Statement

Many studies on adult education participation emphasize the positive role of work-related learning on adult development. Desjardins et al. (2006) stressed the importance of job-related AET in that diverse educational pursuits serve as potential sources to motivate adults to seek continuing education in and out of the workplace. The authors also demonstrated that intended or self-directed non-formal and informal learning in the community or in daily life may lead to active engagement in adult learning activities. Similarly, Maurer et al. (2003) revealed that prior internal and external training and learning experiences at work significantly affect employees' intention to participate in further learning activities. McGivney (1999) argued that informal learning is an important source that potentially brings educational progress because it allows adults to interact with key people who encourage their continued learning and development. Taken altogether, the prominent role of adult education in working adults' career advancement, regardless of its form and type, has been widely researched and acknowledged.

Nevertheless, an unanswered question remains: what determines individuals' participation in adult education and what shapes different patterns of adult education participation? Empirical findings are still obscure on what contextual factors most decisively or relatively importantly contribute to working adults' participation in job-related AET and WL, even though a great deal of studies have been conducted to explore those factors influencing

LLL intention or adult education participation (Boeren et al., 2010). Demographic and socioeconomic characteristics, educational background, human capital such as income and skills proficiency, occupational type, and institutional features have been extensively examined and well-documented as determinants of adult education participation (Boeren, 2017; Kalenda et al., 2020; Knipprath & De Rick, 2015; Kyndt et al., 2011). Still, even when all these studies are put in conversation together, a coherent understanding has not been achieved. One possible reason is that most prior studies have relied heavily on only a few predictors or small numbers of target groups in their investigations. In addition, it may be due to the fact that the factors and their inter-correlations included in the research model are different across the studies, or it may be because the type and/or measurement of adult education, which is treated as a dependent variable, is divergent among many (Kim & Park, 2022). Therefore, it is necessary to re-examine the factors that have a decisive influence on adult education participation, based on the massive dataset systematically collected measuring the degree to which adults learn and related predictors. From a methodological standpoint, when studies either rely on only a few parameters which may have high inter-correlation or traditional parametric regression models which are deficient in coping with the multivariate structure of the data (Breiman, 2001), it may limit the *holistic* understanding of how individual- and organizational-level characteristics simultaneously or together influence the dependent variable.

To address this concern, the current study leverages two analytic methods: (1) random forest classifiers (RFCs) technique and (2) latent class analysis (LCA). Nowadays, machine learning algorithms have been introduced for building prediction models in various fields and have produced remarkable results. Due to the recent outstanding development of technical specifications and machine learning libraries, a statistical approach to the development of a

predictive model using machine learning techniques is being widely attempted in various academic domains, including adult education and LLL (Kalenda et al., 2020; Kim & Park, 2022). As one of the machine learning algorithms, the advantage of using RFCs over traditional regression models (e.g., ordinary least squares [OLS] regression) is that it allows not only a comprehensive examination of multiple factors at once but also estimations of the non-parametric association between predictors and outcome measure, regardless of collinearity. Basically, RFCs allow the examination of the relative power amongst explanatory variables (i.e., variable importance) in shaping the value of outcome variables (Breiman, 2001; Liaw & Wiener, 2002; Strobl et al., 2008). Additionally, because machine learning algorithms do not rely on traditional statistical testing procedures, it is expected to reveal novel findings that have not been reported or even neglected in previous studies, as a by-product. Based on the advantage of using a machine learning technique, this study purposes to propose a prediction method based on classification learning to examine determinants of adult education participation. In this study, a prediction method using the RFCs technique was proposed to re-examine decisive factors in adult education participation among working adults in the United States by using the Program for the International Assessment of Adult Competencies (PIAAC) dataset surveyed across OECD member countries.

Despite the advantage of RFCs, which is beneficial for calculating the relative importance of target variables, the application of RFCs is limited to some extent by its technological capabilities – it does not yield coefficient values (Breiman, 2001; Strobl et al., 2008). In other words, the RFCs results do not show the direction of the effects of the determinants investigated in the model. Hence, employing other statistical approaches subsequentially (e.g., regression-based models) as a supplementary method along with the RECs

technique is often recommended either to compare model performances or to clearly specify the directionality (Choi et al., 2020). For this reason, this study applies LCA as a second quantitative method to produce more comprehensive information about associations of determinants on dependent variables as well as to identify different sub-groups within populations that share certain outward characteristics (Hagenaars & McCutcheon, 2002; Weller et al., 2020), in terms of participating in adult education. In more technical terms, LCA is typically adopted to detect latent sub-populations within samples based on patterns of responses to observed variables (Hagenaars & McCutcheon, 2002; Muthén & Muthén, 2000). When it comes to the purpose of the study, thus, this study's analytic choices help (1) to compare the relative importance of variables across types of adult education participation and (2) to uncover how those predictors shape different patterns of adult education participation across sub-groups within the population. In this context, the purpose of this study is to re-examine the determinants and patterns of adult education participation of working adults by applying emerging analytic techniques to capture population-level insights on (1) *what* drives participation in adult education and (2) *how* discrete patterns in adult education participation emerge. This study seeks to advance the knowledge pertaining to *lifelong learners* and to explore theoretical and practical aspects of working adults' LLL in and out of the workplace.

Research Questions

The purpose of this study is to re-examine the determinants and patterns of the adult education participation of working adults using RFCs and LCA. To that end, the research questions addressed in the present study include the following:

- Research question 1 (RQ1): What were the main determinants and their association with formal AET participation among working adults?

- Research question 2 (RQ2): What were the main determinants and their association with non-formal AET participation among working adults?

- Research question 3 (RQ3): What were the main determinants and their association with informal learning participation among working adults?

- Research question 4 (RQ4): How can working adults be classified according to the extent to which they participate in formal AET, non-formal AET, and informal learning?

- Research question 5 (RQ5): What individual-level and work-related contexts of factors predict class memberships of adult education participation patterns of working adults?

Significance of the Study

First, the significance of this study is theoretically profound. Many researchers in the field of adult education and LLL have shown that the main principle of adult learning can be categorized into three types: formal learning, non-formal learning, and informal learning. Nevertheless, the research approaches to simultaneously looking at three different forms of adult education have been limited, probably because of the equivocality of the boundaries among them (Desjardins, 2011). This study comprehensively reviews foundational and conceptual notions of adult education in the literature; and thereby re-examines job-related adult education as formal AET, non-formal AET, and informal learning at the workplace along with WL and other relevant concepts of work-related learning, all of which are separated but intertwined. This conceptual framework will shed some light on future research to explore how working adults learn in and out of the workplace and what makes them lifelong learners.

Still, the significance of the study is not limited to the theoretical values but also to its methodological potentiality. This study builds a prediction model by using a dataset from the social science domain and tests the predictive performance of machine learning techniques based

on the RFCs algorithm. Machine learning and data mining techniques have been developed for accurate and reliable prediction and have been newly applied in various spheres of educational studies (e.g., Kim & Park, 2022), along with the surge of research interests. The vast majority of the conventional statistics assume linearity and non-multicollinearity between dependent and independent variables; however, these assumptions are difficult to fully satisfy in social science studies – the relationships among the variables are not spatially discrete or independent. Machine learning techniques do not require such assumptions, and the RFCs method is known to be exceedingly effective in handling nonlinear and complex relationships in the dataset and in determining the relative importance of target variables with high predictive accuracy (Breiman, 2001; Lin et al., 2019). In educational studies, employing machine learning techniques is still an ongoing research area; in terms of the topic of this study, no similar attempts have been found. Accordingly, the methodological significance of the study is tied to the novelty of findings that reveals a holistic picture of adult education participation among working adults.

Lastly, this study provides abundant policy suggestions and practical guidance for addressing contemporary challenges encountered by the field of adult education and LLL. The importance of investigating potential sub-populations in the participatory mechanisms of adult education programs and activities has been frequently acknowledged and emphasized (Lim et al., 2020). Still, it has often been dismissed because of methodological constraints. When it comes to the aims of the study and related research questions, this study employs another emerging statistical approach (i.e., LCA) to uncover how individual-level and work-related contexts of factors are contributing to shape different patterns of adult education participation among working adults. Hence, this study will be a significant addition to the field and will provide beneficial information to bridge the research gaps – who is who, which individuals are in which

group (i.e., high- versus low-participation) for what reasons, and what policy and practical strategies can be implemented to help foster adult education participation for each group.

Limitations

This study has several limitations that may prevent this work from being generalized or providing an inclusive delineation of adult education participation. Because this study selected adults in the United States only, findings and interpretations of the study on the examination of determinants and patterns of adult education participation can be limitedly understood in the United States context. The ultimate societal and economic benefits of adult education are extensively acknowledged and studied across the globe. More importantly, the participatory phenomena in the context of LLL are likely to be rooted in the wide range of structures of socioeconomic, cultural, and environmental aspects of each country (Desjardins, 2015). Therefore, future comparative studies will need to include other nationally representative samples in order to assess the explanatory and predictive forces of the model in other contexts, and thus deepen the understanding of adult education participation.

Beyond and in addition to the first limitation, working adults' participation in adult education can be largely influenced by a far-reaching national system (i.e., macro-level context), such as labor market policies, the welfare state, and skill-production regimes of the country (Boeren et al., 2010; Kalenda & Kočvarová, 2022). This study cannot fully exploit the potential influences of country-level factors, as PIAAC data does not provide national-level estimates of these indicators for surveyed individuals. The impacts of macro-level policies and interventions on adult education participation have gained more attention from recent researchers (e.g., Ioannidou & Parma, 2022; Massing & Gauly, 2017). Accordingly, further in-depth investigations

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in the future will need to look at this broad array of factors and forces in a comprehensive fashion, to provide deeper insights.

Finally, while this study attempts to incorporate diverse contexts and factors to present adult education participation of working adults with a holistic frame, it is not without limitations. Higher rates of adult education participation may be attributed to a more entrenched sense of the professional identity and qualifications of individuals (Ross-Gordon et al., 2017). Therefore, very frequently, an adequate level of knowledge and skills required to start new learning makes it more difficult for those who are marginalized (including less-educated, low-skilled, and unemployed) to participate in any adult education programs and activities – also known as a Matthew effect (Boeren, 2009). Improving access and quality of adult education among those populations has been recognized as a central topic in many countries (Brown & Bimrose, 2018; Illeris, 2006), responding to OECD's (1996) 'lifelong learning for all' agenda. Thus, further approaches to narrowing the sample to individuals who have deficits in educational achievements (i.e., education gap) or have mismatched qualifications and skills are needed to draw feasible policy implications and practical diagnoses.

Operational Definitions and Key Terms

Working Adults

As a target population of this study, working adults are referred to as those who (1) are self-directed in their learning and development, (2) are currently working or have recent work experiences, and (3) pursue further adult education opportunities to cultivate job-related knowledge and skills that are often necessitated for their career and professional development.

Adult Education Participation

Adult education is defined as "a form of learning that takes place in addition or as a complement to formal education and is distinct from informal learning, that is intentional but less structured" (Widany et al., 2019, p. 8). An underpinning premise of adult education is that it typically occurs through formal, non-formal, and informal means of participation. According to the conceptual perspectives, this study considers formal AET, non-formal AET, and informal learning as three major aspects of adult education participation.

Formal Adult Education and Training

Formal AET is formally designed and organized learning that mainly occurs in educational institutions such as higher education institutions (e.g., colleges or universities) (Commission of the European Communities [CEC], 2000). For adults who are in the labor force, the primary goal of formal AET is often geared toward gaining certified educational outputs such as college diplomas or course completion credentials to compensate for the lack of educational qualifications and training certificates (Yamashita et al., 2019).

Non-formal Adult Education and Training

Non-formal AET is structured and organized learning that takes place alongside educational facilities; however, it can be distinguished from formal AET by its tacit nature of knowledge accumulation and does not lead to credentials (Eraut, 2000; Punksungka et al., 2021). Embedded in the organization's authority and structure, non-formal AET occurs mostly in institutionalized settings such as the workplace, which offers job-related learning opportunities (Eurostat, 2016; Jarvis, 2010).

Informal Learning

Informal learning is predominantly less-structured, experiential, and non-institutionalized learning that takes place in daily life without a specific intention to acquire formalized credentials (CEC, 2000; Merriam et al., 2007). Informal learning often accounts for the dynamics among individuals and learning collectives (Fenwick, 2008b; Lundgren et al., 2017). Thus, informal learning at the workplace stresses the interconnectedness of employees and their actions with social and organizational environments.

Workplace Learning

WL refers to the accumulation of knowledge and skills mostly by informal sources that take place through work-related interactions (Cacciattolo, 2015). WL limitedly encompasses intentionally designed educational programs, rather, it focuses on non-formal and informal activities that are less structured and incorporated into social networks and everyday practices in the workplace (Eraut, 2004; Marsick & Watkins, 1990). WL is often expected to promise enhanced learning for both individual employees and the organization at large (Doornbos et al., 2008; Fenwick, 2008a).

Lifelong Learning

LLL refers to learning that is pursued throughout one's life, is flexible, diverse, and takes place in different learning contexts (Aspin & Chapman, 2007). The fundamental goal of LLL is to improve adults' "knowledge, skills and competence, within a personal, civic, social and/or employment-related perspective through all learning activity undertaken throughout life" (CEC, 2001, p. 9). In this study, LLL is used almost interchangeably with the term AET.

Random Forest Classifiers

The RFCs technique is one of the robust supervised ensemble machine learning algorithms that utilize multiple decision trees (Breiman, 2001). These decision trees are collected to construct forests that provide information on what factors most efficiently predict and explain the dependent variables without strong parametric assumptions. Most recently, the RFCs method has drawn considerable attention from researchers in the social science field and has been applied to calculate the relative importance of explanatory variables (e.g., Choi et al., 2020; Kim & Park, 2022).

Latent Class Analysis

LCA is an emerging mixed modeling technique employed to capture latent (or unobserved) classes within populations in which the same groups of individuals share similar attributes and characteristics (Muthén & Muthén, 2000). Latent classes are determined by their class membership probabilities across assessment indicators (Kim et al., 2019). The assumption underlying LCA is that heterogeneity in samples determines class membership, and it can explain discrete patterns among identified classes (Wolke et al., 2013).

CHAPTER TWO

Literature Review

In order to clearly understand working adults' participation in adult education, above all, a thorough review of study background, adult learning theory, underpinning concepts, and contributing contexts and factors relating to adult education participation is required. This chapter will begin with the examination of the broader phenomenon to deepen the understanding of adult education participation of working adults, along with benefits, individual and organizational aspects, and the definition of the study target, in terms of adult education. Then, the concept and typology of adult education participation will be discussed: conceptual similarities and differences among formal AET, non-formal AET, and informal learning will be presented. Next, key drivers of adult education participation will be specified to draw inferences that can be made concerning the characteristics of individual- and organizational-level facets influencing adult education participation. Research gaps that have been discovered will also be identified, aligning with the purpose, significance, and research questions of the study. The final section will provide theoretical frameworks that guide this study's entire inquiry and methodology.

Understanding Adult Education Participation of Working Adults

Benefits of Adult Education Participation

In general, the notion that the level of educational attainment is one of the important determinants of the amount of income has been widely accepted. Kazis et al. (2007) observed that "In 2003, the median earnings of an American worker with only a high school diploma were $30,800, 38 percent less than the $48,800 median for those with a bachelor's degree" (p. 4) in the United States; and this income gap based on education level have been widening

continuously. Likewise, the level of education is strongly associated with income, which in turn, adult education participation and credits potentially make differences in earnings. This indicates that adult education programs at colleges or universities that issue academic credentials may provide beneficial economic opportunities (i.e., income mobility) for adults (Agbo, 2000; Creighton & Hudson, 2002; Horn & Li, 2009; Jarvis, 2010). Although not every adult education program guarantees degree attainment, again, it is an important opportunity for those of lower socioeconomic status to improve their career and life.

In addition to monetary advantages, adults can have better chances to make up for educational insufficiency, accomplish career/personal development, and further enhance their overall quality of life as products of adult education participation. Working adults, in particular, are increasingly required to obtain individual, organizational, and societal competencies responding to the rapid changes in the labor market through the pursuits of additional degrees, certificates, or acquiring specialized job training (Desjardins et al., 2006; Jarvis, 2010; Kasworm, 2008; Kazis et al., 2007; Knapper & Cropley, 2000; Röbken, 2009; Schuetze & Slowey, 2000). The majority of adults who already secured jobs, therefore, are then likely to attempt to access adult education in order to gain the required knowledge and skills as well as increased opportunities in wages, career change, and re-entering the job market.

Despite several benefits, working adults' adult education access and participation is not equal for all (Desjardins et al., 2006; Kazis et al., 2007; Soares, 2013). Participating in adult education is influenced by multiple factors: socioeconomic status and educational backgrounds (Agbo, 2000; Aud et al., 2011; Creighton & Hudson, 2002; Kasworm, 2008; Livingston & Wirt, 2004; Schuetze & Slowey, 2000) and socio-contextual aspects in which working adults are embedded, such as family, workplace, or community (Desjardins et al., 2006; Knapper &

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Cropley, 2000; Maurer et al., 2003). Especially for those who have jobs but want to participate in adult education for job-related reasons, they might struggle with managing their work time and daily life; accordingly, additional institutional support for increasing access to adult education is one important facet of LLL policy interventions (Cookson, 1986; Desjardins et al., 2006; Sandmann, 2010). These dissimilarities among working adults in adult education participation stem from personal and contextual environments and even may become barriers to adult education participation to some extent. Hence, identifying diverse contextual factors along with personal characteristics of working adults that influence their participation in adult education would contribute to deepening the understanding of (1) what individual- and organizational-level factors relate to adult education and (2) who working adults are.

Individual and Organizational Contexts of Adult Education Participation

According to Baert et al. (2006) and Boeren et al. (2010), the factors affecting adult education participation can be classified into three categories: (1) micro-level, (2) meso-level, and (3) macro-level. Notably, adults' participation in educational activities is not a single action of individuals but a consequence of a series of actions and chain reactions between individuals and external environments (Cross, 1981). Aligning with this notion and classification, researchers have identified that adult education participation is made up of the dynamics of individual and organizational contexts: adults' personal dispositions, structural position within the organization, and characteristics of learning activities and socio-contextual facets are taken into account together (Kim & Park, 2022).

Internal Aspect of Adult Education: Self-directedness

A great volume of studies indicates that a substantial amount of learning takes place outside of formal education settings (Tikkanen, 2008). For those who graduated high school and

immediately entered the labor force, the decision to participate in educational activities may be largely influenced by one's internal motivation to learn. One important concept to understanding working adults' learning intention is *self-directedness*. From an adult learning perspective, adults' participation in self-directed learning (Knowles, 1975) and self-teaching (Findsen, 2006) is heavily relying on their self-directedness, representing a sound range of knowledge and abilities for planning, organizing, and guiding their own learning (Tikkanen, 2008). This kind of learning can take place outside of formal curriculums that negate the need for experts to frame or guide it (Findsen, 2006). This line of scholarly work has broadened the ideas of what determines adult education participation. As Jarvis (2011) noted, by nature, adult education participation can be equated with greater self-directedness, autonomy, and control of knowledge construction. Research evidence also uncovers that self-directedness appeared to be an important, influential factor in the work-related learning intention and behavior of working adults (Gijbels et al., 2010; Kyndt et al., 2013a).

One of the pioneers of this line of inquiry, Knowles (1975, pp. 14–15), matured the need to study and rationalized three immediate reasons for adults' self-directed learning:

- there is convincing evidence that people who take the initiative in learning (proactive learners) learn more things, and learn better, than do people who sit at the feet of teachers passively waiting to be taught (reactive learners). 'They enter into learning more purposefully and with greater motivation. They also tend to retain and make use of what they learn better and longer than do the reactive learners;'

- self-directed learning is more in tune with our natural processes of psychological development. 'An essential aspect of maturing is developing the ability to take increasing responsibility for our own lives – to become increasingly self-directed;'

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- many of the new developments in education put a heavy responsibility on the learners to take a good deal of initiative in their own learning. 'Students entering into these programs without having learned the skills of self-directed inquiry will experience anxiety, frustration, and often failure, and so will their teachers.'

According to one of the adult learning principles, namely *andragogy*, self-directed learning posits that adult learners "can and do engage in taking control of their learning, assume ownership for their learning, are capable of weighing different learning strategies that they feel are best for their particular learning needs, and can motivate themselves to engage and complete a learning task" (Knowles et al., 1998, pp. 135–136). A key to intentional self-directed learning involves supporting students to "adapt the skills learned in one situation to problems encountered in another: in a classroom, the workplace, their communities, or their personal lives" (Association of American Colleges and Universities, 2002, pp. 21–22). Likewise, the idea that taking account of the importance of everyday experiences in one's work, family, and community is considered the central theme of andragogical learning principles (Knowles, 1990; Merriam, 2001). Therefore, it implies the distinctive nature of adult learners who are capable of managing, planning, implementing, and evaluating their own learning for their continuous development and growth.

Another core principle of andragogy is that it assumes the previous experiences of adults in the learning environment can shape and leverage the educational outcome (Knowles et al., 1998). Darkenwald and Merriam (1982) claim that adults' learning "occurs as very different individuals reacts to commonalities of human experience over their life span" (p. 88), based on an accumulation of life experiences in which he or she generates a "reservoir" for learning. The differences across individuals' experiences serve as unique and personalized learning tools as

well as a rich resource for learning in adulthood (Merriam et al., 2007). It also implies why adult-focused education organizations should put more emphasis on each student's experiences. As Cranton (2002) argues, successful adult education practices are heavily dependent upon the educators' role in introducing or integrating familiar instructional strategies aligned with adult learners' past experiences. Interestingly, according to the andragogical assumption of learning, adults may be willing to draw on their individual life and educational experiences in the learning environment, and in turn, these experiences are integrated into their new learning. Hence, it is one of the major responsibilities of adult-focused academic institutions to effectively combine these experiences so as to promote learners to actively participate in the adult education processes.

As such, adults act as self-regulated and self-directed agents when processing incoming information and integrating them with existing knowledge and experience. As Silverman and Casazza (2000) suggest, "the self-awareness of cognitive processing strategies and the ability to control them plays a significant role in most theories of learning" (p. 49). According to the authors, the capacity to be critically aware of one's own cognition, to determine whether he or she has properly met the learning goals, and to assess and reflect on the relevance of learning in real-life contexts is critical to adult learners in participating in any form of educational activities. As one of the fundamental principles of adult learning, self-directed learning occurs when adults engage proactively in cognitive or behavioral processes in initiating their own experiences, without any imposed instructions (Brookfield, 1986; Cranton, 2002; Mezirow, 2000). Self-directed learners have the capacity to determine their own purposes, values, and meanings of learning rather than simply acting on those from external authorities. In this sense, increased self-directedness can be considered a cognitive initiator of the continuous learning and development

of adults. These distinctive aspects of adult learners indicate that the personal characteristics and experiences, cognitive and behavioral learning styles, and social and cultural backgrounds of individuals comprehensively affect their participation in adult education.

External Aspect of Adult Education: Socio-contextual Influences

In addition to internal motivation (i.e., self-directedness) influencing adult education participation, various rationales and principles have been discussed in relation to socio-contextual aspects of learning. According to Findsen (2006), self-directedness is supportive when it comes to adults' options or opportunities for learning and development. However, this perspective is supposed to be discussed along with material, economic, and social conditions that can result in unequal educational opportunities in adult education participation across different sub-groups of adulthood. One perspective related to adult education participation is "learning culture" as or in a social institution (Tikkanen, 2008, p. 28). To promote and recognize adult education in everyday contexts, especially in the workplace and elsewhere, organizations and employers need to facilitate the creation of a learning culture that directs toward the development of the learning society at large (Antikainen, 2001).

In organizational settings, learning workers are deemed as an important asset contributing to the accumulation of an organization's intellectual capital, enhancement of resources, and return on its investment in training (Merriam, 2008). Now in response, more and more business leaders and employers are introducing adult education as a key strategy to improve the performance and efficiency of the organization. This highly acknowledges the significant role of adult education provisions for employees in various workplaces. Looking at the perception of organizational aspects towards LLL, when more employees recognize their organizations to be supportive and informative in their learning, higher learning intention and adult education

participation take place (Kyndt et al., 2013a). In this vein, participating in adult education not only depends on adults' individual internal motivation but also on external socio-contextual aspects, such as their perception of how supportive an organization is toward employees' learning and development (Tharenou, 1997).

According to Bronfenbrenner's (1979, 1986) ecological system theory of the microsystem, mesosystem, and macrosystem proposed in the contexts of human development, individual learning and development occur through which the progressive process of complex reciprocal relationships and interactions are explicitly included. These interactions are not limited to simple communications but accommodate the exchange of values between an active bio-psychological human organism and persons, objects, and symbols embedded in its immediate external environment. Originating from Bronfenbrenner's scholarly contributions, Baert et al. (2006) put particular attention to meso- and macro-levels relating to LLL participation along with micro-level. In addition to micro-level factors representing individual characteristics, both meso- and macro-levels indicate the surrounding environments of adult learners in which social and institutional interactions take place. Put simply, organizations' institutional characteristics and learning activities constitute the meso-level context, whereas the broader social context and its actors are associated with the macro-level (Kim & Park, 2022).

While learning takes place, to some extent, adult learners apply their personal and educational experiences in specific instructional situations (Cranton, 2002); thus, the success of adult education practices completely rely on establishing a learning-oriented institutional environment that provides ample opportunities for adults to build new ideas based on the reflection of their experiences. Meaningful learning may occur when educators utilize a process of mutual inquiry, rather than simply conveying information and expecting adult learners to

merely accept and conform to their instructions. Moreover, based on a deeper comprehension of adult education principles, greater emphasis should be placed on the organizational efforts incorporating diverse learning styles or preferences in adult education programs and offering flexible learning options, thereby overcoming the learning barriers of adult students. To put it more concretely, given the foci of LLL, which contains adult learners' experience, expertise, and self-directedness (Booth & Schwartz, 2012), identifying learners' needs and experiences should be placed on a higher priority among the various roles and responsibilities of the adult education providers. Furthermore, creating and sustaining a flexible and interactive learning atmosphere is required to ensure supportive learning culture within organizations. In such environments, adults can become "active agents" in the learning process in which they are "constructing a different, more just reality" (Merriam et al., 2007, p. 141).

The role of institutional elements in adult education participation has been supported by the line of research findings. These studies reiterate that adult education participation is able to take place not only through the personal backgrounds or psychological characteristics of individuals but also by the influence of organizations to which interactions between individuals and among segments of the organization occur. For instance, Ivy (2008) presented accessibility to learning courses and supportive environments as the main factors that affect adult education participation. A recent study conducted by Thongmak (2021) also suggests the effects of institutional and pedagogical factors on adult learners' self-determination and LLL intention, which again, improves learning culture in organizations.

Definition of Working Adults

From the LLL perspective, working adults are often seen as those who have divergent educational demands, dispositional characteristics, and learning expectations compared to adult

learners in general. More specifically, Illeris (2003) classified working adults into three groups based on their distinctive situational characteristics in learning and development: (1) young adults who wish to enter the labor market; (2) adults who work but need to develop their job-related skills in order to retain and maintain employability; and (3) adults who are unemployed and want to re-enter the labor market by increasing their work-related skills and abilities. In line with the specific classification of working adults by Illeris (2003), working adults can be simply described as those who have various educational and job-related experiences throughout their personal lives and in and out of the workplace. Empirical studies conducted to comprehensively look at the demographic and socioeconomic characteristics of working adults have revealed that most working adults have a higher career-related internal motivation when they participate or are willing to participate in adult education (Adamuti-Trache & Schuetze, 2009; Desjardins et al., 2006). Specifically, when it comes to their employment status, working adults who have part-time jobs were more likely to engage in adult education than full-time employees (Kazis et al., 2007), as well as occupation types that require advanced skill sets were positively related to working adults' LLL intention (Desjardins et al., 2006).

According to the above definition and characteristics, it is reasonable to understand working adults as a distinctive group of adult learners. More specifically, in an effort to define and classify who working adults are, studies have commonly identified that they can be seen as those with various learning and work experiences obtained throughout their lifetime in and out of the workplace. It is worth noting that their previous and/or current work-related conditions and characteristics and educational attainment could possibly be related to their decision or intention to pursue further learning activities. The definition of working adults who participate in adult education is not uniform or coherent; therefore, this study identifies working adults by utilizing

some part of the definitions stated above or by the broader rationale of adult education. Consequently, in this study, *working adults* are referred to as those who (1) are self-directed in their learning and development, (2) are currently working or have recent work experiences, and (3) pursue adult education opportunities to cultivate job-related knowledge and skills that are necessitated for their professional and career development. Based on this fundamental conception of who working adults are and how they learn, the conceptual scope and substantive components of adult education will be discussed comprehensively in the following section.

Concept and Typology of Adult Education

The Concept of Adult Education

The concept of adult learning has been widely reviewed over the past few decades, particularly in terms of the social and policy implications (Jarvis, 2011). Many researchers have contended that learning is not limited to the traditional K-12 school system but embraces the entire spectrum of experience gained throughout an individual's lifetime (Openjuru, 2011). Learning is an ongoing process in which knowledge, skills, and values are acquired and developed from various places where individuals engage in everyday practices. In light of human capital ideals, for working adults, maintaining fundamental skills and competencies could be significant indicators of if they can remain employed (Wanberg, 2012; Yamashita et al., 2018). For adults who are in the labor force, work-related adult education is an important arena through which they can access learning activities and/or take responsibility for learning and is deemed as a primary focus of the LLL agenda (Rainbird, 2010). In response, adequate and timely provisions of occupational adult education have received increased policy attention (Yamashita et al., 2018). Both job-related AET and WL are often seen as potential sources of facilitating individual skills development and improving organizational-level outcomes (Kis, 2016). As such, many

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corporate leaders and employers provide educational programs such as on-the-job training responding to the concrete evidence that employees' learning is a substantial proportion of organizational success (Kleefstra et al., 2020). According to Desjardins (2011), the conceptual similarity and distinction of AET and WL are supposed to be well-reviewed to cope with the overarching inquiry of adult education participation. The guiding questions are: what are the similarities and differences between AET and WL and how are they compatible under the umbrella concept of adult education?

Traditionally, AET has been researched extensively mostly in the LLL sphere across countries and over time, as AET, especially job-related, is a dominant form of adult education (Desjardins, 2011). In general, AET comes with a broad range of explanations with respect to formats of learning, participants, and providers. The definition of AET refers to "a form of learning that takes place in addition or as a complement to formal education and is distinct from informal learning, that is intentional but less structured" (Widany et al., 2019, p. 8). In many countries, AET plays a pivotal role in improving the "match between educational qualifications and skills, increasingly the key competencies, basic skills, as well as a broad participation in the labor market" (Findsen & Formosa, 2016, p. 324). An underpinning premise of AET is that it typically occurs through both formal and non-formal pathways of participation (OECD, 2013). Whereas formal learning takes place in planned and structured environments and is associated with traditional forms of institutionally sponsored courses that often lead to a qualification, non-formal learning is an additional and alternative type of learning that complements formal training and is often considered a part of the process of LLL (Widany et al., 2019).

In regard to WL, the workplace is becoming a primary venue of adults' learning and development as the workplace is regarded as the most suitable and viable location "to learn

and/or develop [employees'] vocational practices" (Billett, 2004, p. 317). What is more, learning

at work is often seen as a potential source not only for improving individual skills development

but also unleashing corporate productivity (Kis, 2016). Broadly, WL refers to educational or

training activities undertaken in the workplace with the intention of improving individual and

organizational performance (Boud & Garrick, 1999; Craig, 1996). According to Fenwick

(2008b), WL plays an essential role in "expanding human possibilities for flexible and creative

action in contexts of work" (p. 19). Garavan et al. (2002) also suggested that the primary focus of

WL should be placed on the acquisition of new concepts and skills that result in "individuals and

teams refocusing and fundamentally changing their behavior" (p. 61). An underpinning premise

of WL is that it occurs mostly through informal means (Burke et al., 2015; Livingstone, 2008).

Whereas formal and non-formal learning takes place in planned and structured environments and

is associated with traditional forms of institutionally sponsored courses, informal learning arises

while individuals carry out daily activities and tasks (Schürmann & Beausaert, 2016). Next,

following this description of the concept of adult education, this study pays particular attention to

formal AET, *non-formal AET*, and *informal learning at the workplace*.

The Typology of Adult Education

Along with the definition of LLL, which is "… all purposeful learning activity,

undertaken on an ongoing basis with aim of improving knowledge, skills and competence"

(CEC, 2000, p. 3), adult education can be seen as inclusive of any learning activities from a

personal, social, and employment-related perspectives (Yamashita et al., 2019). A broad scope of

policies and initiatives across countries have been implemented in an effort to provide LLL that

is largely in line with labor market demands. Many studies have uncovered that there is a strong

linkage between adult education participation and an individual's work life (Merriam et al.,

2007). In addition to the positive impact on labor market outcomes for individuals, evidence of the quality of various forms of adult learning helps organizations make an informed decision on whether and how to invest in adult education for their employees (OECD, 2019c).

Various Forms of Learning: Formal, Non-formal, and Informal Learning

LLL theories highlight the different approaches to delve deeper into the understanding of how adults learn. According to the representative study about the typology of adult learning conducted by Jarvis (2010), learning, in general, can be classified into three different forms: formal, non-formal, and informal learning. Formal learning is defined as a highly institutionalized, chronologically graded, and hierarchically structured education system, spanning lower primary school and the upper reaches of the university (Boeren, 2011), or the "organized settings leading to official degrees and credits refers to formal education" (Boeren, 2011, p. 8). Jarvis (2010) provides a similar definition as formal learning is "formal education and training that occurs in an education institution and any other bureaucratic organization" (p. 42), which includes short- or long-term certificates or degrees provided by higher education institutions such as colleges or universities.

Boeren (2011) also identified non-formal learning as an "organized education taking place outside the formal education system… In contrast with formal education, non-formal education focused on the needs of special groups such as women or adults with literacy problems" (p. 335). Jarvis (2010) described non-formal learning as it "refer[s] to the ongoing nature of learning that occurs in places such as the workplace, the community, and so on, sometimes the learner is actually mentored in these situations" (p. 108). The most representative forms of non-formal learning include the planned endeavors of organizations under HRD-driven purposes, which take place in and out of the workplace. In addition, non-formal learning often

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encompasses diverse paid and voluntary community education provided by private, nonprofit, religious, and public organizations. According to the differences in physical space where learning takes place, non-formal learning is distinguished from formal learning that occurs mostly in higher education institutions and does not lead to official credentials such as diplomas, credits, or degrees.

Informal learning is described as the "natural accumulation of knowledge and skills in daily life, often unorganized and incidental" (Boeren, 2011, p. 335). For example, it includes unstructured learning activities that take place from interactions with family, friends, and colleagues, from using printed materials, computers, television, radio, and video, and from guided tours in museums and from visiting learning centers such as libraries (Boeren, 2011). Corresponding to this fundamental conceptual distinction of adult learning, recent researchers have re-classified adult education subsequently into three types based on the difference in primary focus and settings of learning: (1) *formal AET*, (2) *non-formal AET*, and (3) *informal learning at the workplace* (Desjardins, 2011; UNESCO Institute for Lifelong Learning, 2016).

Formal Adult Education and Training

The terminology of adult education has been used to describe all aspects of learning activities that take place in and out of the school system. Formal AET is formally designed and involves organized learning that mainly occurs in educational institutions such as colleges or universities (CEC, 2000). The goal of formal AET is often geared toward gaining certified educational outputs such as college diplomas or course completion certificates to compensate for the lack of educational qualifications of the workforce (Yamashita et al., 2019). Financial support from an employer often serves as a threshold that opens up the possibility of, and attributes to adult education participation among working adults, especially low-educated and

low-income workers. Desjardins et al. (2006) indicated that tuition aid from employers is a significant factor in prompting access to adult education programs at higher education institutions. Hence, one of the important facets of formal AET is an organization's investment in human resources to improve their employees' availability of training funds or accessibility for formal education through tuition reimbursement and other supports.

Today, more and more companies have attempted to provide work-related learning themselves as a part of HRD interventions and strategic plans. Still, colleges or universities are widely acknowledged as the primary venues for available adult education opportunities (Jarvis, 2010). Given that formal AET frequently accommodates degree programs at higher education institutions, it is important to understand that formalized adult education programs at colleges or universities can be described by the work-to-school transitions paradigm. The concept of work-to-school transitions is considered a primary agenda across multiple countries not only to address quality job transitions and employment rate improvement but also to accommodate industrial demands in higher education settings. Many employees are pursuing varied career paths and transitions, and this set of ongoing changes illustrates the value of work as a composite of experiences; accordingly, recurrent education takes place during their lifetime upon the ever-emerging needs for learning (Brown, 2001). Working adults who experience unexpected mid- and later-life career transitions may seek as many opportunities as possible to move into a schooling situation that will eventually lead them to a new job or career (Milheim, 2005).

Interestingly, while there are still discrepancies, or even disagreements abound, gaining higher education credentials still seems to be the best strategy against unemployment (Kwiek, 2012). The career transitions might include new professional roles or responsibilities, and it may also require formal certificates that indicate the receipt of specific knowledge and skill sets.

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According to Coughlin et al. (2016), recent outcomes of adult education in higher education institutions are accompanied by job market access and employability (Gallagher, 2020). Therefore, degree-seeking at colleges or universities and credentialing agencies that issue degrees, certificates, and any other academic awards to the workforce play an important role in explaining the concept of formal AET of working adults. In summary, new or additional learning is highly required for those who encounter career transitions and necessitate career adaptability. Accordingly, the notions of work-to-school transitions and credentialing may articulate well how and why formal AET frequently occurs in conjunction with higher education institutions.

Non-formal Adult Education and Training

Non-formal AET is often understood in line with its contemporary standard conceptualization, which corresponds to all organized learning activities for adults which occurs outside of the formal education system (Kalenda et al., 2020). Because non-formal AET has been acknowledged as a means to increase knowledge and skills in daily life both in and outside of the labor market (Roosmaa & Saar, 2017), non-formal AET is seen as a key driver in socioeconomic growth, skills development, and social inclusion of adults (Rubenson, 2018). As such, almost equivalent to formal AET, non-formal AET is also structured, organized, and intentional learning that takes place alongside educational facilities; however, it can be distinguished from formal training by its tacit nature of knowledge accumulation and of which does not lead to credentials (Eraut, 2000; Punksungka et al., 2021). By accommodating organized forms of the learning process, it occurs mostly in institutionalized settings such as the workplace offering short- and mid-term courses, workshops, and seminars (Eurostat, 2016; Jarvis, 2010). Embedded in the organization's authority structure and accountability system, non-formal AET is defined as organizationally supported and often occurs through classroom-oriented learning of explicit

knowledge (Cseh et al., 2000; Marsick & Watkins, 2001). Importantly, in the workplace, non-formal AET predominantly occurs through involvement in structured group activities that entail social interactions among employees.

In general, non-formal AET encompasses a planned approach of the organization through which trainees can attain specific work-related knowledge and skills (Park & Jacobs, 2011). Also emphasized is the use of a systematic approach that the organization involves in the learning process to ensure explicit or formalized learning outcomes. As non-formal AET is typically developed and implemented systematically, the trainer/facilitator may play an active role during the employees' learning process (Jacobs & Park, 2009). The apparent examples of non-formal AET contain typical organization-led training and development programs such as structured on-the-job training and formal mentoring/coaching. As repeatedly shown, learning opportunities are not limited to the school system. Rather, non-formal AET, such as on-the-job training, provides adults with a better chance of being employed and well-skilled, as well as a higher likelihood of receiving psychological work contracts (e.g., organizational commitment, job satisfaction, and knowledge transfer) than formal AET (Pate et al., 2000; Rowden & Conine, 2005).

Informal Learning at the Workplace

In contrast to formal AET and non-formal AET, which are both structured and organized, informal learning refers to those forms of learning that are "predominantly unstructured, experiential, and non-institutionalized" (Marsick & Volpe, 1999, p. 4). Generally speaking, informal learning activities take place in daily life without a specific intention to acquire formalized credentials that are typical in organized programs (CEC, 2000; Jacobs & Park, 2009; Merriam et al., 2007). By nature, adult education or WL cannot be separated from the cultural/social circumstances in which social interactions occur (Illeris, 2007; Merriam et al.,

2007). Conceptually, informal learning is often embedded in everyday practices, entails both cognitive and affective activities, and accounts for the dynamics among individuals and learning collectives (Fenwick, 2008b; Lundgren et al., 2017).

In this sense, informal learning at the workplace stresses the interconnectedness of employees and their actions within social environments. Notably, informal or incidental learning through the form of social interactions may bring specific benefits to individuals in obtaining information, resources, and alternative viewpoints in order to solve immediate problems and pursue challenges or opportunities (Conlon, 2004; Marsick & Watkins, 2001). Examples of informal learning often involve a broader scope of individual activities that are not necessarily relevant to occupational needs (e.g., visiting a museum, listening to the radio, and reading a book). Besides, the advantage of informal learning at the workplace is that it is often more efficient than formal training in occupational and vocational capacity acquisition. As workers tend to prefer participating in learning in a socially constructed context (Smith, 2003), in-person interactions with colleagues may empower their skills and competencies development (Jeon & Kim, 2012).

Some confusion may arise if the term informal learning is used without a specification of how it is related to other similar types of adult education. More specifically, there are still several arguments that shed light on the blurred definitional boundaries of non-formal AET and informal learning, which both fall outside the categories of formal adult education (Colley et al., 2002; Longworth, 2003). Traditionally, non-formal learning and informal learning have been used almost interchangeably because of the mutual correspondence and complementarity between them (Rubenson, 2011). As Desjardins et al. (2006) highlighted, both informal and non-formal learning, self-directed and experiential in common, can be a potential source to spur adults to

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seek further personal and/or professional development opportunities. More recently, however, the concept of non-formal learning is often seen as a midway point between formal and informal learning. Especially in the workplace, whereas non-formal AET involves intended pedagogical strategies and occurs in time/space formally set aside for trainees' work and learning, informal learning is conceived as taking place in daily tasks and thus encompasses a wide array of learning and interactive activities (Livingstone, 1999). All in all, two criteria can be used to present the conceptual distinctions among formal AET, non-formal AET, and informal learning (see Table 1).

Table 1

Classification of Adult Education

	Institutionalized	Non-institutionalized
Credentials	Formal AET (e.g., postsecondary education institutions)	
Non-credentials	Non-formal AET (e.g., on-the-job training, mentoring, apprenticeship)	Informal learning (e.g., self-directed learning, communities of practice)

Relationships Between/Among Formal AET, Non-formal AET, and Informal Learning

Many studies have shown the positive role of work-related adult education in adults' learning and development. Interestingly, non-formal AET and informal learning serve as antecedents to pursuing formal AET opportunities at colleges or universities and beyond. McGivney (1999) argued that informal learning in the community is an important source that may lead to educational progress because it allows adults to interact with significant others who encourage individuals to take further learning and development. Maurer et al. (2003) revealed that prior education and training experiences in and out of the workplace significantly affect

employees' intention and decision to participate in further learning activities. Desjardins et al. (2006) emphasized the important role of learning at the workplace in that diverse work-related learning serves as a potential source to motivate adults' continuous learning and development. The authors also substantiated that intended or self-directed non-formal AET or informal learning in the community or daily life can result in active engagement in further adult education programs.

This line of research has identified that personal good experiences and timely feedback obtained from past work-related learning experiences that occurred in non-formal and informal settings, such as apprenticeship, short-term training, mentoring, on-the-job training, seminars, and workshops at the workplaces, may affect adults' decisions to engage in further education and training, over formal educational attainment. This decision-making about learning would have significant implications, especially for working adults without college-level credentials. Through the workplace, working adults may have less-formalized learning related to their job, which in turn, this experience may drive them to pursue formalized adult education. Given that formalized forms of education (i.e., adult education programs at higher education institutions) requires more investment of time, energy, and financial input in general, it is not easy for working adults to start or to be involved in formal learning activities. Yet existing studies do not provide much evidence on whether non-formal AET or informal learning helps formal AET to take place or vice versa.

Kyndt and Baert (2013) noted that "Taking both formal and informal learning into account and differentiating between them might not only enable us to identify mutual and distinct antecedents but also allow us to investigate empirically how both forms of learning relate to each other. For example, future research could confirm empirically if formal and informal

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learning are indeed complementary to each other" (p. 307). Although there has been scarce empirical evidence that articulates the association, the European Commission (2006) designed and proposed the decision-making process of learning. To be specific, through working activities, employees may identify their intention to learn for several reasons. If they intend to learn and if it takes place in a non-institutionalized setting, it can be informal learning. If learning takes place in institutionalized settings such as workplaces or community learning organizations without providing education credentials, it can be non-formal AET. Formal AET finally takes place within institutionalized settings and provides learners with education credentials officially recognized in the nation's education qualifications system.

The boundaries between adult education and other relevant forms of learning for adults often seem to be unclear; nonetheless, it is imperative to recognize the fact that work-related adult education and LLL provide a comprehensive picture of bridging the disciplinary gap. When learning takes place, adult learners are often more externally motivated by job security, career advancement as higher occupational status, and the educational opportunities to build new social relationships (Brown, 2001; McGivney, 1999; Merriam, 2001). This is not limited to improving their qualifications and skills, but social responsibilities to uplift their organizations and communities (Geduld, 2014). Figure 1 depicts a simplified schematic of how three types of adult education and other relevant learning concepts are intertwined and interrelated. For working adults, WL (encompasses mostly non-formal AET and informal learning, limitedly formal AET) is perhaps the most accessible and appealing form of learning; simultaneously, non-formal AET experiences may act as a pipeline to broaden their learning opportunities taking place 'beyond work' (Desjardins et al., 2006; Maurer et al., 2003). Higher education and apprenticeships can be a "last resort" for low academic achievers who are eager to be compensated for their learning

demands (Campbell et al., 2006, p. 82). Looking at another side of 'beyond work' learning (see right in Figure 1), an increased sense of community as a psychological outcome of AET or WL participation (Tynjälä, 2013), in turn, likely leads adults to seek developmental learning activities (e.g., communities of practice) in their organizations and communities (Billett, 2002a, 2002b). Ultimately, adult education plays an integral role in binding the peripheral concepts of work-related learning altogether.

Figure 1

Graphical Representation of the Relationships of Adult Education and Other Relevant Work-related Learning Concepts
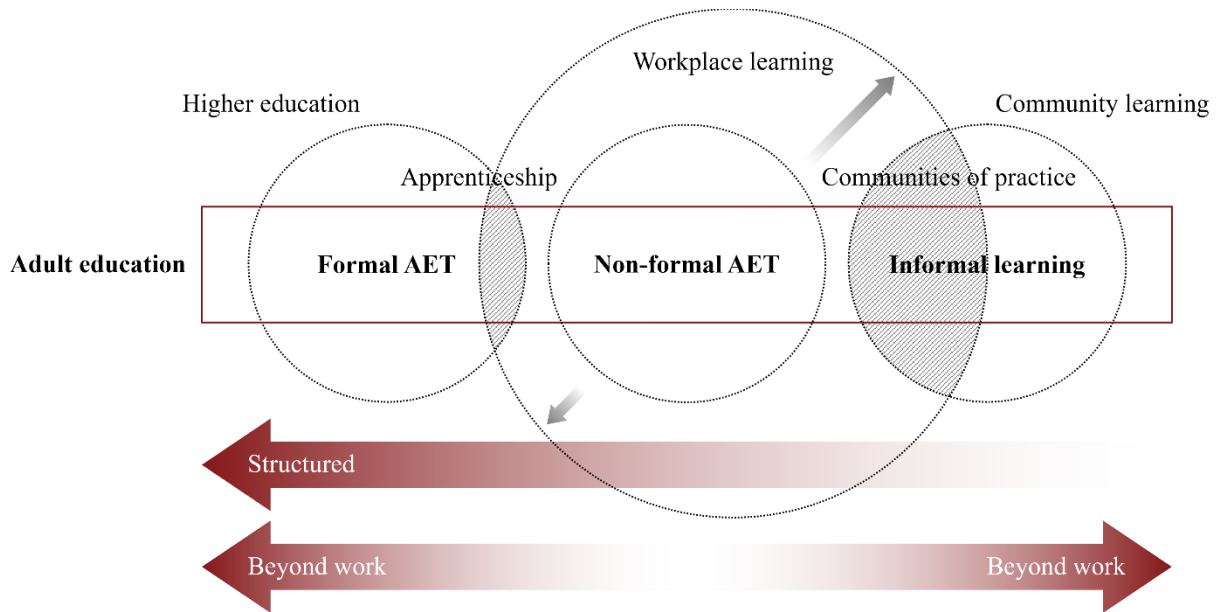
Note. AET = adult education and training.

Research Gaps

Notwithstanding many researchers have emphasized the potential importance of diverse forms of adult learning for career advancement for adults, there has been limited academic scrutiny directly toward comprehensively looking at the dynamics across situational factors on working adults' adult education participation and examining how these contexts shape discrete patterns according to the types of adult education participation and the degree to which they

participate. As shown, there is a substantial research gap in specifying how different types of adult education occur according to individual and organizational aspects and how employees participate in any form of adult education for what reasons. Also, it is necessary to empirically identify if those different types of adult education are complementary to each other in order to understand why and how working adults learn.

These limitations demand an integrated approach to a thorough understanding of working adults' participation in adult education by the consideration of multiple factors holistically rather than simply an investigation of the parts. From the perspective of the complexities surrounding the recognition of the typology of adult education, much of this study's focus is to re-examine what contextual factors affect working adults' adult education participation and how they shape different patterns of participation. According to the conception of adult learning, the present study considers formal AET, non-formal AET, and informal learning as three major *pillars* of adult education. More specifically, this study premises that determinants and patterns of adult education participation of working adults may vary across types of adult education participation and its related aspects of factors; accordingly, based on the distinctive nature of adult education as assumed, this study investigates how individual-level and work-related contexts of working adults are associated differently with formal AET, non-formal AET, and informal learning, respectively.

Key Drivers of Adult Education Participation

According to the report issued by OECD, adult education participation is defined as people's involvement in formal, non-formal (e.g., on-the-job training, seminars, workshops, private lessons), and informal educational activities or training programs (OECD, 2013). As reviewed, profound evidence shows that the adult education participation of individuals may

diverge across different factors and contexts. Given that employees' participation in learning is constructed from a variety of individual experiences and relations with an organizational structure, many researchers have sought to explore how personal dispositions and experiences and work-related contextual factors predict formal AET, non-formal AET, and informal learning participation of employees (e.g., Punksungka et al., 2021; Schürmann & Beausaert, 2016; Tikkanen & Nissinen, 2018). Based on previous studies addressing what determines working adults' participation in adult education, two categories of contexts (i.e., individual-level and work-related) and their relevant factors are suggested in the following subsections.

Individual-level Context

Past studies on adult education theories and practices have broadened the understanding of how individual-level context factors influence adult education participation (Schürmann & Beausaert, 2016; Tikkanen & Nissinen, 2016). In other words, a great deal of research evidence has shown that personal backgrounds, individual human capital, and various socio-contextual characteristics can be a motivator or a barrier to adult education participation. Components of the individual-level context widely and commonly studied in the literature include (1) demographic information such as *gender* and *age*, (2) human capital such as *education level*, *income*, *health*, and *skills proficiency*, and (3) learning-related socio-psychological states such as *learning attitudes*, *cultural engagement*, and *social trust*. In the following, empirical findings and observations are elaborated on how these components have contributed to the formation of a knowledge basis with respect to the examination of adult education participation at the individual-level perspective of working adults.

Demographic Information

Demographic characteristics have been considered to have a strong influence on working adults' participation in continuing education (Cookson, 1986; Darkenwald & Merriam, 1982). Among many, previous findings on *gender* and *age* as influential factors for adult education participation have shown inconsistent results. Typically, it is known that workers who are male (Ioannidou & Parma, 2022) and younger (Aldridge & Hughes, 2012; Desjardins et al., 2006; Boeren et al., 2010) were more likely to participate in adult education programs than female and older cohorts. According to Desjardins et al. (2006), older-career adults (aged over 55) were least likely to pursue further education for job-related reasons, while the 25-29 age group participated more in adult education programs compared to others. Similarly, Adamuti-Trache and Schuetze (2009) claimed that younger adults under 25 years of age were more likely to participate in university continuing education programs (49%) than those over 25 years of age (38%). Although there is a widespread belief that adult education activities are positively related to economic and psychological well-being among older workers (Narushima et al., 2018), empirical findings have indicated that aging is associated with a lower likelihood of adult education participation or negative attitudes toward adult education (Boeren et al., 2010; Roosmaa & Saar, 2017).

However, discordant results have also been reported with respect to the association between demographic characteristics and adult education participation, indicating that participating in adult education may vary across divergent institutional contexts of countries or organizations, more specifically, depending on their adult education and HRD policies and systems and/or the notion of educational needs and human values. For example, Massing and Gauly (2017) found that the training participation of female employees was higher than males in

Nordic countries. Similarly, Boeren (2011) suggests that there are no significant gender differences in participation in adult education. Adamuti-Trache and Schuetze (2009) also demonstrated insignificant differences in participation rates in adult education based on gender. In addition, several researchers focused on informal learning at the workplace (e.g., Berg & Chyung, 2008; Livingstone, 1999); both studies revealed analogous results of the extent to which working adults engaged in job-related adult education increased with age. It implies the significance of the aging workforce in maneuvering loosely structured learning and development strategies in the workplace.

Human Capital

It is widely acknowledged that individuals who have higher human capital tend to pursue additional knowledge and skills (Boeren et al., 2010). Such statements have been supported by research demonstrating a direct association between the *level of educational attainment* and the degree of adult education participation. Among many, educational attainment has been regarded as a salient indicator that predicts working adults' participation in adult education (Bailey et al., 2003; Horn & Li, 2009; Kopka & Peng, 1993). In a study conducted by Ioannidou and Parma (2022), for instance, highly educated workers were more likely to engage in job-related adult education activities, which reiterates that higher education level can improve the possibility of adults' subsequent learning participation (Kyndt et al., 2009; Punksungka et al., 2021; Yamashita et al., 2019). Desjardins et al. (2006) proposed that previous education has a substantial influence on working adults to pursue further learning; therefore, those whose educational attainment is lower are less likely to participate in adult education. According to Støren (2013), qualifications (i.e., education) mismatch (not having appropriate education levels for the job) and overeducation reduced the likelihood of employees' learning engagement, whereas

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undereducation increased it. In terms of qualifications mismatch and educational attainment, thus, it is imperative to note that educational shortage can positively affect working adults seeking additional learning opportunities, especially among low-educated.

Income can also act as an important driver and an extrinsic reward for participating in LLL (Tikkanen & Nissinen, 2016). Massing and Gauly (2017) showed that financial burden is one of the most significant barriers to further formal training access for adults in almost all countries. These barriers to adult education participation may be originated from the structure of each country's specific socioeconomic/cultural contexts (Desjardins, 2015). Akin to findings reported in existing scholarly works, Punksungka et al. (2021) demonstrated that higher levels of educational attainment and income, which are indicative of greater socioeconomic status, are closely associated with adults' participation both in formal AET and non-formal AET. Notably, adults, in effect, make a choice by evaluating available resources and expected values return in and around them (Cookson, 1986). This concept seems to be highly associated with decisions on adult education participation since adults are more likely to be self-directed, goal-oriented, and cost-sensitive (Bailey et al., 2003). Therefore, it is straightforward to consider that if one decides that there is no extra value or reward in heightening their current educational achievement and financial status as a consequence of participating in adult education programs, it is likely that he or she might not consider spending their time and money.

The relationship between *health* and adult education participation has often been neglected; however, it is important to note that health can be understood under a range of non-economic benefits of adult education (Punksungka et al., 2021). According to rational choice theory (Scott, 2000), people always seek to maximize their welfare when pursuing goals. To this end, they always evaluate the expected costs and benefits of any action prior to making a

decision. Thus, it is reasonable to assume that adults' health status may influence participation in educational activities in response to today's rapid changes in working conditions, including increased work intensity with tight task schedules and deadlines, often paralleled with the aging workforce (Eurofound, 2012). Patterson (2018) proposed that incremental decline in health increases the likelihood of non-participation in adult education, indicating that poor health can be a strong concern for adults to decide not to participate in adult education programs. Additionally, adults' basic skills and LLL were both positive influencers on their health and well-being (Tikkanen & Nissinen, 2016), such that enabled their better health information-seeking behaviors (Schuller et al., 2010).

The last two factors relating to human capital are skills proficiency in literacy and problem-solving in technology-rich environments (PS-TRE). OECD (2013) has shown that *skill proficiency in literacy* is generally of a crucial indicator in predicting adults' participation in adult education and thereby in improving labor market outcomes and their social and civic life. Defined broadly as "understanding, evaluating, using and engaging with written text to participate in society, to achieve one's goals and to develop one's knowledge and potential" (OECD, 2012a, p. 20), literacy skill allows adults to make sense of and utilize resources and information found in written texts for coping with job-related or practical matters. According to the "use-it-or-lose-it" hypothesis proposed by Salthouse (2006), staying mentally active and prepared will help maintain one's cognitive functioning and thus prevent cognitive decline. In this context, skills proficiency and utilization can reinforce and complement each other (Punksungka et al., 2021). More importantly, literacy skill does not simply mean being "literate" versus "non-literate" dichotomy, rather, it is a continuum of foundational skills and LLL that can

be improved across one's lifetime (Rubenson, 2011). Thus, skill proficiency in literacy is one of the major prerequisites for, and often a by-product of, adult education participation.

In response to today's fast-advancing technological developments, computers and other information and communications technologies (ICT) have been extensively integrated into our daily lives (Desjardins & Ederer, 2015). Accordingly, technology-related skills acquisition and knowledge of how to use computers and ICT efficiently have become crucial for adults to do their tasks both in and out of the workplace. Since many current jobs increasingly require problem-solving skills in the workplace, these technology-based changes necessarily result in the need for *skill proficiency in PS-TRE* (Jyung et al., 2020). OECD (2012a) defined PS-TRE skill as that used in "digital technology, communication tools, and networks to acquire and evaluate information, communicate with others, and perform practical tasks" (p. 47). Hämäläinen et al. (2019) report that ICT skill use at work has positively related to PS-TRE skill development. According to Jyung et al. (2020), the association between skill proficiency in PS-TRE and adult education participation (i.e., formal AET and informal learning) was insignificant, even though it was one of the salient factors affecting adults' sustainable employability and adaptability in Korea and Japan. The role of literacy skill proficiency in adult education participation has been shown in the literature (Desjardins, 2020), yet there is no clear consensus on the relationship between skill proficiency in PS-TRE and adult education participation. The influence of skill proficiency in PS-TRE on adult education participation may be sensitive to and vary depending on employees' work environments: the degree to which PS-TRE skill is related to task implementation.

Learning-related Socio-psychological States

Over the demographic characteristics and backgrounds, working adults' *learning attitudes* were among the most powerful predictors of adult education participation (Boeren et al., 2010; Maurer et al., 2003). Being labeled interchangeably along with similar terms, such as learning dispositions, learning intentions, or simply readiness-to-learn, the concept of learning attitudes indicates a psychological state of adults "against which learning processes takes place and which influence the capacity of the individual to successfully perform the processes (Lavrijsen & Nicaise, 2015, p. 39). Learning attitudes have been known as a central ingredient of skilling (Allen & van der Velden, 2012), and accordingly, have received substantial attention in LLL policy across countries (OECD, 2012b). In effect, attitudes toward learning in the form of intentions, expectations, and the perceived significance of adult education are part of a complex process of decision-making in relation to adult education participation among adults (Boeren, 2016, 2017). The series of scholarly literature came to straightforward conclusions that if one underrates adult education or is not interested in it, they tend not to participate (Baert et al., 2006; Kyndt et al., 2013b).

Both Rubenson (1977) and Cross (1981) emphasized the importance of learning attitudes, which act as potential drivers resulting in participation in adult education. Maurer et al. (2003) found that once adults perceived the benefits of work-related adult education, they were more likely to engage in learning activities. Hence, it is important how adults perceive the importance and necessity of adult education for their personal and professional growth. Adults' perceived potential benefits of adult education can be separated into two types: extrinsic and intrinsic. Extrinsic expectation indicates the perceived outcome that is tangible, capable of being evaluated, or visible as a product of education. Often, extrinsic expectation of employees

includes better pay, promotions, or job security. Meanwhile, intrinsic motivations are those that may fulfill an individual's interests or increase one's potential which include maintaining one's human resources or acquiring new knowledge and skills. Contrary to extrinsic motivation, intrinsic motivation is often invisible and intangible but pertains to one's enjoyment of learning. In general, work-related adult education bears both extrinsic and intrinsic learning motivations. Working adults' learning needs, such as getting a degree or certificate and changing jobs (i.e., extrinsic) and learning advanced work-related skills and techniques or exploring academic knowledge (i.e., intrinsic), all influence their decisions to participate in adult education (Feldman & Ng, 2011). Bailey et al. (2003) claimed that adults attending community colleges are more likely to have specific expectations on attaining job skills rather than have other general and academic purposes. In similar, Desjardins et al. (2006) and Adamuti-Trache and Schuetze (2009) conclude that most adults have strong job and career-related motivations to participate in adult education programs.

In empirical studies, learning attitudes have been researched frequently in relationship with respondents' levels of education. In general, low-educated adults tend to hold negative attitudes toward adult education in that they feel it is meaningless in their personal lives as well as in whatsoever learning needs (Boeren, 2016; Illeris, 2006; Rubenson, 2011, 2018). In contrast, Lavrijsen and Nicaise (2015), showed that the impact of readiness-to-learn on participation in LLL decreases with increasing educational attainment, indicating learning attitudes can be considered to be by far the most significant predictor of adult education participation among low-educated adults. Although it is still widely accepted that well-educated adults tend to have positive learning attitudes (Støren, 2013; Tikkanen & Nissinen, 2016), the impact on learning attitudes to adult education among working adults should be carefully reviewed, as the attitudes

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on learning can be influenced or differentiated by diverse meso- and macro-levels of context: situational and institutional features of social and organizational groups as well as the welfare state and skill-production regime of the country (Kalenda & Kočvarová, 2022; Rubenson & Desjardins, 2009).

Cultural engagement and social trust are a pair of variables which frequently appear together within the notion of civic engagement, extensively studied in adult education. The role of cultural engagement and social trust are well-documented (Boeren et al., 2010). As suggested by Bourdieu's (1973) theory of cultural reproduction, cultural capital is known to be positively associated with one's socioeconomic status across the lifecycle, and individuals with higher socioeconomic status are more likely to possess higher cultural/social values and learning opportunities, which in turn, influences their further involvement in educational and cultural activities (Desjardins et al., 2006; Tikkanen & Nissinen, 2016). According to the study performed by Rüber et al. (2018), the more adults participated in AET, the more likely adults possess higher interpersonal skills and trust perceiving other people will behave with good intentions, which are key indicators of civic engagement and democracy. Thus, adults' cultural/social orientation and engagement are important aspects in explaining LLL (Rose et al., 2019) and notably, access and availability of adult education participation may be part of what characterizes inclusive social cohesion and citizenship (Desjardins, 2017; Lavrijsen & Nicaise, 2015). In response, the examination of the effect of cultural activities and social trust on adult education participation is arousing the interest of researchers.

Work-related Context

Desjardins et al. (2006) suggest that "working life, and more specifically the nature of the workplace, is a potentially important factor that motivates many adults to be participative in

learning" (p. 77). Suffice it to say, learning-oriented organizational features and working

conditions play a vital role in fulfilling employees' learning potential (Marsick, 2009). To

encourage working adults to engage in further educational opportunities, many organizations

provide relevant environments and multiple options for learning. This study posits that the extent

to which employees participate in adult education may differ depending on the type of

organization since particular job- or task-related factors representing the characteristics or

institutional efforts of the organization can affect employees' adult education participation

differently. Previous studies have identified several work-related predictors associated with adult

education participation, including *employment status and economic sector*, *years of work

experience and managerial status*, *organization size*, *working time*, *job satisfaction*, and *skills

use at work*.

Regarding working adults' *employment status* and the *economic sector* in which they

labored, adult education participation rates were higher among workers in professional and

higher managerial occupations compared to others (White, 2012). According to Desjardins et al.

(2006), occupation types that require adults to utilize cognitive or technology-related skills in

their business are positively associated with their intentions to participate in adult learning

activities. In contrast, adults who work in labor-intensive occupations (e.g., manufacturing,

transportation) end up having less opportunity to participate in adult education due to the

occupational characteristics which may be relatively insufficient in time, space, and support for

learning. Additionally, it is more likely for adults to be involved in job-related LLL programs, if

they have full-time jobs (Dieckhoff et al., 2007; Kalenda et al., 2020; Kazis et al., 2007) and are

working in public sectors (Tikkanen & Nissinen, 2018).

Both *years of work experience* and *managerial status* may reflect the extent to which employees are experienced and seasoned in the workplace. Years of work experience are known to be related to the basic skills of adults and often signal a better chance of transitions to high-quality employment over the course of their life (Roberts & Côté, 2014). Empirical findings report that years of work experience did not significantly increase the learning attitudes of the aging workforce (Lim et al., 2020). However, the strong association between years of work and skills proficiency (Rose et al., 2019) reiterates that the extent to which how much adults are experienced in the labor force may serve as a motivator to seek further learning activities, in order for their continuous skills development, increased earnings, and well-being (Lim et al., 2018). Particularly, across multiple countries, individuals employed in elementary, assembly, trades, and service occupations are less likely to engage in work-related learning and skills development activities in the workplace compared to their counterparts employed in managerial occupations (OECD, 2013; Pullman & Chen, 2020). Thus, it is reasonable to conclude, adult education participation, to respond primarily to the learning and skill demands of working adults, is related closely to whether they are experienced in managerial practices in their job performance (Lorenz et al., 2016).

Theoretically, *organization size* is known to be correlated to formalization within the organization (Grinyer & Yasai-Ardekani, 1981). When it comes to the rationale of centralization, organization size may influence social capital in the workplace; a larger firm size has more concentrated decision-making processes, making human relationships among employees more impersonal and less congenial. In contrast, organization size represents the organization's capacity to provide sizable interactions, sufficient learning options, and continuous investment in AET (Kwon, 2019). Interestingly, the learning experiences of adults may also depend on the

degree of social support from their colleagues (Brown & Bimrose, 2018). In effect, social

support from "significant others" (Clochard & Westerman, 2020, p. 16) has a positive effect on

participating in adult education. Aligning with this line of academic discourse, Desjardins et al.

(2006) revealed that firm size strongly influences the likelihood of working adults' learning

opportunities pursuance. Similarly, employees who work at larger companies were much more

likely to participate in work-related adult education and any other professional development

programs compared to their counterparts working in a small-sized company (Agbo, 2000;

Feldman & Ng, 2011; Tikkanen & Nissinen, 2018).

Several organizational support and resources in terms of flexible *working time* act as a

vehicle for working adults to seek adult education opportunities. A series of literature has shown

various non-financial supports pertaining to adult education participation, including but not

limited to flexible working time and schedules, provision of sufficient work-related learning

opportunities through the interaction with supervisors, coworkers, and subordinates, the

availability of access to professional development programs, and organization's learning-

oriented resources and policies (Maurer et al., 2003; Merriam et al., 2007). Importantly, the more

time and support given for further education, the more likely working adults tend to seek

additional learning opportunities intentionally and in a self-directed manner, which in turn,

influences their active participation in adult education (Desjardins et al., 2006). Empirical

research results support this notion that working adults who have more extra time and work

autonomy to take responsibility for their learning participated more in adult education (Doornbos

et al., 2004; OECD, 2013; Tikkanen & Nissinen, 2016). Taking the above together, these

scholarly works indicate how organizations' work-related conditions play an important role in

encouraging decisions or shaping intentions on adult education participation among working adults.

Working adults' perceived *job satisfaction* and *skills use at work* are other important work-related predictors of adult education participation. Commitment to one's job is of utmost significance to the progress of continuous learning (Desjardins, 2019; Schürmann & Beausaert, 2016). Accordingly, task satisfaction, which is closely linked to changing demands of the job, serves as the main stimulus for adult education participation. In a similar vein, Schmidt (2007) found that job satisfaction has a positive relationship with workplace training. Others also discovered that task satisfaction has a positive relationship with informal learning at work (e.g., Jeon & Kim, 2012; Rowden & Conine, 2005).

When it comes to skills use at work, it is a critical factor for working adults' continuous skills maintenance and development. Recently, skills underutilization has been known as a widespread concern for both employees and companies in today's increasingly complex and competitive world of work (Desjardins & Warnke, 2012; OECD, 2013). Accordingly, some studies paid particular attention to the utilization of skills under the "use-it-or-lose-it" hypothesis (Salthouse, 2006). In short, the more employees use their skills in their tasks, the more likely they participate in adult education to continue to develop their occupational potential, and vice versa (Desjardins & Warnke, 2012). In a study of Nordic countries, Tikkanen and Nissinen (2018) discovered that above-average utilization of skills at work increased employees' likelihood of participation both in formal AET and non-formal AET. Researchers have also suggested that working adults in a skills shortage situation were less likely to participate in employer-sponsored training programs (Desjardins & Rubenson, 2011). In a similar vein, several studies also paid special attention to the issue of skills mismatch under the assumption that

continuing education can bring extrinsic rewards for adults in the later stages of their life. Desjardins and Rubenson (2011) suggest that high-skilled adults were more likely to participate in employer-sponsored training programs. On the contrary, Brown and Bimrose (2018) contend that negative experiences in previous education and a deficit in skills may rather motivate working adults to re-engage in LLL. In alignment with the statements and rationale about skills proficiency described above, this study looks at literacy and ICT as two sub-items of skills use at work.

Based on the overview of the literature on how demographic characteristics, human capital, learning-related socio-psychological dispositions, and working conditions influence working adults' adult education participation, this study targeted and categorized the individual-level and work-related contexts of factors. Table 2 briefly presents the selected key drivers indicating empirical evidence of their effects and relevant theoretical and conceptual underpinnings. It is important to know that these factors act as initiators to participation, or vice versa, and the results are incoherent according to divergent study samples and research design along with a larger context of the study. The existing empirical evidence of using only a few predictors in the statistical analysis is somewhat limited to generalizing the results. When it comes to the purpose of the study, this present study focuses on providing a holistic picture of adult education participation. In this sense, the findings of this study may contribute to shedding light on novel insights and knowledge basis: an examination of the extent to which how the relative importance of these factors differ and how those are associated with shaping different patterns of adult education participation among working adults.

Table 2

Selected Key Drivers of Adult Education Participation

Factor	Effect on adult education participation and theoretical rationale
Demographic information	
Gender	Men participated more in general (Ioannidou & Parma, 2022); female employee participation was higher in Nordic countries (Massing & Gauly, 2017).
Age	An inverse relationship (Boeren et al., 2010; Desjardins et al., 2006); elderly workers were more likely to participate in informal learning (Berg & Chyung, 2008; Livingstone, 1999).
Human capital	
Education level	A salient indicator predicting AET (Kopka & Peng, 1993); higher educational attainments increase the likelihood of subsequent learning (Ioannidou & Parma, 2022; Punksungka et al., 2021).
Income	An extrinsic reward for AET (Tikkanen & Nissinen, 2016); a barrier to non-participation of low-skilled (Massing & Gauly, 2017).
Health	Declines in health increase the likelihood of non-participation in AET (Patterson, 2018); inversely, LLL and health information-seeking increased health (Tikkanen & Nissinen, 2016) – rational choice theory (Scott, 2000) and motivation theory (e.g., Maslow's).
Skills proficiency	A major prerequisite for and often a by-product of AET (Desjardins, 2020; Jyung et al., 2020); a relationship between basic skills and LLL can be seen as a continuum (Rubenson, 2011).
Socio-psychological state	
Learning attitudes	A central ingredient of skilling and AET (Allen & van der Velden, 2012; Boeren, 2017; Lavrijsen & Nicaise, 2015); intertwined with both extrinsic and intrinsic motivations (Fouarge et al., 2013; Kyndt et al., 2011) – theory of reasoned action quoted in Tikkanen & Nissinen (2018).
Cultural engagement	A positive relationship between volunteerism (i.e., civic engagement) and AET (Desjardins et al., 2006; Rose et al., 2019) – theory of cultural reproduction (Bourdieu, 1973).
Social trust	Access and availability of AET are what characterize inclusive social cohesion and citizenship (Desjardins, 2017; Lavrijsen & Nicaise, 2015).

Factor	Effect on adult education participation and theoretical rationale
Work-related context	
Employment status	Higher participation among full-time employees (Dieckhoff et al., 2007; Kalenda et al., 2020).
Economic sector	Participation across sectors varies (Dieckhoff et al., 2007); higher participation among professionals (with cognitive or technology-related skills) (Desjardins et al., 2006; White, 2012) and public sectors (Tikkanen & Nissinen, 2018).
Years of work experience	A signal of a better chance of transitions to high-quality employment over the life course (Roberts & Côté, 2014); a motivator to seek further learning for skills and career development (Rose et al., 2019).
Managerial status	Related to basic skills (Roberts & Côté, 2014); higher participation among managerial employees across multiple countries (OECD, 2013; Pullman & Chen, 2020).
Organization size	Indicating the organization's capacity to invest in AET (Kwon, 2019) and the amount of social capital (Brown & Bimrose, 2018; Clochard & Westerman, 2020); higher participation among large firms (Feldman & Ng, 2011).
Working time	Related to non-financial support (Maurer et al., 2003), work overload is a barrier (Massing & Gauly, 2017); more work autonomy is likely to take more responsibility for learning (OECD, 2013).
Job satisfaction	Commitment to the job is of utmost significance to learning progress (Desjardins, 2019); directly associated with training (Schmidt, 2007) and informal learning (Jeon & Kim, 2012).
Skills use at work	Positive effect: the more participation in AET, the more likely higher skills utilization (Tikkanen & Nissinen, 2018) and the less likely skills shortage or deficit mismatch (Desjardins & Rubenson, 2011) – 'use-it-or-lose-it' (Salthouse, 2006) and intellectual challenge (Desjardins & Warnke, 2012) hypotheses.

Theoretical Framework

The former section provides a substantial body of theoretical underpinnings and empirical evidence of the dynamics of factors affecting working adults' participation in adult education. In this section, two theoretical frameworks are applied accounting for adult education

participation of working adults: (1) HRD learning participation theory (LPT) proposed by Wang

and Wang (2004) and (2) comprehensive lifelong learning participation model (CLLPM)

suggested by Boeren et al. (2010). These two theories hold similar perspectives on adult

education participation: the nature of work-related learning participation is that of depending on

a variety of individual-, organizational-, and environmental-levels of factors and can be seen as a

composite of their dynamics.

HRD Learning Participation Theory

The HRD LPT (see Figure 2) captures a comprehensive picture of how individual and

contextual variables interact and thereby influence the mechanisms of learning through the lens

of HRD. Given that enhancing human capital is the overarching goal of HRD and thus, enriching

learning opportunities may be the most desired strategy of the organization (Marsick & Watkins,

2015). In addition, comprehending the various dimensions of learning is essential to investigate

the phenomena of adult education participation in-depth. This theoretical framework offers

multi-dimensional constructs articulating employees' learning participation, including individual,

learning process, organizational, and environmental clusters.

The *individual* cluster includes factors pertaining to the demographic and psychological

dispositions of adult learners, such as motivation, self-efficacy, organization membership,

personal characteristics, learning style, and perceived learning needs and benefits. The *learning

process* cluster contains learning-related variables measuring the degree to which institutional

efforts offer learning activities such as needs assessment, quality instructional design, learning

delivery platform, and instructor or facilitator. Evidently, participating in any form of adult

education (i.e., formal AET, non-formal AET, informal learning) may diverge according to the

physical or environmental features of the organization in which employees work. The

organizational cluster represents workplace contexts such as organizational support, policies, and regulations. According to Wang and Wang (2004), significant factors that encourage employees to seek further education and training opportunities include whether the organization has a learning-oriented culture and policies that encourage adult education participation. Finally, factors in the *environmental* cluster (e.g., economic and labor market conditions) play a mediating role in connecting the previous three clusters.

Figure 2

Graphical Representation of HRD Learning Participation Theory
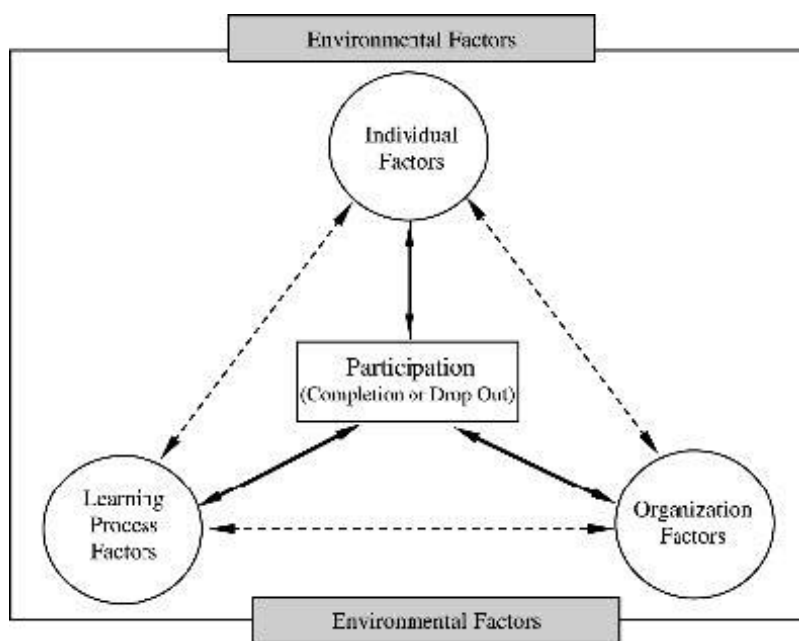
Source: Wang & Wang (2004, p. 334)

Comprehensive Lifelong Learning Participation Model

The CLLPM (see Figure 3) present an outline of an integrated model of participation in adult education. According to Boeren et al. (2010), the decision to participate in adult education relies on a variety of factors at three layers: individual, institution, and socioeconomic contexts. To be specific, this model is presented as individuals (micro-level) and organizations (meso-level) are embedded in society (macro-level) as a whole. The authors articulate that the

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individual (i.e., left block in the figure) and educational institutions (i.e., right block in the figure) are the central elements of adults' learning participation, and the two blocks are interconnected; therefore, the intention and decision to participate in adult education are structured by the means of an interaction between individuals' demand and institution's supply.

The central unit on the *micro-level* is obviously the individual. Boeren et al. (2010) propose a comprehensive review of adult learners' personal background, and illustrate that the perception of adult education participation is dependent upon myriad factors including but not limited to the adults' socioeconomic (e.g., employment status, occupational status), socio-demographic (e.g., gender, age, educational attainment), sociocultural (e.g., cultural engagement, social participation), psychological (e.g., attitudes, motives, satisfaction, intentions), and relevant others (e.g., family, employer, reference group). The list of individual-level factors reiterates that adults are embedded in the social context, which is built upon the basis of rules and tasks that are to be kept. The core element of *meso-level* is the educational institution, indicating a series of organizational factors associated with the institution at large. The factors included but not limited to are organization size, accessibility, flexibility, the degree to which the level of learning support systems is developed, and the extent to which it attracts marginalized groups of people within the organization. The organization's learning culture is the basis of affecting working adults' decision to participate in adult education. Thus, lowering institutional barriers and striving for enough flexibility to respond to the educational needs of individuals can be a promising strategy for the institution. Finally, the *macro-level* factors contain much broader aspects, such as the labor market regime, welfare policies, and skill formation systems of the country. The underlying assumption is that LLL can be defined as of the utmost importance of which human capital and social outcomes can be increased at large. Therefore, it is

straightforward to conclude that the realm of national economic policy has a considerable impact on individual adult education participation.

Figure 3

Graphical Representation of Comprehensive Lifelong Learning Participation Model
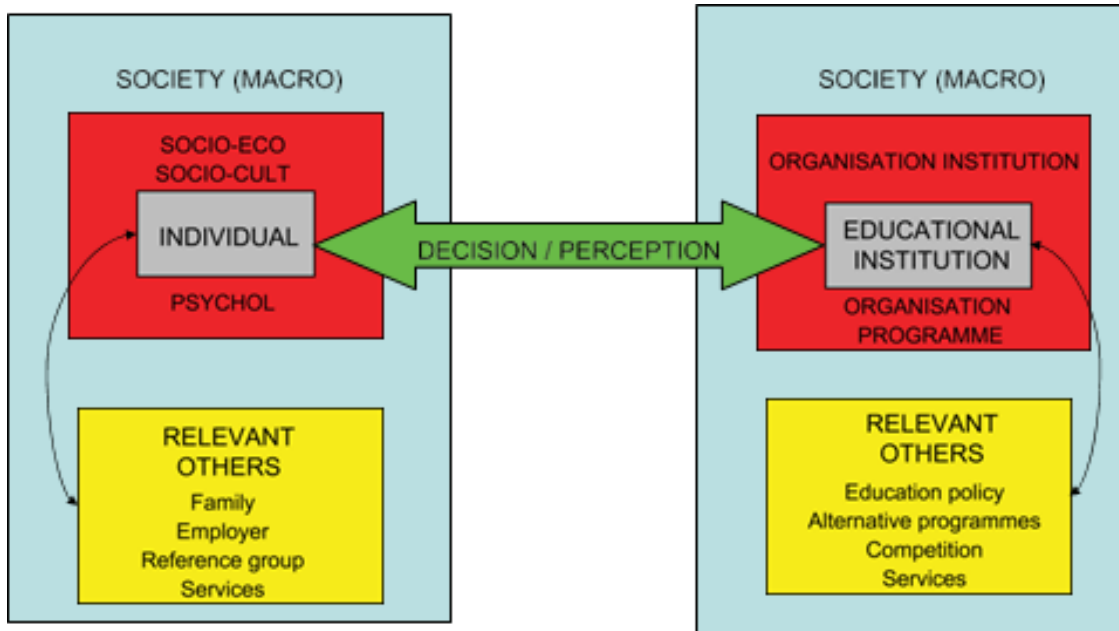
Source: Boeren et al. (2010, p. 56)

Taken together, both HRD LPT and CLLPM elaborate that participating in adult education can be seen as the consequence of the interactions between individual- and organizational-level factors that are intertwined and complementary to each other. Of fundamental concern is the fact that both the individual and the institutional contexts are embedded in social structure and the complex nature of learning may influence participation in adult education. The primary focus of these models is therefore broadening the scope of adult education or LLL inquiry by embracing a holistic approach (Boeren et al., 2010). By far, these theoretical frameworks have drawn considerable research attention, and have contributed to making huge progress in testing and uncovering the complexities of adult education participation. This line of scholarly works provides a deeper understanding of how various

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aspects of factors are intertwined. Nonetheless, they are limited in aggregating a wide range of micro and institutional levels of factors at once. The purpose of this study is to re-examine determinants and patterns of working adults' adult education participation. To address the research gap and aforementioned research questions concerning the decisive role of individual-level and work-related contexts in predicting and shaping patterns of adult education participation among working adults, this present study places particular attention on the individual-level (i.e., micro-level) and organizational (or institutional)-level (i.e., meso-level) layers illustrated in both HRD LPT and CLLPM.

CHAPTER THREE

Methods

In this methodology chapter, the research design will be discussed to fulfill the purpose and the research questions of this study as aforementioned. More specifically, first, the data source and sample that are utilized for data analysis will be described. Then, selected variables and their measurements will be depicted. Target variables were carefully chosen based on the key drivers and theoretical frameworks regarding adult education participation discussed in previous sections. In addition, the analytic strategy section will specify the two main analytic techniques (i.e., RFCs and LCA) and how they can be employed to obtain novel information about determinants and patterns of working adults' adult education participation, along with the advantages and limitations of the analytic choice.

Data Source and Sample

The data is drawn from the PIAAC dataset conducted and developed by the OECD. PIAAC gathers data with respect to basic skills such as literacy, numeracy, and PS-TRE, along with extensive background data including but not limited to demographic, socioeconomic status, education and work history, and behavioral information among adults who are aged 16 to 65 years old. PIAAC data provides nationally representative estimates of adults' learning and development in and out of the workplace by measuring the degree to which their participation in various types of education and training activities undertaken by adults for professional or personal reasons. Hence, PIAAC data is valid to use, given a widely accepted perception of the importance of adult education as a prerequisite for working adults' social inclusion and effective job performance (CEDEFOP, 2016). For this current study, the latest U.S. PIAAC data collected in 2017 is used. The respondents aged 25 to 65 years old who had recent work experience in the

12 months prior to the survey were selected, while those aged 16 to 24 years old were excluded to reflect the theoretical rationale and nature of adult education in which individuals aged 25 or over typically participate (Desjardins, 2015).

Noticeably, data pre-processing is an imperative step in data mining techniques after data exploration. Particularly in non-parametric data analytics, missing values present in datasets can cause a decrement in efficiency while the data is selected or extracted if it is not handled properly (García et al., 2016). From a machine learning standpoint, treating missing data is pivotal as it may lead to the misclassification of the classifier and thereby negatively affects the predictive performance of the model (Chakraborty et al., 2021). Hence, missing data were eliminated from the original dataset by dropping the empty column before the RFCs formulation. For developing RFCs models, training and testing sub-datasets were yielded from the cleaned dataset. Consequently, the total sample size for this study includes 1,283 respondents.

Variables

As noted earlier, the investigation of both individual-level and work-related contexts of factors addressed by the enormous volume of literature has contributed to deepening the understanding of what makes working adults become *lifelong learners*. In this section, the target variables of this study are specified based on the comprehensive review of key drivers of adult education participation of working adults (see Table 2 above) as well as two theoretical frameworks that holistically demonstrate how the individual and organizational aspects are interrelated and how the dynamics of these aspects influence adult education participation: the HRD LPT proposed by Wang and Wang (2004) and the CLLPM presented by Boeren et al. (2010).

Outcome Measure

Although it is widely known that employer-sponsored educational opportunities are the predominant form of job-related adult education, simultaneously, others argue that informal or incidental learning at the workplace often occupies a substantial proportion of work-related learning compared to formal training (Patterson & Paulson, 2016). In this vein, this study posits that the study findings will provide a better understanding of different patterns of learning participation depending on the types of adult education. Herein this study focuses on working adults' participation in formal AET, non-formal AET, and informal learning as major outcome measures based on the evidence that the majority of adult education programs are undertaken for fulfilling occupational needs (Desjardins, 2011).

In the PIAAC dataset, *formal AET* is recorded as a binary measure indicating whether the respondent has participated in job-related formal education and training (0 = did not participate, 1 = participated) in the past 12 months preceding the survey. Similar to formal AET, *non-formal AET* is a binary variable that refers to whether the respondent has participated in non-formal education for job-related reasons (0 = did not participate, 1 = participated) in the last 12 months prior to the PIAAC assessment.

The measurement of participation in *non-formal AET* consists of four survey items in the PIAAC dataset: (1) open or distance education, (2) on-the-job training, (3) seminars or workshops, and (4) private lessons. These four sub-items were combined to construct the targeted non-formal AET participation variable. In the original dataset, *informal learning* is an ordinal variable that refers to the degree of how often the respondent participates in informal learning activities for job-related reasons (1 = never to 5 = every day) in the last 12 months preceding the survey.

The sub-items measuring informal learning participation include (1) learning from co-workers/supervisors, (2) learning-by-doing, and (3) keeping up to date. Similar to the variable aggregation method used for non-formal AET, these three sub-items were also combined as one to represent a larger category of informal learning participation. Also, the informal learning variable was recoded and treated as a dummy variable to change the original response scale (i.e., ordinal) to a binary (0 = did not participate, 1 = participated). In detail, the "never" response was recoded into 0, and the remaining options scored between 2 and 5 points were collapsed into 1 (to be further explained in the next section). The objective of the procedure was basically to make every measurement scale of adult education participation variables identical, which is a pre-processing step to run both RFCs and LCA.

All three larger categories of adult education participation were treated as dependent variables in each RFCs model configuration. In two-step LCA modeling (to be explained in detail in the next section), however, sub-items for adult education participation variables were entered as indicators instead of aggregated ones: one formal AET, four non-formal AET, and three informal learning.

Independent Variables

Independent variables of this study include the respondent's individual-level and work-related contexts. The individual-level context reflects the respondent's demographic information (i.e., gender and age), human capital (i.e., education level, monthly income, health, and skills proficiency in literacy and PS-TRE), and learning-related socio-psychological states (i.e., learning attitudes, cultural engagement, and social trust). The work-related context of respondents contains variables representing their job-related conditions: employment status,

years of work experience, economic sector, organization size, managerial status, working time, job satisfaction, and two sets of skills use at work (i.e., literacy and ICT).

Individual-level Context

Demographic Information. In measuring the demographic information of respondents, *gender* is a dummy-coded variable (0 = female, 1 = male). *Age* was measured in 10-year intervals ranging from 25 to 65 years old (1 = 25-34 years old to 4 = 55-65 years old).

Human Capital. In the PIAAC survey, *education level* is measured by the highest level of formal education obtained by respondents, with six categories (1 = lower secondary or less to 6 = tertiary – master/research degree). This study recoded this variable into a binary in which 0 indicates "less than a bachelor's degree" and 1 indicates "a bachelor's degree or higher". *Monthly income* was measured by a derived variable of the monthly income percentile rank with six levels (1 = less than 10% to 6 = 90% or higher). The respondent's state of *health* was measured based on self-assessment using a 5-point rating scale where the lowest value of 1 indicates "poor", to the highest value of 5 indicates "excellent". *Skill proficiency in literacy* is a continuous variable with scores ranging from 0 to 500. It was measured by the assessment of survey participants' skills in reading, understanding, and applying different sorts of texts for specific purposes. To address measurement error of the PIAAC literacy evaluation (see Feinberg et al., 2019), this study used the average score of all ten plausible items (PVLIT 1–10), which were administered to respondents to collect information on literacy proficiency. Similar to literacy proficiency, *skill proficiency in PS-TRE* is a continuous variable indicating the score (ranges 0 to 500) of respondents' skills in using digital technology and tools to acquire information and complete relevant activities with certain goals. To account for measurement

error, the average score of ten plausible items (PVPSL 1–10) was used, which were generated to assess participants' performance on PS-TRE.

Learning-related Socio-psychological States. In the PIAAC assessment, *learning attitudes* are estimated with an index derived from a set of six items measuring the degree to which participants rate their learning motivation and strategies by a 5-point scale (1= not at all to 5 = to a very high extent): (1) relate new ideas into real life, (2) like learning new things, (3) attribute something new, (4) get to the bottom of difficult things, (5) figure out how different ideas fit together, and (6) looking for additional information. This study used the average value of these sub-items. As another independent variable representing the respondent's socio-psychological states, the PIAAC identifies *cultural engagement* as the extent to which how much the respondents participated in voluntary work for non-profit organizations such as a charity, political party, trade union or other non-profit institutes, with a 5-point scale (1= never to 5 = every day). This measurement of volunteerism is straightforward to the notion of cultural (or civic) engagement (Rose et al., 2019). The PIAAC survey measures *social trust* with two statements with a 5-point Likert scale (1 = strongly agree to 5 = strongly disagree): "There are only a few people you can trust completely" and "If you are not careful, other people will take advantage of you". It is worthwhile to know that in PIAAC studies, social trust has long been seen as a core aspect of the estimation of social cohesion and has often been used by researchers to examine a prime attribute of a democratic society (Rose et al., 2019). For the social trust variable, these two sub-items were averaged and used for statistical analysis.

Work-related Context

In general, *employment status* indicates whether respondents were employed full-time (i.e., working 35 hours or more per week) or part-time (i.e., working less than 35 hours per

week) and unemployed. As described, the target sample of this study is working adults who were currently in the labor force or had recent work experience in the 12 months prior to the PIAAC survey. Hence, unemployed adults were not considered for the analysis; accordingly, employment status was measured as a dummy-coded variable (0 = full-time, 1 = part-time) in this study. The *years of work experience* variable is a continuous variable ranging from 0 to 47 and was measured by respondents indicating how long they had been paid in the workforce during their lifetime. For the *economic sector* variable, working adults' job sector is separated into dummy categories (0 = private, 1 = public). In the original dataset, employees who are working in non-profit organizations were combined into the value of 1, indicating the public sector. *Organization size* was measured by an ordinal scale that indicates the amount of people working for the employer (1 = 1-10 people to 5 = more than 1,000 people). *Managerial status* was a binary measure indicating whether the respondent performs managerial/supervisory duties or not (0 = no, 1= yes). *Working time* represents respondents' work hours per week at their job or business and was measured by an ordinal scale (1 = 0-20 hours to 6 = more than 100 hours), with higher values indicating more working time.

In terms of the variables measuring respondents' perception of their working conditions, the PIAAC survey assesses *job satisfaction* with the statement, "All things considered, how satisfied are you with your current job?" by a 5-point Likert scale (1 = extremely dissatisfied to 5 = extremely satisfied). Two skills use at work (i.e., literacy and ICT) measure the degree to which the respondent utilizes different types of skills required to do their job with a 5-point Likert scale (1 = never to 5 = every day). The scale of each type of skill use at work varies according to the number of questionnaire items. *Literacy skill use at work* is comprised of twelve sub-items. Eight items measure reading literacy: (1) read directions or instructions, (2) read

letters, memos or mails, (3) read newspapers or magazines, (4) read professional journals or publications, (5) read books, (6) read manuals or reference materials, (7) read financial statements, and (8) read diagrams, maps or schematics. Whereas four items measure writing literacy including (1) write letters, memos or mails, (2) write articles, (3) write reports, and (4) fill in forms. *ICT skill use at work* is composed of seven sub-items. Three sub-items measure the extent to which how often the respondents usually use the internet (1) for emails, (2) for work-related information, and (3) to conduct transactions. The other four items are related to computer use at the workplace, including (1) spreadsheet, (2) Word, (3) programming language, and (4) real-time discussions.

Analytic Strategy

Random Forest Classifiers

Scholars in education research have sought to understand various factors affecting individuals' formal, non-formal, and informal learning experiences. This body of scholarship has primarily utilized traditional statistical analysis. For instance, many studies use OLS regression or any other linear estimation method to calculate the effect size of numerous explanatory variables in shaping dependent variables and provide information regarding the statistical significance of those factors. While these studies have significantly contributed to the understanding of this matter, one of the limitations is that classical statistical approaches are heavily based on several strong parametric assumptions, such as linearity and non-multicollinearity. For instance, when researchers include interrelated independent variables, the statistical significance of inter-related variables is affected. Given the limitation of traditional statistical approaches, this study utilizes an alternative analysis technique – RFCs, which is a non-parametric and data-driven modeling strategy.

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The RFCs technique is a popular machine learning method that social scientists have recently applied to calculate the relative importance of explanatory variables (e.g., Choi et al., 2020; Kim & Park, 2022) and is also known as a robust supervised classification algorithm that is composed of a collection of tree-structured classifiers. The RFCs method is one of the ensemble machine learning algorithms that utilize multiple decision trees. These decision trees are collected to construct forests that provide information on what factors most efficiently predict and explain the dependent variables without strong parametric assumptions. The RFCs method is widely acknowledged for achieving a higher classification accuracy (Lin et al., 2019). RFCs are yielded by drawing a subset of training samples through replacement (i.e., a bagging approach), and the classification results are decided by the votes of all trees (Breiman, 2001; Schapire et al., 1998). To fully understand RFCs, therefore, it is necessary to look closely at how decision trees work.

Figure 4 displays an example of one of the decision trees yielded from the dataset. Decision trees are built by randomly selected samples – the entire population is divided into *training* and *testing* datasets with a ratio of 7:3. The training dataset is used for predictor discovery through supervised classification and to generate a plausible model. The testing dataset tests the model performance generated in the training sample. To build a decision tree classification model, Classification and Regression Trees (CART) analysis was employed through the "rpart" package in R software which is based on the Gini impurity index (Ripley, 2023; Therneau & Atkinson, 2022). The CART analysis searches and partitions the variable and then assigns a predicted class to each sub-group (e.g., non-participated, participated). With repetition of the same process on each predictor in the dataset, the CART identifies the optimal overall split by iteratively testing all possible splits and producing the greatest reduction in Gini

impurity. The CART model recursively splits these subsets until a specified number of nodes are created, or a further reduction in node impurity becomes impossible (Loh, 2011).

For this decision tree example, from the total sample of 1,283 working adults regarding formal AET participation, 886 were assigned to the training dataset, and 397 were assigned to the testing dataset, respectively. Two sub-groups were identified: a group of working adults who participated in formal AET and a group of working adults who did not participate. As illustrated in Figure 4, the first variable selected to split the data was *years of work experience*, as this variable is associated with the lowest Gini impurity. In this decision tree, 14 terminal nodes were identified, representing the number of working adults who participated in formal AET or not. Moreover, in the far-right node, among 11 working adults who satisfied the data splitting rule (i.e., years of work experience < 8, literacy skill use at work < 3.75, employment status ≠ 0, and age < 2), 10 working adults were predicted to participate in formal AET.

Figure 4

A Part of Decision Tree of Formal Adult Education and Training Participation

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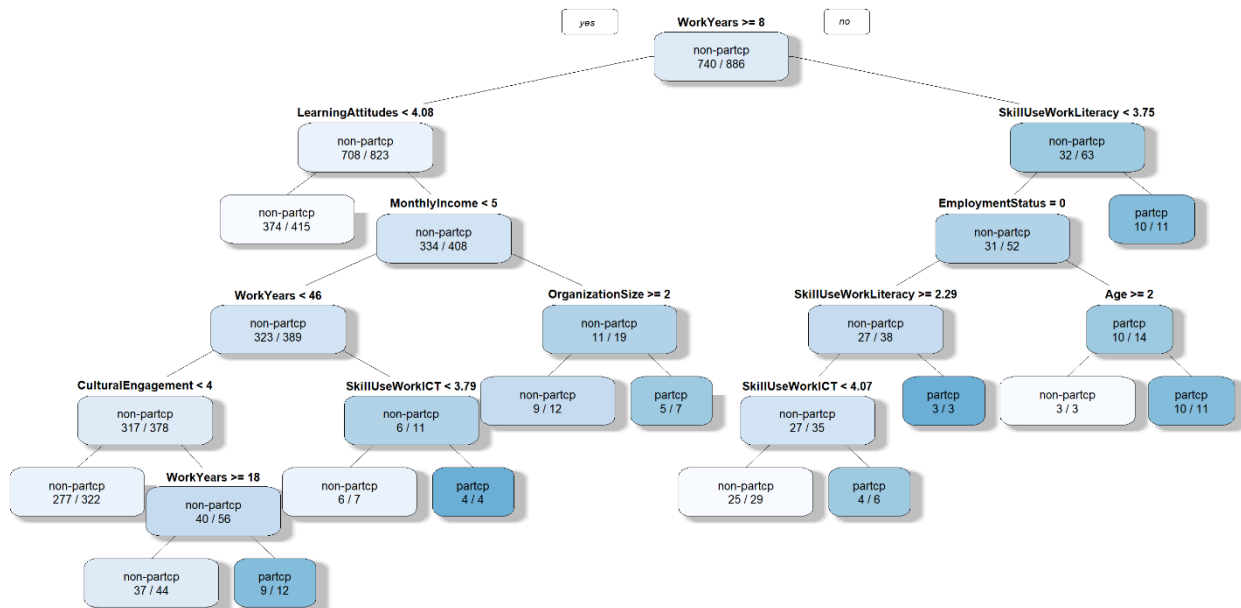
In RFCs, each decision tree is trained using a subset of data (i.e., testing dataset) that is randomly sampled from the original training dataset. This strategy is applied to improve the robustness against overfitting (Zhong et al., 2015). To reduce the redundancy of independent variables while increasing the robustness of the trees in a forest, only a subset of randomly selected variables is considered to form the split nodes of each tree (Liaw & Wiener, 2002; Xu et al., 2019). Then, the final results of RFCs are decided by aggregating predictions of each individual tree (Lin et al., 2019). The RFCs technique uses two hyperparameter values to improve model performance: n_{tree} and m_{try}. n_{tree} is simply the number of trees in a forest, and a larger n_{tree} can increase the stability of the RFCs model while decreasing the degree of overfitting (Liaw & Wiener, 2002). As another hyperparameter, m_{try} is the number of variables available for splitting at each tree node, which determines the diversity among decision trees.

Next, two computational strategies are broadly employed as the optimization criterion to validate the model performance when tuning hyperparameters: k-fold cross-validation and out-of-bag (OOB) errors (Kohavi, 1995). The first one is k-fold cross-validation, in which multiple rounds of validation are performed using different partitions of a dataset, and the final result is averaged over the k-rounds to evaluate the model performance (Xu et al., 2019). The RFCs technique also gives an unbiased estimate based on OOB data, which is not drawn by bootstrapping for growing an individual decision tree at the training phase. In consequence, OOB error provides information in relation to the mean prediction error of each subset for training (Lin et al., 2019). Liaw and Wiener (2002) suggest that combining these two strategies can reduce the overfitting risk. According to Liaw and Wiener (2002) and Xu et al. (2019), there are four steps of the RFCs model configuration described as follows (see also Figure 5):

- Bootstrapping sampling: Produce n_{tree} subset samples from the original training dataset, where n_{tree} is the number of trees to grow.

- Model training using the random variable subset: Grow decision trees on each bootstrap sample, during which, randomly draw a subset containing m_{try} independent variables at each splitting node and determine the optimal split based on this subset of variables only.

- Model prediction: Obtain classification predictions over n_{tree} decision trees. For each individual tree, the prediction is the mean of the dependent variable values at the corresponding leaf nodes.

- Result aggregating: Compute the final prediction by averaging n_{tree} predictions in the forest.

Figure 5

A Schematic of the Random Forest Classifiers Algorithm based on Bagging Method
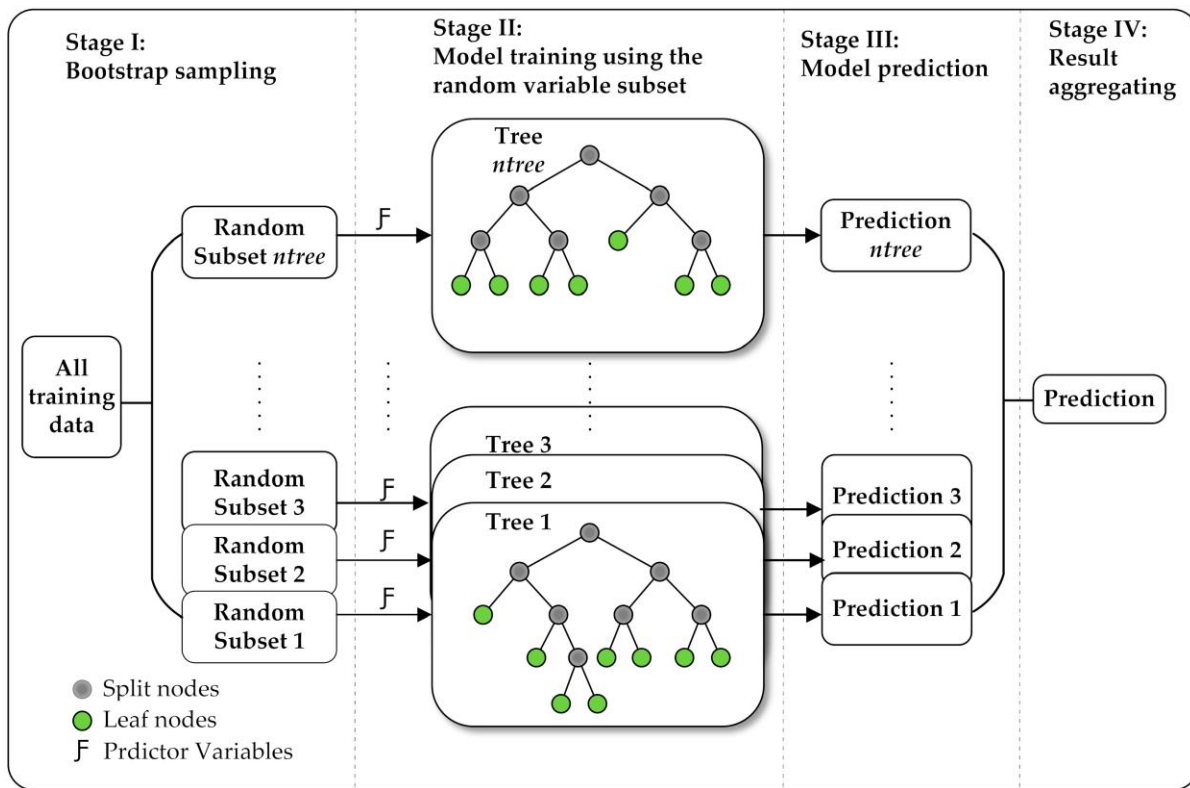
Source: Xu et al. (2019)

In these steps of RFCs model configuration, it is important to know how variable importance is calculated. Decision trees randomly select samples from the entire dataset and split them into several subsets via a tree-based algorithm to understand relatively important factors in shaping individual predictions on the dependent variable. Each split utilizes simple rules – if an explanatory variable is measured as a binary variable (e.g., 0 = no, 1 = yes), it is straightforward that the tree simply splits the data based on these two values. Every time the tree splits the data based on an independent variable, it calculates how much variance in the dependent variable is reduced, denoted as variance reduction, and it is logged for each independent variable. After the initial dataset was divided into two subsets, the decision tree continued to split these subsets based on the independent variables associated with the highest variance reduction. The decision tree kept splitting the data according to the same rule until the variances of the subsets became zero. At the end of this process (when the tree completes the splits), the average variance reduction of the dependent variable is calculated for each independent variable. When an independent variable is associated with a larger variance reduction than others, it concludes that this particular independent variable is more important than others in predicting the dependent variable.

Consequently, machine learning computation for RFCs model configuration contributes to producing a measure of the importance of the independent variable on the predictive model (Breiman, 2001, 2017; Liaw & Wiener, 2002). Arguably, the most practical advantage of utilizing the RFCs algorithm is that it can provide relative importance evaluation among variables, which allows for determining informative salience indicators on a dependent variable (Lin et al., 2019; Strobl et al., 2008).

Conducting Random Forest Classifiers

In this study, a prediction model on adult education participation of working adults' was constructed based on the RFCs algorithm as follows. First, requested k samples from the input dataset using bootstrap sampling (random sampling with replacement) to produce the training dataset with k trees. As mentioned earlier, RFCs employ multiple decision trees for each forest. In this study, each forest includes 500 decision trees and calculates the mode rankings of each independent variable. Then, approximately 1/3 of the samples were selected (OOB data) and were used as the testing dataset to evaluate model performance. Second, m variables were randomly selected in each node and generated the best split based on the lowest OOB errors. Due to the socioeconomic nature of the dataset (Choi et al., 2020), this study also implements a *4*-fold cross-validation strategy before concluding on the variable importance. This means, 4 forests were created that include a total of 2,000 decision trees using random sampling with replacement. This strategy helps to improve the model accuracy. Next, the classification results were obtained based on the voting result of all trees, and the relative variable importance was ranked by the *mean decrease accuracy* (MDA). The MDA indicates the increase in OOB errors when random noise is added to one variable (Lin et al., 2019). For this measure, a higher value suggests greater importance of the predictor on the dependent variable. It should be noted that the RFCs method is not a parameterized model, therefore, does not provide the estimated coefficients or their statistical significance, unlike traditional parametric regression models (Strobl et al., 2008). As such, a careful interpretation is needed as the utilization of RFCs provides information on the relative importance of each independent variable but not on the directionality of these variables.

In order to address the aforementioned purpose of the study and related research questions (RQs 1–3), each RFCs model was built using the "randomForest" package (Liaw & Wiener, 2015), which is deployed to estimate a tree-based classification model in R software version 4.1.1 (R Core Team, 2021). To compare the model performance (i.e., classification accuracy) of the RFCs algorithm over the traditional OLS regression method, binary logistic regression (BLR) analysis was also conducted using IBM SPSS version 28. BLR analysis presents disparate results compared to RFCs, based on the estimation of coefficients of independent variables to dependent variables.

Latent Class Analysis

LCA is an emerging mixed modeling technique employed primarily to identify sub-groups within populations in which the same groups of individuals share similar attributes and characteristics (Hagenaars & McCutcheon, 2002; Lim et al., 2020). Sub-groups are referred to as class membership or latent groups, which means respondents who have similar patterns of responses or behaviors on the observed variables are classified into the same class; in this statistical procedure, group classification is determined by their class membership probabilities (Kim et al., 2019; Muthén & Muthén, 2000). Therefore, the assumption underlying LCA is that latent (or unobserved) heterogeneity in samples determines class membership, and it can explain discrete patterns of scores across survey questions and assessment indicators among sub-groups within populations (Muthén & Muthén, 2000; Wolke et al., 2013). As LCA continues to evolve and advance, scholars have debated how to address several key issues: (1) selecting indicator variables, (2) determining the final class model, and (3) deciding how to include covariates in the model and which additional statistics to be used (Weller et al., 2020).

First, LCA uses respondents' responses to cross-sectional categorical indicator variables to capture the hypothesized unobserved classes (Weller et al., 2020). This implies that the response scale of the indicators must be confirmed whether it is adequately coded or categorized for performing LCA. For example, if adult education participation is of main interest in sub-group classification, multiple response categories measuring the degree to which respondents participated in educational activities by continuous or ordinal scale can be collapsed into two options (e.g., 0 = did not participate, 1 = participated). Integrating multiple response options into a smaller set of categories makes it easier to interpret the class solution (Weller et al., 2020). In the PIAAC dataset, the original sub-items for the informal learning variable were ordinal measures (i.e., 1 = never to 5 = every day). Based on the practical groundings from previous studies in conducting LCA, for this current study, informal learning participation of working adults was treated as a dummy variable: the "never" response was categorized as "did not participate," and the rest were collapsed into "participated." This coding strategy was to align the response scale (i.e., ordinal) of the informal learning variable with that of other adult education participation (i.e., formal AET, non-formal AET), measured as dummy variables.

Second, the primary focus of LCA is the estimation of probabilities of class membership in which an individual falls into a certain latent class (Lim et al., 2020). In LCA, fit statistics are used to determine the probability of class membership and optimal numbers of latent classes. Although there is no consensus regarding the best criteria for identifying final latent class solutions, the most common and frequently reported fit indexes are (1) the Bayesian Information Criteria (BIC), (2) the Akaike Information Criteria (AIC), (3) the consistent Akaike Information Criteria (CAIC), (4) the Bootstrapped Log-likelihood Ratio Test (BLRT), and (5) Entropy. These

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fit statistics serve as the decision criteria for confirming the goodness of fit of the latent class models.

The BIC rewards parsimony in the LCA technique (thus, tends to favor models with fewer groups) and can be used to compare competing for latent class solutions (Killian et al., 2019). Lower ICs in BIC and other criteria, such as AIC and CAIC, indicate better model fit. The BLRT provides a *p*-value, indicating whether one model is statistically better than others in terms of classification error (Kim et al., 2019; Nylund et al., 2007). It is recommended to consider BIC and other ICs first in general, prior to looking at BLRT's *p*-value (Nylund et al., 2007). According to Wang et al. (2017), entropy is another diagnostic statistic indicating how accurately the model defines latent classes, ranging from 0 to 1. There is no agreed-upon cutoff criterion, however, entropy values close to 1 are considered to be ideal, and those above .8 are acceptable (Celeux & Soromenho, 1996). In determining the final class model, the number of sample members in each class is also considered (Weller et al., 2020). In general, class sizes with fewer than 50 cases (Muthén & Muthén, 2000) or classes containing less than 5% of the population (Shanahan et al., 2013) are not to be encouraged in general.

Finally, the observed class membership probability can be connected to other external variables, such as covariates. The inclusion of covariates in latent class models allows researchers to address such questions as, "Does the composition of sub-groups vary according to demographic characteristics?" In doing so, many recent studies employ a two- or three-step approach (Asparouhov & Muthén, 2014; Muthén & Muthén, 2000; Vermunt, 2010). These approaches require researchers to identify the best measurement model with class memberships (i.e., the final class model using goodness of fit indexes) and then add covariates only (i.e., two-step approach) or add distal outcomes subsequently after adding covariates (i.e., three-step

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approach). Both of these strategies aim at investigating the relationships between the observed class membership and variables of interest (Nylund et al., 2007). Typically, incorporating the external variables simultaneously in the process of identifying the latent class model can result in the model being influenced by the covariates, which causes changes in the class definitions (Kim et al., 2019; Vermunt, 2010). Applying two- or three-step approaches are encouraged to cope with this concern. In model construction and subsequent estimation using these approaches, firstly, the latent class model that best fits the given dataset is identified. After that, an investigation of relating class membership to covariates (and distal outcomes) is performed in consideration of the sub-group classification probabilities and errors (Bakk & Vermunt, 2016).

Conducting Latent Class Analysis

Based on the related research questions (RQs 4 and 5) that are related to identifying discrete patterns of adult education participation according to individual-level and work-related contexts of factors, this study followed a two-step approach proposed by Vermunt (2010). The first step is to conduct LCA with the indicators (i.e., formal AET, non-formal AET, informal learning) only. This is to identify latent classes within populations and to keep the class specification from the influence of covariates (Lim et al., 2020). Here, optimal numbers of classes are determined using fit statistics: BIC, AIC, CAIC, BLRT, and entropy. Second, in the model of latent classes in which every respondent is assigned to each class based on membership probability, covariates (i.e., individual-level and work-related contexts of factors) are incorporated into the model. Multinomial logistic regression (MLR) analysis was performed using IBM SPSS version 28 to examine which factors influence the probability of class memberships in each latent class. This allows for examining discrete adult education

participation patterns depending on classes that share similar profiles of individual-level and work-related contexts of characteristics.

In relation to the purpose and research questions of this study aforementioned, LCA was carried out using the "snowLatent" module developed by Seol (2022), in jamovi software version 2.3.21 (The jamovi project, 2022). Also, the "ggplot2" package (Wickham, 2016) in the R environment was used in plotting the LCA results (i.e., profile plots). The structural model for this study is shown in Figure 6.

Figure 6

Graphical Representation of the Latent Class Model with Covariates
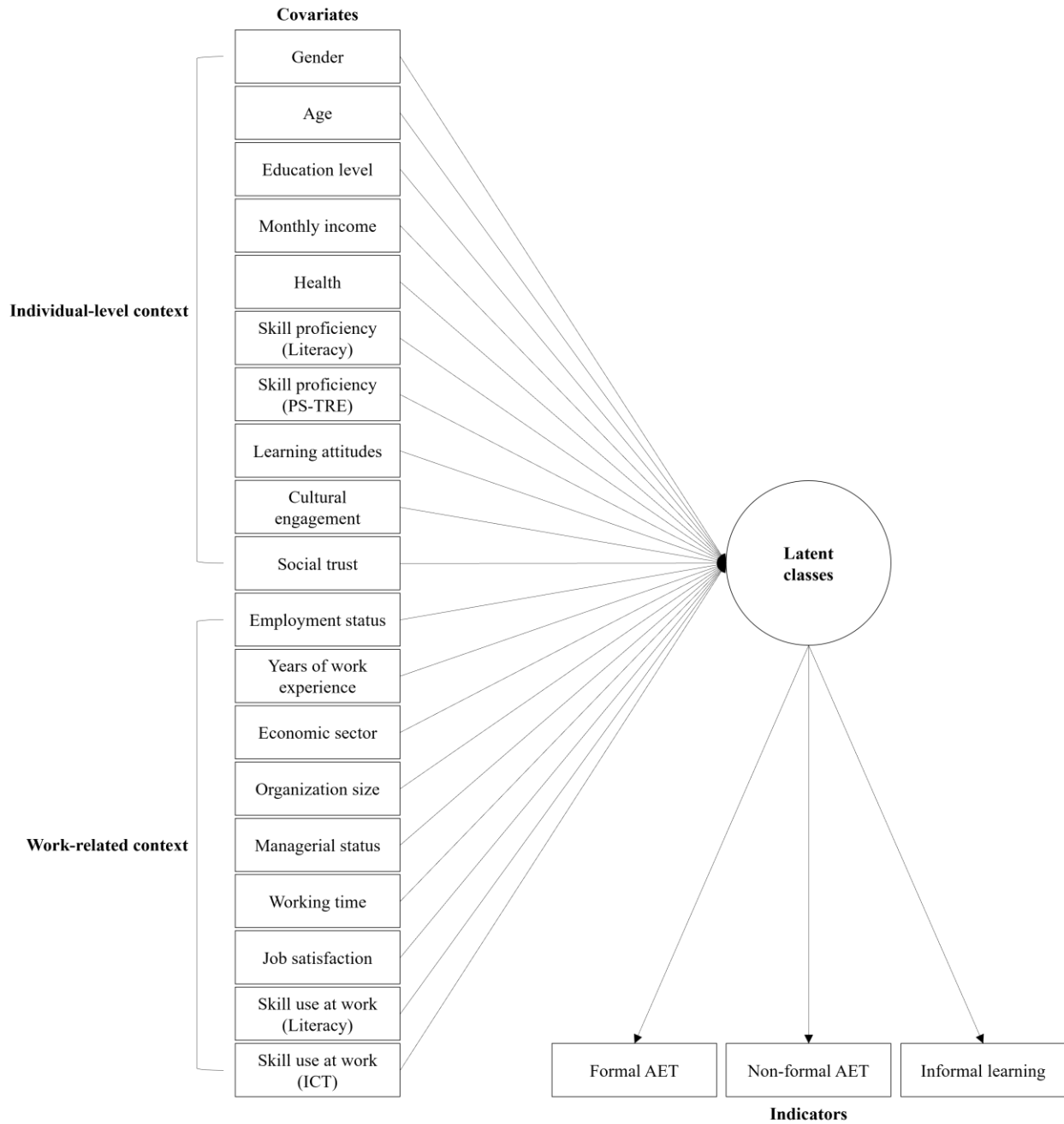
Note. AET = adult education and training, PS-TRE = problem-solving in technology-rich environments, ICT = information and communications technology.

CHAPTER FOUR

Results

This study was guided by the following primary questions: *what* drives working adults to become lifelong learners, and *how* do they participate differently in adult education? This chapter presents results obtained from the two main analytic techniques (i.e., RFCs and LCA). First, BLR analysis was conducted to estimate coefficients of factors and explanatory powers of regression models across each type of adult education participation. BLR analysis was used as a preliminary analysis prior to embarking on the RFCs model configuration. Next, the RFCs technique was deployed. Along with model performances (i.e., classification accuracy) calculated by the RFCs method, importance rankings of factors for formal AET, non-formal AET, and informal learning were investigated respectively and compared to each other. Model performances and divergent results between BLR and RFCs models were also compared. Finally, LCA results illustrate the underlying patterns of adult education participation among working adults by segmenting them into latent classes that share similar profiles. It also demonstrates how individual-level and work-related characteristics are associated with such patterns.

Descriptive Statistics

In order to reveal the overall response characteristics of the study sample, descriptive analysis was performed using IBM SPSS version 28. Table 3 presents descriptive statistics of independent and dependent variables of this study, including the number of cases, percentages, mean values, and standard deviations, in addition to some statistical comparisons across demographic and categorical segments of the sample. All survey items were screened to check normal distribution and to identify any outliers that might be present. Skewness and kurtosis statistics confirmed that the normality assumption is met. No outliers were detected, according to

the data pre-processing procedure that was performed to exclude potentially troublesome data

such as missing and imbalanced observations.

Table 3

Descriptive Statistics of Selected Variables

Variable	Range/Category	*n*	*%*	*M*	*SD*
Continuous variables					
Skill proficiency (Literacy)	0–500	1,283	100.00	287.87	42.31
Skill proficiency (PS-TRE)	0–500	1,283	100.00	283.18	40.87
Years of work experience	1–50	1,283	100.00	23.40	11.76
Ordinal variables					
Age	25 to 34 years old	368	28.68	2.36	1.11
	35 to 44 years old	357	27.83		
	45 to 54 years old	282	21.98		
	55 to 65 years old	276	21.51		
Monthly income	Less than 10%	12	.94	2.56	1.20
	10% to less than 25%	68	5.30		
	25% to less than 50%	195	15.20		
	50% to less than 75%	371	28.92		
	75% to less than 90%	348	27.12		
	90% or higher	289	22.52		
Health	5-point scale	1,283	100.00	3.67	.92
Learning attitudes	5-point scale	1,283	100.00	4.07	.60

Variable	Range/Category	*n*	*%*	*M*	*SD*
Cultural engagement	5-point scale	1,283	100.00	2.07	1.08
Social trust	5-point scale	1,283	100.00	2.34	.97
Organization size	1 to 10 people	191	14.89	2.92	1.29
	11 to 50 people	338	26.34		
	51 to 250 people	344	26.81		
	251 to 1,000 people	206	16.06		
	More than 1,000 people	204	15.90		
Working time	0 to 20 hours	84	6.55	2.39	.65
	21 to 40 hours	649	50.58		
	41 to 60 hours	519	40.45		
	61 to 80 hours	29	2.26		
	81 to 100 hours	1	.08		
	More than 100 hours	1	.08		
Job satisfaction	5-point scale	1,283	100.00	4.03	.85
Skill use at work (Literacy)	5-point scale	1,283	100.00	3.14	.72
Skill use at work (ICT)	5-point scale	1,283	100.00	3.04	.95
Categorical variables					
Gender	Female	682	53.16	.47	.50
	Male	601	46.84		
Education level	Less than a bachelor's degree	474	36.94	.63	.48
	A bachelor's degree or higher	809	63.06		

Variable	Range/Category	n	$\%$	M	SD
Employment status	Full-time	1,086	84.65	.15	.36
	Part-time	197	15.35		
Economic sector	Private	824	64.22	.36	.48
	Public	459	35.78		
Managerial status	Non-managerial	788	61.42	.39	.49
	Managerial	495	38.58		
Formal AET	Did not participate	1,074	83.71	.16	.37
	Participated	209	16.29		
Non-formal AET	Did not participate	308	24.01	.76	.43
	Participated	975	75.99		
Informal learning	Did not participate	213	4.52	.83	.37
	Participated	1,065	95.48		

Note. $N = 1,283$; AET = adult education and training, PS-TRE = problem-solving in technology-rich environments, ICT = information and communications technology.

Determinants of Adult Education Participation using Binary Logistic Regression

BLR is one of the most commonly used multivariate analysis methods, where the dependent variable is a binary response that indicates whether an event occurs. In order to validate the advantage of the tree-based classification algorithm over traditional OLS regression-based approaches, there is a need to evaluate the results by comparing them. Hence, this study introduced BLR analysis as a preliminary step to compare the results with RFCs models. First, classification accuracy was assessed using a confusion matrix. Next, estimated coefficients and odds ratios of independent variables on adult education participation are presented along with the explanatory powers (pseudo-R^2 values) of BLR models.

Model Performance: Classification Accuracy Assessment

BLR models were validated by overall accuracy in the confusion matrix that predicts the occurrence of non-participation or participation in adult education. The overall accuracy index is used to evaluate the classification performance. The advantage of using the overall accuracy measure is that it produces easily interpretable results – a proportion of the correctly classified sample units to the total number of sample units. The confusion matrix (see Table 4) exhibits overall classification accuracy scores across BLR models: 84.33% for formal AET, 76.85% for non-formal AET, and 83.57% for informal learning, respectively, indicating the ratio of correctly classified individuals in adult education participation. The highest accuracy in formal AET represents a better classification performance than others. The scores are regarded as a benchmark against which to evaluate the accuracy of the RFCs method.

Table 4

Classification Accuracy of Binary Logistic Regression Models of Adult Education Participation

		Observed	Predicted	Correct prediction (%)
Formal AET	Did not participate	1,065	9	99.16
	Participated	192	17	8.13
	Overall accuracy (%)			84.33
Non-formal AET	Did not participate	72	236	23.38
	Participated	61	914	93.74
	Overall accuracy (%)			76.85
Informal learning	Did not participate	13	200	6.10
	Participated	10	1,055	99.06
	Overall accuracy (%)			83.57

Note. $N = 1,283$; AET = adult education and training.

Estimated Coefficients of Factors and the Explanatory Power of Models

Table 4 presents the estimated regression coefficients and odds ratios of independent variables of three BLR models, respectively. Concerning formal AET participation, for one unit increase in the health category, the odds increased by 19.8%. Regarding skills proficiency, the results show conflicting findings: the odds decreased by 1.4 % for literacy, whereas it increased by 1.2% for PS-TRE. The odds increased by 44.4% for working adults with higher levels of learning attitudes. Compared to working adults with part-time jobs and working in the private sector, those with full-time jobs and employed in the public sector were 2.49 and 1.37 times more likely to participate in formal AET, respectively. Working adults with managerial positions were less likely to participate in formal AET by 31.6%. For one unit increase in the working time category, the odds decreased by 24.2%. The odds increased by 46.7% for working adults who frequently use literacy skills at work.

When looking at non-formal AET participation, no individual-level factors were statistically significant; but effects of several work-related factors were discovered. Compared to working adults in the private sector, those are employed in the public sector were 1.93 times more likely to participate in non-formal AET. The odds increased by 24.3% for working adults who belong to large organizations. The odds increased by 95.7% for literacy skill use at work.

For informal learning participation, the odds increased by 36.1% and 77.5%, respectively, when one unit increased in the monthly income and learning attitudes categories. The odds decreased by 57.7% for working adults with full-time jobs. For one unit increase in the years of work experience category, the odds decreased by 5.5%. The higher the job satisfaction and the more frequent the use of literacy skills at work, the more likely working adults participate in informal learning by 1.60 and 2.71 times, respectively.

The results imply that working adults' participation in adult education may be differentiated by the types of adult education and their associated factors. Simply put, working adults who are healthier, have lower levels of literacy skills but upper levels of problem-solving skills, have higher levels of learning intention, have part-time jobs, have public sector jobs, have non-managerial positions, and utilize literacy skills at work frequently are more likely to participate in formal AET. Additionally, public sector employment, larger organizations, and frequent utilization of literacy skills at work were the main aspects of what drive working adults to participate in non-formal AET. Lastly, working adults who participate in informal learning can be characterized as those who earn more, have higher levels of learning attitudes, with full-time jobs, have fewer years of work experience, are satisfied with their job, and use literacy skills more frequently at work.

BLR analysis proposes the goodness of fit (i.e., pseudo-R^2 tests), which is akin to the coefficient of determination R^2 calculated in OLS regression models (Bewick et al., 2005). Pseudo-R^2 values ranged from 0 to 1, and higher values indicate a better fit. For formal AET, the Cox & Snell pseudo-R^2 was .097 and the Nagelkerke pseudo-R^2 was .165, respectively. For non-formal AET, the Cox & Snell pseudo-R^2 was .144 and the Nagelkerke pseudo-R^2 was .216, respectively. For informal learning, the Cox & Snell pseudo-R^2 was .062 and the Nagelkerke pseudo-R^2 was .202, respectively. Typically, pseudo-R^2 values greater than .2 indicate a relatively good fit (Bewick et al., 2005; Kruskal, 1964). According to this decision criteria, it can be concluded that the explanatory powers of BLR models were low, which may be due to the high variation within the dataset. More importantly, it should be noted that when a parametric regression model contains too many predictors with a small sample size and relies solely on R^2

values, it may lead to overfitting (Sheather, 2009). The possible issues in the data and existing method, thus, suggest the need for non-parametric statistical diagnosis.

Table 5

Binary Logistic Regression Analysis Results Across Types of Adult Education Participation

Item	Formal AET		Non-formal AET		Informal learning	
	B	*OR*	*B*	*OR*	*B*	*OR*
Individual-level context						
Gender (Ref. = female)	-.127	.881	-.240	.787	.014	1.014
Age	-.180	.835	-.003	.997	.202	1.224
Education level (Ref. = less than a bachelor's)	.278	1.320	.165	1.180	.509	1.664
Monthly income	.115	1.122	.070	.932	.308[*]	1.361
Health	.181[*]	1.198	.096	1.101	.073	1.075
Skill proficiency (Literacy)	-.014[***]	.986	.002	1.002	-.005	.995
Skill proficiency (PS-TRE)	.012[**]	1.012	.005	1.005	-.002	.998
Learning attitudes	.368[*]	1.444	.153	1.165	.574[*]	1.775
Cultural engagement	.128	1.136	.095	1.100	-.066	.936
Social trust	-.083	.920	.046	1.047	.114	1.121
Work-related context						
Employment status (Ref. = full-time)	.913[***]	2.493	-.136	.873	-.860[*]	.423
Years of work experience	-.015	.985	.004	1.004	-.057[*]	.945

Item	Formal AET		Non-formal AET		Informal learning	
	B	*OR*	*B*	*OR*	*B*	*OR*
Economic sector (Ref. = private)	.317[*]	1.373	.658[***]	1.930	.298	1.347
Organization size	.103	1.109	.218[***]	1.243	.067	1.070
Managerial status (Ref. = non-managerial)	-.380[*]	.684	-.205	.815	.176	1.192
Working time	-.277[*]	.758	.170	1.186	.193	1.213
Job satisfaction	-.084	.920	-.028	.973	.471[**]	1.602
Skill use at work (Literacy)	.383[*]	1.467	.671[***]	1.957	.997[***]	2.711
Skill use at work (ICT)	.092	1.097	.007	1.007	-.040	.961
Constant	-4.051[***]	.017	-4.928[***]	.007	-2.869	.057
-2 Log likelihood	1009.252		1214.443		390.261	
χ^2 (*df*)	131.198 (19)[***]		199.813 (19)[***]		82.272 (19)[***]	
Cox & Snell R^2	.097		.144		.062	
Nagelkerke R^2	.165		.216		.202	

Note. N = 1,283; OR = odds ratio, AET = adult education and training, PS-TRE = problem-solving in technology-rich environments, ICT = information and communications technology.
[***]$p < .001$, [**]$p < .01$, [*]$p < .05$

Determinants of Adult Education Participation using Random Forest Classifiers

In this study, the major purpose of implementing the RFCs algorithm is to identify the most important feature for predictive model optimization of adult education participation (RQs 1–3). Based on the proposed theoretical framework and propositions derived from the literature, target variables were selected and put into RFCs models to calculate the score of the accuracy of their contribution to the RFCs classification. OOB error estimates were used to assess the model

performances. Again, OOB error estimates are almost identical to those from cross-validation and are known to present the most accurate classifications as the estimation based on the testing dataset when configuring RFCs models (Breiman, 2001). Then, variable importance was evaluated using the MDA measure, indicating higher MDA values have a stronger association with the prediction of the model. Variable importance scores were compared in and across models, as each RFCs model shows different features in predictions.

Model Performance: Classification Accuracy Assessment

The confusion matrix for RFCs classifications was yielded based on the testing dataset, then the OOB error estimates and accuracy scores of three RFCs models were calculated (see Table 6). The classification error (i.e., OOB error) allows appreciating the classification accuracy (computed as 100 – OOB error rate), which represents RFCs model performance. In terms of RFCs model optimization, the classification performance is assessed by a classifier performance scale suggested by Shukla et al. (2018): scores of over .90 indicate 'excellent,' .80 to .90 imply 'good,' .70 to .80 represent 'fair,' and less than .70 show 'poor' performances. As indicated in Table 6, every accuracy score of RFCs models predicting adult education participation was above 70%, thus confirming satisfactory performances according to the classification assessment criteria. Overall, the results of the classification accuracy assessment obtained through the RFCs method are very positive, taking into account a large number of variables entered into the model and the complexity of the dataset.

More specifically, the accuracy scores of the RFCs prediction on participating in formal AET was 84.31% (an OOB error rate of 15.69%), non-formal AET was 75.51% (an OOB error rate of 24.49%), and informal learning was 95.68% (an OOB error rate of 4.32%), respectively. The classification accuracy score of the RFCs model on informal learning participation was the

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highest: approximately 10% higher than formal AET and 20% higher than non-formal AET,

respectively. This means that classification for informal learning participation has a stronger

generalization capacity in the training process, whereas the others tend to relatively overfit their

model to the training dataset. To be brief, the comparative results show that the RFCs model

pertaining to informal learning participation stood out with the highest classification accuracy,

indicating its relative effectiveness in handling interference the most when configuring the

predictive model.

Table 6

Classification Accuracy of Random Forest Classifiers Models of Adult Education Participation

	Formal AET	Non-formal AET	Informal learning
OOB error rate (%)	15.69	24.49	4.32
Accuracy score (%)	84.31	75.51	95.68

Note. AET = adult education and training, OOB = out-of-bag; Accuracy score was calculated by 100% minus OOB error rate.

Variable Importance Assessment using Mean Decrease Accuracy Measure

In RFCs algorithms, the optimal decision is made by aggregating predictions of the

ensemble of decision trees through the majority voting rule. The primary purpose of variable

importance assessment in the RFCs method is to rank the independent variables according to

their contribution to predictive accuracy. One of the most widely used measures for assessing the

variable importance of a given variable set is the MDA estimate, which is obtained from the

OOB error rate. The MDA is calculated by the average of the decrease in accuracy computed for

all aggregated trees on original and permuted OOB samples. To be specific, MDA is estimated

by the degree to which the accuracy decreases after a variable is randomly permuted or excluded

from the model. If the misclassification increased (i.e., accuracy decreased) after the

permutation, it could be interpreted that the variable has significant importance for the prediction (Strobl et al., 2007). Therefore, the higher the MDA score, the less misclassification and thus the more important the variable, ultimately indicating that the variable contributes to the accuracy of the RFCs model.

The MDA scores of each variable across types of adult education participation are presented in Table 7. For the interpretation of the results, MDA values over 10 are regarded as 'highly important,' those between 5 to 10 are as 'moderately important,' and those under 5 are as 'less important.' In the following, the relative importance of factors for participation in formal AET, non-formal AET, and informal learning and their interpretations are described, respectively. The subsequent figures (i.e., Figures 7–9) depict graphical representations of Table 7 in which variable importance rankings for each type of adult education participation are shown and sorted according to MDA scores. Next, based on combined results from those observations with respect to RFCs models, a comparative discussion on adult education participation is suggested.

Table 7

Mean Decrease Accuracy Score of Variables Across Types of Adult Education Participation

	Formal AET	Non-formal AET	Informal learning
Individual-level context			
Gender	1.486[c]	.172[c]	.126[c]
Age	8.426[b]	3.926[c]	6.340[b]
Education level	5.951[b]	7.245[b]	1.725[c]
Monthly income	5.496[b]	7.480[b]	5.358[b]
Health	1.941[c]	.594[c]	1.756[c]
Skill proficiency (Literacy)	12.584[a]	5.713[b]	15.110[a]

	Formal AET	Non-formal AET	Informal learning
Skill proficiency (PS-TRE)	9.251[b]	6.721[b]	15.493[a]
Learning attitudes	1.465[c]	6.956[b]	1.036[c]
Cultural engagement	2.623[c]	7.427[b]	2.538[c]
Social trust	5.408[b]	2.171[c]	4.481[c]
Work-related context			
Employment status	7.481[b]	.896[c]	1.494[c]
Years of work experience	15.977[a]	7.301[b]	8.151[b]
Economic sector	2.228[c]	2.382[c]	1.307[c]
Organization size	1.451[c]	7.793[b]	.171[c]
Managerial status	2.422[c]	.052[c]	1.133[c]
Working time	1.400[c]	4.922[c]	1.859[c]
Job satisfaction	2.144[c]	.382[c]	1.876[c]
Skill use at work (Literacy)	5.156[b]	19.867[a]	10.784[a]
Skill use at work (ICT)	4.622[c]	10.111[a]	12.286[a]

Note. AET = adult education and training, PS-TRE = problem-solving in technology-rich environments, ICT = information and communications technology.
[a] 'Highly important' variables with MDA scores over 10.
[b] 'Moderately important' variables with MDA scores between 5 and 10.
[c] 'Less important' variables with MDA scores under 5.

Variable Importance for Formal Adult Education and Training Participation

Figure 7 provides the overall importance rankings of each independent variable on formal AET participation. The *x*-axis represents the percentage of the variable importance based on MDA scores, whereas the *y*-axis indicates the list of variables in the model. The interpretation is straightforward – the greater the accuracy, the more influential the independent variable is for the classification. If a variable is associated with a higher percentage (longer bar), it indicates that

this variable is more important than others in the prediction. However, it does not mean this variable is more important than other variables by certain percentage points. Therefore, the variable importance should not be interpreted as an absolute value (Choi et al., 2020; Strobl et al., 2008).

The results display that *years of work experience* (*MDA* = 15.977%) and *skill proficiency in literacy* (*MDA* = 12.584%) were the most important variables in shaping individuals' formal AET participation. Followed by this 'highly important' group of variables that contributed the most, skill proficiency in PS-TRE, age, employment status, education level, monthly income, social trust, and literacy skill use at work, with MDA scores ranging from 5–10, seem to be 'moderately important' variables in the model. Lastly, ICT skill use at work, cultural engagement, managerial status, economic sector, job satisfaction, health, gender, learning attitudes, organization size, and working time, with MDA scores under 5, were included in the 'less important' category. The results imply that skills proficiency and utilization, along with individuals' chronological age, work/life experiences, and human capital, were found to be more important than any other variables in explaining working adults' participation in formal AET, than work-related factors.

Figure 7

Variable Importance Rankings for Formal Adult Education and Training Participation
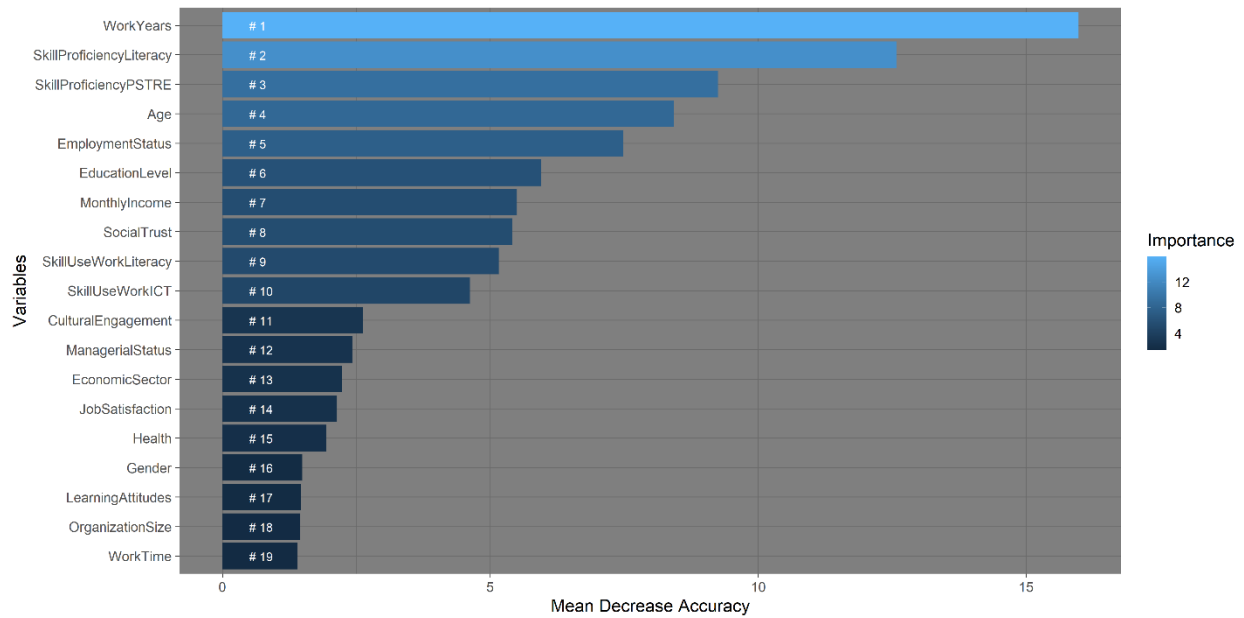
Note. Variable importance ranked by MDA measure.

Variable Importance for Non-formal Adult Education and Training Participation

Figure 8 illustrates the overall importance rankings of each independent variable on non-formal AET participation. The results show that two sets of *skills use at work* appeared as the most important variables in shaping individuals' non-formal AET participation (i.e., *MDA* for literacy skill use at work = 19.867%, and *MDA* for ICT skill use at work = 10.111%, respectively). For the 'moderately important' group in which the variables with MDA scores ranging from 5–10, organization size, monthly income, cultural engagement, years of work experience, education level, learning attitudes, and skills proficiency in PS-TRE and literacy were found. Working time, age, economic sector, social trust, employment status, health, job satisfaction, gender, and managerial status, with MDA scores under 5, were included in the 'less important' group. The results suggest that the degree to which working adults utilize skills at the workplace and other organizational-level characteristics (e.g., organization size) and learning-

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related socio-psychological dispositions (e.g., cultural engagement and learning attitudes) tended to be more influential in determining working adults' participation in non-formal AET, relative to individual-level characteristics.

Figure 8

Variable Importance Rankings for Non-formal Adult Education and Training Participation

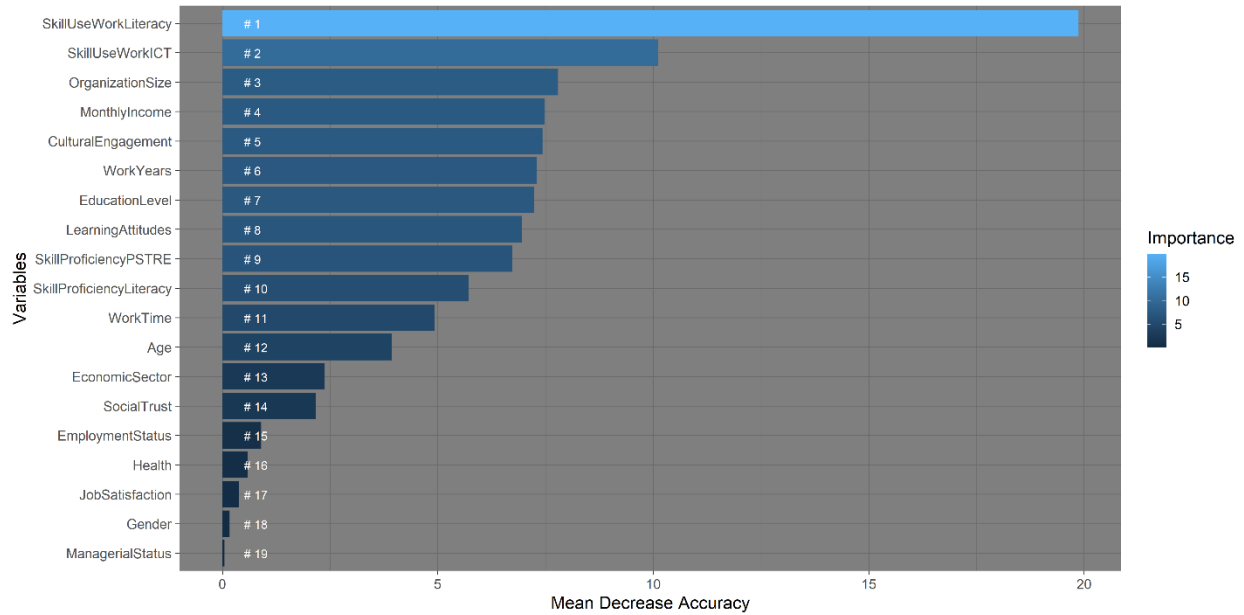*Note*. Variable importance ranked by MDA measure.

Variable Importance for Informal Learning Participation

Figure 9 depicts the overall importance rankings of each independent variable on informal learning participation. Two respective sets of *skills proficiency* (MDA for skill proficiency in PS-TRE = 15.493%, and MDA for skill proficiency in literacy = 15.110%, respectively) and *skills use at work* (MDA for ICT skill use at work = 12.286%, and MDA for literacy skill use at work = 10.784%, respectively) were identified as the 'highly important' group of variables. Years of work experience, age, and monthly income were included in the 'moderately important' group, indicating the variables with MDA scores ranging from 5–10. The MDA scores of the rest twelve variables were under 5; thus, they were 'less important' in

contributing to predictive accuracy. The results point to the interesting fact that both skills proficiency and utilization were the most important factors in shaping working adults' participation in informal learning at the workplace. On the other hand, the determining role of the rest of individual-level and work-related contexts of characteristics was definitely lower in this model.

Figure 9

Variable Importance Rankings for Informal Learning Participation
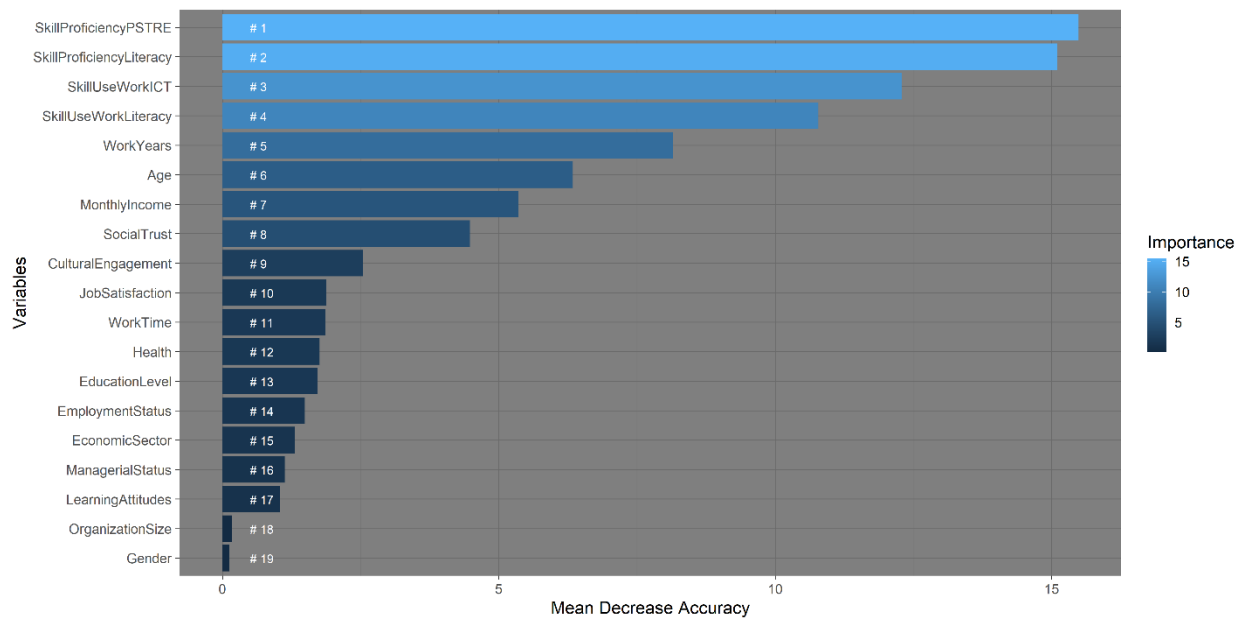

Note. Variable importance ranked by MDA measure.

Comparison of Results Across Random Forest Classifiers Models

As shown above, the RFCs method provides easily interpretable results by calculating rankings of independent variables in order of importance based on each of their relative contribution to the classification accuracy of the model. Taken altogether, the results from RFCs models commonly demonstrate the decisive role of skills proficiency and utilization in determining whether to participate in any type of adult education. More specifically, when it comes to formal AET, as one of the critical elements of human capital, skills proficiency played

more significantly in working adults' participation in formal AET than skills use at work. In contrast, the predictive influence of skills use at work was shown to be the most robust for non-formal AET participation. Both skills proficiency and utilization make a large contribution when they were used to predict informal learning participation. The results reiterate the widely accepted claim "skills matter" (OECD, 2016, 2019a) in education and training. A great volume of literature has supported the linear connections between adult education participation and skills proficiency and/or utilization. According to the "use-it-or-lose-it" hypothesis (Salthouse, 2006), the relationship between foundational skills and LLL can be seen as a continuum, whereby continuous processes of learning and development entail. In contrast, the following several variables never scored above .5 of MDA, meaning the least contributed to every RFCs model: gender and health among individual-level characteristics, and economic sector, managerial status, working time, and job satisfaction among work-related factors.

In comparisons of three RFCs results, especially focusing on groups of variables that appeared to be highly or moderately important in each prediction, intriguing findings are observed. In addition to the variables indicating the skilling of working adults, age, employment status, and years of work experience were prominent variables that predict formal AET participation, whereas learning attitudes, cultural engagement, and organization size served to explain non-formal AET participation. Put simply, those factors representing working adults' individual human capital and work/life experiences tended to be more influential in their formal AET participation. Meanwhile, learning-related socio-psychological states as well as organizational-level characteristics where working adults are affiliated, seemed to be more predictive in non-formal AET participation. Even though less remarkable, several work-related factors played a relatively important role in informal learning participation compared to

individual-level factors. It reveals the distinctive nature of non-formal and informal learning in that working adults' learning experiences are undertaken depending on individuals' job-related conditions or organizational support and resources.

Comparison of Results Between Binary Logistic Regression and Random Forest Classifiers

When comparing classification performance between BLR and RFCs models, calculated accuracies of formal AET and non-formal AET were similar in both models: 84.33% and 84.31% for formal AET, respectively; 76.85% and 75.51% for non-formal AET, respectively. When it comes to informal learning participation, however, the classification accuracy of the RFCs model (95.68%) was much higher than that of the BLR model (83.57%). The RFCs algorithm is favorable in training tree-based classifier models, and robust in reducing error rates and variance, especially when leveraging larger and more complex data, thereby yielding more precise prediction accuracies (Breiman, 2001, 2004). As validated, therefore, the RFCs technique may produce comparatively accurate and predictive classification results. Thus, it is clear that the RFCs method can be a preferred approach in terms of its accuracy and efficiency in predictions.

There is a trade-off between the OLS regression model and RFCs algorithms pertaining to the interpretability of the results because machine learning algorithms are often seen as a black box (Kyeong & Shin, 2022) – how the algorithms arrive at given results and how to understand them adequately. To cope with the trade-off, many studies have employed several analytic tactics that compare and incorporate results from conventional modeling approaches and machine learning techniques, in turn, to draw the optimal solutions that estimate significant predictors in the model. In classification modeling, logistic regression analysis results are often used as a benchmark. Although not a central focus of this study, similar to RFCs results, BLR analysis results also demonstrated that adult education participation could be explained differently by

their segmented nature across types of adult education. However, the explanatory powers of each model were fairly low, indicating poor fit. As such, it reiterates the strength of the RFCs method in handling potential overfitting issues that may be inherent in the complex data structure (Breiman, 2004).

Patterns of Adult Education Participation using Latent Class Analysis

Another primary purpose of this study is to discern different sub-groups within populations that share certain homogeneous characteristics in terms of adult education participation (RQs 4 and 5). LCA was performed to identify latent classes of respondents and their associations with individual-level and work-related contexts of factors. Individuals who show similar response profiles are classified into the same group, and the optimal number of classes is determined by their posterior class membership probabilities. In order to assess the best latent class model, one-to-seven class solutions were computed. Model fit was examined based on the following statistical criteria: BIC, AIC, CAIC, BLRT, and entropy. Next, relationships between identified latent classes and external variables of interest (i.e., covariates) were investigated. Each covariate was assigned to a specific class based on their membership probabilities and errors of adult education participation. In this two-step LCA approach, selected covariates (i.e., individual-level and work-related contexts of factors) were entered into the model as auxiliary variables to identify discrete patterns of adult education participation across sub-groups of working adults.

Identified Latent Classes

Table 8 presents a comparison of model fit indices for LCA results. As Nylund et al. (2007) recommended, BIC and other ICs were considered primarily before examining BLRT's *p*-value and entropy to find out the best class solution. The values of BIC and CAIC continued to

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decline as the number of latent classes increased, and they began to increase from the 3-class model. The values of AIC start to decrease at a slower rate after the 4-class model. As shown in the elbow plot of BIC, AIC, and CAIC (see Figure 10), a plateau in the decrease of the information criteria is placed somewhere between 3 and 4 classes. In addition, starting with the 2-class model, BLRT's *p*-value began to be insignificant after the 5-class model, indicating the 4-class model can be preferably considered. The value of entropy for the 4-class model was highest, followed by the 3-class model, confirming the classification across four latent classes is the most adequate. Taking the above together, the 4-class model was selected for this study; it means there identified four distinctive sub-groups of adult education participation within the population of working adults.

Table 8

Comparison of Model Fit Indices for Latent Class Solutions

Number of classes	Model fit indices					
	LL	*BIC*	*AIC*	*CAIC*	*BLRT* (*p*)	*Entropy*
2 classes	-5675	11472	11384	11489	**.000**	.552
3 classes	-5570	**11326**	11192	**11352**	**.000**	.613
4 classes	-5539	**11328**	**11148**	11363	**.000**	**.685**
5 classes	-5527	11369	11142	11413	.060	.580
6 classes	-5516	11411	11138	11464	.140	.612
7 classes	-5508	11459	11139	11521	.180	.604

Note. $N = 1,283$; LL = log-likelihood, BIC = Bayesian information criteria, AIC = Akaike information criteria, CAIC = consistent Akaike information criteria, BLRT = bootstrapped log-likelihood ratio test; Bold-faced values indicate the best-fit solutions.

Figure 10

Elbow Plot of Selected Information Criteria for Latent Class Solutions
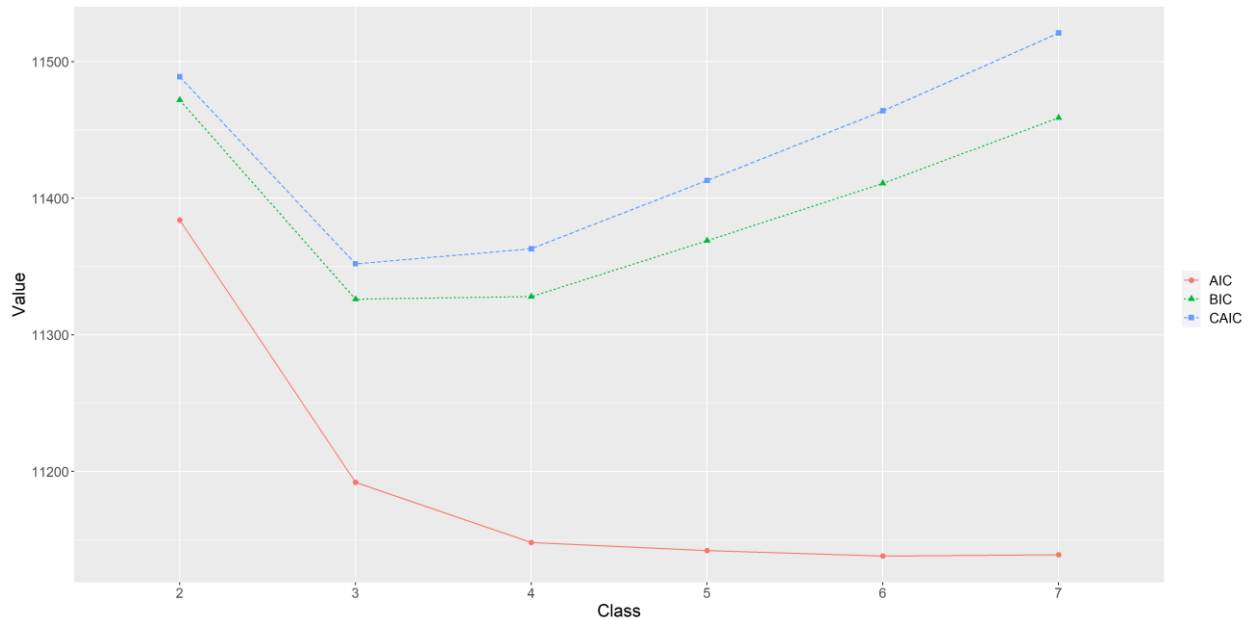
Note. A 4-class model was selected; BIC = Bayesian information criteria, AIC = Akaike information criteria, CAIC = consistent Akaike information criteria.

Figure 11 shows a graphical representation of the selected 4-class model. Each line graph represents the respective adult education participation patterns of working adults by eight different types of adult education. The *x*-axis lists the categories of eight sub-items of adult education participation (one formal AET, four non-formal AET, and three informal learning variables), which serve as indicators in the LCA model. The *y*-axis provides the average probability of class membership for each of the indicators; as the number approaches 1, the probability of class membership is higher. All indicator variables were coded as binary ranging from 0 to 1 (0 = did not participate, 1 = participated), indicating the value of 1 means participated in adult education; thus, probabilities closer to 1 are desirable. Figure 11 also displays the characteristics of four sub-groups based on responses to the indicators. Consequently, the identified latent classes were named as follows: *low-participation learners*

(class 1), *high-participation learners* (class 2), *informal learners* (class 3), and *structured learners* (class 4).

Informal learners, to which the majority of samples were included ($n = 606$; 47.2%), accommodated individuals whose probabilities of participating in sub-items of informal learning were comparatively higher than low-participation learners and structured learners: learning from co-workers/supervisors (.912), learning-by-doing (.710), and keeping up to date (.800). Conversely, structured learners ($n = 225$; 17.5%) had those with relatively higher mean values of formal AET and sub-items of non-formal AET, compared to informal learners and low-participation learners: formal AET (.927), open or distance education (.927), on-the-job training (1.000), seminars or workshops (.603), and private lessons (.964). In other words, this class of working adults tended to seek formally designed and organized learning opportunities. When it comes to the low-participation learners ($n = 203$; 15.8%), which occupies the smallest proportion of observations, had remarkably low probabilities of participation across every type of adult education. In contrast, high-participation learners ($n = 249$; 19.4%) showed the highest mean values for almost every indicator, all of which exceeded the probabilities of .750. Interestingly, not only informal learners dominated the total sample of working adults, but also the discrepancy of the mean values across the four latent classes was bigger for the category of informal learning than for categories of formal AET and non-formal AET. This implies that the latent class identification was dependent more on individuals' informal learning experiences in the workplace than the degree of their formal AET and non-formal AET participation.

Figure 11

Item Probability Plot of the Selected Model
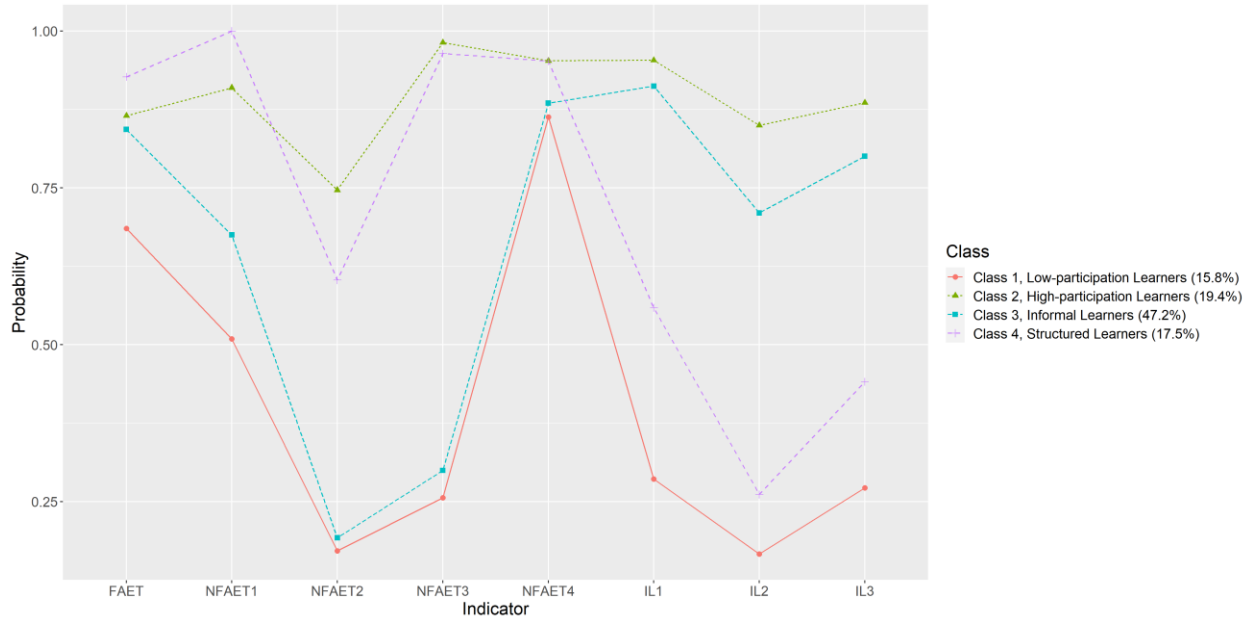
Note. FAET = formal AET, NFAET1 = open or distance education, NFAET2 = on-the-job training, NFAET3 = seminars or workshops, NFAET4 = private lessons, IL1 = learning from co-workers/supervisors, IL2 = learning-by-doing, IL3 = keeping up to date.

Covariates and Fit Statistics

In order to test whether the selected covariates predict class memberships, three separate MLR analyses were performed (see Table 9). The first MLR analysis was conducted by setting class 1 as the reference group in order to compare the predictive power of the covariates against classes 2, 3, and 4. The second MLR analysis was to compare classes 2 and 3, and also classes 2 and 4, by assigning class 2 as the reference. The last MLR analysis was to compare classes 3 and 4 when class 3 was the reference category. Table 9 presents the MLR analysis results of covariates on class memberships, along with coefficients, odds ratios, and *p*-values. The MLR analysis results demonstrate how each covariate is associated with latent classes, some of which were neglected in the results of RFCs models. Across every MLR model, the most frequently appearing covariates that statistically significantly contributed to latent classes were *skill*

proficiency in literacy, *learning attitudes*, *economic sector*, *organization size*, *job satisfaction*, and *literacy skill use at work*. Contrastively, *gender*, *skill proficiency in PS-TRE*, *cultural engagement*, *social trust*, *employment status*, *years of work experience*, and *ICT skill use at work* appeared to be no contribution to the identification of adult education participation patterns.

When looking at the results more closely, class 1 was 1.01 times more likely to have higher proficiency in literacy skills than class 3. The higher the literacy skill is proficient, the probability of falling into class 4 was higher than 0.9% and 1.4%, compared to classes 2 and 3, respectively. Having higher levels of learning attitudes increased the probability of falling into class 2 to 52.3%, into class 3 to 47.0%, and into class 4 to 33.3%, respectively, relative to being class 1. Class 2 was 1.40 times more likely to have higher learning attitudes levels than class 4. For the economic sector, the probability of working in the public sector increased by 53.0% in class 2 and by 59.8% in class 4, respectively, compared to class 1. Class 2 was 1.65 times more likely to have public sector jobs than class 3. The probability of being employed in the public sector increased by 48.1% in class 4 than in class 3. Working in large organizations increased the probability of falling into class 2 to 26.2%, compared to being in class 1. Class 2 was 1.26 times and 1.17 times more likely to work with more employees than classes 3 and 4, respectively. The degree to which working adults satisfy with their job increased the probability of falling into class 2 to 25.6% and into class 3 to 24.1%, respectively, relative to being class 1. Classes 2 and 3 were 1.23 and 1.20 times more likely to have higher levels of job satisfaction than class 4, respectively. Literacy skill use at work was the most salient covariate in patterning adult education participation across latent classes. A higher degree of literacy skills utilization at the workplace increased the probability of falling into class 2 to 83.0%, into class 3 to 64.5%, and

into class 4 to 66.3%, respectively, compared to being class 1. Class 2 was 2.08 times and 1.98 times more likely to use literacy skills at work more frequently than classes 3 and 4, respectively.

For further interpretation, not all results are discussed in detail; instead, this study underlines how classes 1 and 2 and classes 3 and 4 selectively differed in adult education participation patterns – through a comparison between low-participation learners versus high-participation learners and informal learners versus structured learners, respectively. When comparing low-participation (class 1) and high-participation learners (class 2), work-related situational factors were more influential than individual-level factors. Compared to low-participation learners, high-participation learners can be characterized as those who are being employed in the public sector ($OR = .470$, $p < .01$), working in large organizations ($OR = .738$, $p < .01$), satisfied with their job ($OR = .744$, $p < .05$), and utilizing literacy skills at work more frequently ($OR = .170$, $p < .001$). Among individual-level context, learning attitudes ($OR = .477$, $p < .001$) was the only covariate contributing to the identification of low- and high-participation learners. In terms of the comparison between informal learners (class 3) and structured learners (class 4), interestingly, individual-level factors tended to be more influential in this latent class segmentation. Relative to informal learners, more likely structured learners were older ($OR = .747$, $p < .05$), having higher educational attainment ($OR = .665$, $p < .05$), earning less ($OR = 1.178$, $p < .05$), healthier ($OR = .776$, $p < .01$), and proficient in literacy skills ($OR = .986$, $p < .01$). Among work-related context, structured learners were more likely to work in the public sector ($OR = .519$, $p < .01$) and less satisfied with their job ($OR = 1.202$, $p < .05$), compared to informal learners.

Taking the results into consideration, work-related situational factors served significantly to the extent to which working adults access and participate in adult education at large.

Meanwhile, individuals' demographic characteristics and human capital tended to classify varying patterns of participation by the types of adult education. For instance, the younger the age and the less educated, the more likely working adults were to respond favorably to informal learning experiences. The results also imply that working adults' lower levels of income and job satisfaction can be a motivator to participate in formal AET and non-formal AET, in accordance with their expected returns on further educational investment (e.g., financial rewards, better employment opportunities, and job mobility).

Lastly, the goodness of fit was evaluated using pseudo-R^2 tests. The MLR analysis results (see Table 9) demonstrate that the Cox & Snell pseudo-R^2 was .281 and the Nagelkerke pseudo-R^2 was .309, respectively, indicating that the model explained 28.1% and 30.9% of the variance, respectively. Based on the decision criteria for model fit (Bewick et al., 2005; Kruskal, 1964), pseudo-R^2 values greater than .2 obtained from the current MLR analysis validated that the model has strong goodness of fit.

Table 9

Multinomial Logistic Regression Analysis Results Across Class Membership by Covariates

Item	Ref. = Class 1[a]						Ref. = Class 2				Ref. = Class 3	
	Class 2[b]		Class 3[c]		Class 4[d]		Class 3		Class 4		Class 4	
	B	*OR*	*B*	*OR*	*B*	*OR*	*B*	*OR*	*B*	*OR*	*B*	*OR*
Individual-level context												
Gender (Ref. = female)	.417	1.518	.067	1.069	.147	1.158	-.350	.705	-.270	.763	.080	1.083
Age	.264	1.303	.154	1.166	-.138	.871	-.111	.895	-.403[*]	.669	-.292[*]	.747
Education level (Ref. = less than a bachelor's)	-.459	.632	-.312	.732	-.720[**]	.487	.147	1.158	-.261	.770	-.408[*]	.665
Monthly income	-.033	.968	-.061	.941	.103	1.108	-.028	.972	.135	1.145	.164[*]	1.178
Health	.149	1.160	.201	1.223	-.052	.949	.052	1.054	-.201	.818	-.253[**]	.776
Skill proficiency (Literacy)	.008	1.008	.012[**]	1.013	-.001	.999	.005	1.005	-.009[*]	.991	-.014[**]	.986
Skill proficiency (PS-TRE)	-.001	.999	-.001	.999	-.002	.998	.000	1.000	-.001	.999	-.002	.998

Item	Ref. = Class 1[a]						Ref. = Class 2				Ref. = Class 3	
	Class 2[b]		Class 3[c]		Class 4[d]		Class 3		Class 4		Class 4	
	B	OR	B	OR	B	OR	B	OR	B	OR	B	OR
Learning attitudes	-.741***	.477	-.636***	.530	-.405*	.667	.105	1.111	.336*	1.399	.231	1.260
Cultural engagement	.033	1.034	.133	1.143	.019	1.020	.100	1.105	-.014	.986	-.114	.892
Social trust	.004	1.004	.076	1.079	.024	1.024	.072	1.075	.020	1.020	-.052	.949
Work-related context												
Employment status (Ref. = full-time)	.143	1.154	.007	1.007	.063	1.065	-.137	.872	-.081	.922	.056	1.058
Years of work experience	-.015	.985	-.008	.992	-.004	.996	.006	1.007	.011	1.011	.005	1.005
Economic sector (Ref. = private)	-.756**	.470	-.254	.775	-.911***	.402	.502*	1.651	-.155	.856	-.657**	.519
Organization size	-.303**	.738	-.071	.931	-.144	.866	.232**	1.261	.160*	1.173	-.072	.930
Managerial status (Ref. = non-managerial)	.252	1.286	.226	1.254	.420*	1.522	-.025	.975	.168	1.183	.194	1.214

| Item | Ref. = Class 1[a] | | | | | | Ref. = Class 2 | | | | Ref. = Class 3 | |
| | Class 2[b] | | Class 3[c] | | Class 4[d] | | Class 3 | | Class 4 | | Class 4 | |
	B	OR	B	OR	B	OR	B	OR	B	OR	B	OR
Working time	-.158	.853	.154	1.167	.056	1.058	.313*	1.367	.215	1.240	-.098	.907
Job satisfaction	-.295*	.744	-.275*	.759	-.092	.913	.020	1.020	.204*	1.226	.184*	1.202
Skill use at work (Literacy)	-1.770***	.170	-1.036***	.355	-1.089***	.337	.734***	2.083	.681***	1.976	-.053	.948
Skill use at work (ICT)	.013	1.013	-.080	.923	-.257	.774	-.093	.911	-.269*	.764	-.176	.838
Intercept	8.617***		4.240**		8.552***		-4.377***		-.065		4.312***	
-2 Log likelihood	2664.439											
χ^2 (df)	423.025 (57)***											
Cox & Snell R^2	.281											
Nagelkerke R^2	.309											

Note. $N = 1,283$; OR = odds ratio, PS-TRE = problem-solving in technology-rich environments, ICT = information and communications technology.
[a] Class 1: Low-participation learners ($n = 203$; 15.8%).
[b] Class 2: High-participation learners ($n = 249$; 19.4%).
[c] Class 3: Informal learners ($n = 606$; 47.2%).
[d] Class 4: Structured learners ($n = 225$; 17.5%).
*** $p < .001$, ** $p < .01$, * $p < .05$

CHAPTER FIVE

Summary and Discussions

Chapter five is the conclusion of this dissertation. It discusses how the key findings of this study satisfy the research purposes and how the knowledge gaps are addressed. It also suggests several recommendations for future research and practice regarding the topic of access and availability to adult education of working adults. First, in this section, an encapsulated summary of the results is presented. It summarizes the main results of the study and discusses how they met the abovementioned research purpose and questions. In addition, through further discussions on the extent to which the findings are aligned with the existing conceptual underpinnings from the literature, it concludes with a demonstration of how this work can be a significant addition to bridge existing research gaps.

Summary of Results

The primary purpose of this study was to re-examine the determinants and patterns of adult education participation within the adult population aged 25 to 65 years old who were in the labor market in 2017. Through the application of emerging analytic techniques, this study empirically attempted to capture population-level insights on (1) *what* drives working adults' participation in adult education and (2) *how* patterns in adult education participation diverge. By doing so, this study sought to advance the knowledge pertaining to *lifelong learners* and to reveal theoretical and practical implications that ensure working adults' LLL in and out of the workplace. A brief summary of the results is given below.

Determinants of Adult Education Participation

In order to respond to the research questions about the determinants of adult education participation (RQs 1–3), this study leveraged the RFCs technique to understand which factors

most decisively influence working adults' participation in adult education across different types (i.e., formal AET, non-formal AET, and informal learning). First and foremost, the main findings indicated that two respective sets of skills proficiency (i.e., literacy and PS-TRE) and skills utilization (i.e., literacy and ICT) appeared, by far, to be the most critical influencers for adult education participation, which pinpoint the vital role of skills development and acquisition of working adults. For adults, the decision to participate in job-related adult education relies on the degree of the expected value of learning – how much the learning experiences transfer to their work performance. Inversely, a successful transition from learning to work depends on the extent to which how much knowledge and skills learned will be integrated into new work processes. Given the mutual relationship between adult education and work-related skills development and acquisition, it is obvious that the capacity to attain and situate basic skills of individuals will increase the possibility of being able to improve new learning opportunities (Cieslik, 2006). It resonates with existing empirical studies specifying a direct association between skills proficiency and adult education participation (e.g., Punksungka et al., 2021; Tikkanen & Nissinen, 2018).

Second, education level and monthly income were the common salient predictors across every type of adult education participation. For education level, which was found to be more important for formal AET and non-formal AET participation, the results support the existing evidence demonstrating a consistent connection between the educational attainment of individuals and participation in structured forms of adult education. According to Heisig and Solga (2017), higher educational attainment enabled adults to enhance their foundational knowledge and skills, which in turn, prepared them to participate in subsequent adult education. Positive attitudes toward adult education participation may be originated from successful prior

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experiences in formal education program completions (Illeris, 2006). In contrast, because formal AET offers certificates or degree programs (often non-formal AET also does), it may be an appealing option to relatively less-educated adults who need further learning to compensate for their educational deficiencies. Another variable that has long been studied is income level as a major driver of adult education participation. This study reconfirms similar findings from the literature; working adults' financial or economic status seems to remain a potential influencer or barrier in adult education participation regardless of their skills proficiency and employers' support for education and training opportunities (Boeren et al., 2010). Taking the above into consideration, the results imply that personal factors pertaining to working adults' individual human capital may be more influential on their educational participation than organizational or societal-level factors.

Third, predictors explaining adult education participation somewhat varied according to the types of adult education. Several interesting findings are revealed when comparing working adults' participation in formal AET with non-formal AET and informal learning. The variable importance of years of work experience and age were relatively higher for formal AET participation than non-formal AET or informal learning participation. Previous studies have shown a significant "age-participation effect" (Fouarge & Schils, 2009); all else being equal, the willingness to invest in LLL tends to decrease as people age. Similarly, in an United Kingdom study in 2017, the younger the age, the higher the participation rates found for formal AET (Egglestone et al., 2018). As such, researchers have supported the inverse relationship between age and adult education participation (Boeren et al., 2010; Desjardins, 2010; Roosmaa & Saar, 2017). Given the above, a reasonable conclusion is that individuals' years of work experience or age tend to have a close association with formally designed learning that leads to college

diplomas or university degrees compared to non-formal and informal learning. This is probably because there are still existing perceptions that higher education is more suitable for less-seasoned workers or certain age groups' career development – that is to say, age dependency.

Among others, learning attitudes, cultural engagement, and organization size were ranked higher in non-formal AET participation compared to formal AET and informal learning participation. In this study, both learning attitudes and cultural engagement were included in the set of variables representing learning-related socio-psychological states of working adults. Thus far, a large volume of studies has convincingly shown that positive learning attitudes and dispositions in learning were among the most powerful predictors of adult education participation, reinforcing the 'virtuous cycle' of education (Boeren et al., 2010; White, 2012). Additionally, cultural engagement, conceptually contiguous to inclusive social cohesion and citizenship, has been deemed as a pivotal component accounting for LLL (Desjardins, 2017; Lavrijsen & Nicaise, 2015). However, both of them have shown inconsistent relationships with adult education participation and have even been overlooked in mainstream research. Non-formal AET, in particular, can be explained as an inclusive form of learning that focuses on 'community-oriented' educational activities within the learning network (van Merriënboer et al., 2009). Given that, this study arouses the need for academic attention to investigate a deeper analysis of the linkage between adult education participation and cultural/social orientation and engagement.

Last but not least, the results of this study showed how well organizational or institutional features are corresponding to the conceptual underpinnings of non-formal AET. Organization size, for example, points directly toward the amount of capability of organizations that entail developmental interactions, learning opportunities, and investment in human capital (Kwon,

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2019). By nature, non-formal learning occurs through interpersonal relationships in which knowledge and skills are shared and facilitated (Strawn, 2003). Therefore, the findings advocate the important role of a learning-rich work environment that acts as a conduit for channeling employee relations, which in turn, may potentially invigorate non-formal AET participation among working adults.

Despite of advantages in interpretability and applicability of the RFCs algorithm, the results should be interpreted with caution, as they do not indicate the direction of predictive powers of selected variables on dependent variables. Note also that calculated variable importance scores are essentially limited as they only provide information about the relative decisiveness among independent variables. For instance, we can say that educational attainment was more important than others in prediction. Yet it is hard to affirm that working adults who have upper levels of education are more likely to participate in adult education than their lower counterparts. To address the limitation of the RFCs model, this study applied LCA as a supplementary method to clearly specify the directionality of study variables and to reveal multi-faceted aspects behind the phenomenon of adult education participation.

Patterns of Adult Education Participation

In regard to the aforementioned research questions (RQs 4 and 5), this study attempted to investigate discrete patterns of adult education participation among sub-groups of working adults that share similar profiles of individual-level and work-related contexts of characteristics. Using the LCA approach, this study also sought to demonstrate detailed and nuanced information about the best-guiding principle to improve adult education participation and to address individual- and organizational-level issues on LLL, particularly for underrepresented or marginalized groups of

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learners. Four latent classes in adult education participation were identified: (1) low-participation learners, (2) high-participation learners, (3) informal learners, and (4) structured learners.

The subsequent MLR analysis results showed that skill proficiency in literacy, learning attitudes, economic sector, organization size, job satisfaction, and literacy skill use at work were the most contributed variables to the latent class identification, which indicates overall patterns of adult education participation. When looking closely at specific profiles by latent classes, organizational work-related factors served to diverge different patterns between high- and low-participation learners. More specifically, compared to low-participation learners, high-participation learners were characterized as those who are employed in the public sector, work in large organizations, have higher levels of job satisfaction and learning attitudes, and use literacy skills at work more frequently. When comparing informal learners who are likely to engage more in informal learning opportunities over structured learners who tend to participate more in formal AET and non-formal AET activities, the influence of individual-level characteristics was reported. To be specific, structured learners were more likely to be older, have upper levels of education but lower income levels, be healthier, proficient in literacy skills, work in the public sector, and have lower job satisfaction levels than informal learners. As such, it is noticeable that the overall segmentation of working adults' participation in adult education itself was strongly affected by situational and institutional contexts, whereas individual preference or selection across types of adult education relies on personal demographics and human capital.

In general, adult education opportunities are more often pursued by high-income workers than their low-income counterparts (Massing & Gauly, 2017; Shadovitz et al., 2021); accordingly, low-income workers have been identified as vulnerable to access and participation in adult education. However, the results of this study show that working adults who earn more

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tended to participate more in informal learning, whereas low-income employees were more likely to participate in formal AET and non-formal AET. Therefore, this study partially refutes the commonly held assumptions that working adults who are financially insecure are less likely to seek further education and training. This contradiction with present studies may be because the findings of this study reflect the emerging trends in adult education policy and practice. For low-income adults, higher education and non-formal learning are frequently seen as appropriate venues for improving their labor market outcomes: higher payment, job security, and employability, to name a few (Cook & King, 2004). In response, there is an increased demand for tertiary institutions (i.e., HEIs) to expand their role in LLL provisions by designing tailored education and training programs to accommodate the needs of employers, organizations, and industries. Successful involvement of colleges and universities in LLL can be achieved through partnerships with the business sector, and policy initiatives that grant financial support for the increased access of low-income adults (OECD, 2008). Moreover, in the United States, financing schemes for AET are being implemented followed by the enactment of the 2014 Workforce Innovation and Opportunity Act (U.S. Department of Labor, Employment and Training Administration, 2020). The AET funding model includes training funds for financially vulnerable workers; the evidence shows that government-sponsored programs are particularly beneficial for low-income and unemployed adults with insufficient financial aid to self-fund their higher education or AET access (Cummins et al., 2022).

This study also ascertained that specific job conditions are likely to increase the possibility of participating in adult education. According to previous studies, the private sector, large organizations, skilled occupations, and quality of employment (e.g., job satisfaction) are known to be key indicators of an organization's capacity to devise investment strategies for

enhanced adult education access and quality (Desjardins, 2015; Grotlüschen, 2016). Among others, the results of this study offer opposite evidence about the economic sector. It has been widely believed that the private sector is more feasible to contribute toward adult education, as the public sphere have relatively insufficient fund/resources and incentive system to expropriate the emerging demands on learning and development of their employees. In response, many countries including the United States, have prioritized market-driven policies to support adult education and to develop adult learning systems directed toward developing a skilled and competent workforce (Lee & Desjardins, 2021). Unexpectedly, however, employers are often reluctant to invest in adult education because of the concern of return on investment – if employees obtain advanced skills and then become employable at competing firms, then the sponsoring firm may lose its investment in human resources (Desjardins, 2015). Moreover, as several researchers have suggested, higher rates of adult education participation are shown among rather public sector workers (Tikkanen & Nissinen, 2018), indicating evidence of a failure of market-led strategies, which may exacerbate inequalities (Lee & Desjardins, 2021).

Human Capital and Skilling for the Workforce

Based on the summary of the results and their comparisons with existing documents, several key points stood out for further discussions regarding adult education theories and practices. First and foremost, this study provides strong evidence of the relationship between working adults' skills acquisition and adult education participation. A deeper understanding of the relationship can be approached from the theoretical traditions of adult education. Originating from the idea that people would invest in educational opportunities with the aim of increased skills and productivity (Boeren et al., 2010), human capital theory (Becker, 1964) has been used

predominantly to answer the following question: what influences individuals to participate in developmental activities?

Human capital theory starts from the assumption that individuals' decision on learning relies heavily on their perceived benefit and cost of the investment (Becker, 1964). Individuals tend to maximize their welfare and minimize costs when pursuing goals (Boeren et al., 2010); thus, every human action can be seen as an outcome of rational economic calculus of benefit and cost (Rubenson & Sailing Olesen, 2007). The rationale of human capital theory has been used in the adult education domain not only to explain individuals' investment in adult education participation but also the expected return on investment of employers based on its rationality and causal line of reasoning – upgraded knowledge and skills of employees are a product of the investment in training, which in turn, results in increased performance and competitiveness of the organization (Becker, 1964; Rubenson & Sailing Olesen, 2007). Under the umbrella principle of human capital, it has long been acknowledged that there is an innate association between the development of human capital (e.g., work-related skills and competencies) and returns in improved productivity in the labor market, which benefits both individuals and organizations (Mincer, 1989). Accordingly, for working adults, the workplace, which offers various types of learning opportunities, has often been recognized as an adequate place where knowledge and skills can be further improved.

In terms of skills and competencies advancement in the workplace, empirical findings have revealed that the extent to which working adults use skills at work serves as an indicator of their capability for further education participation (Yamashita et al., 2019). Boeren et al. (2010) asserted that individuals who have higher levels of human capital are likely to value additional learning and development. By the same token, proficient skills may reinforce positive behaviors

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and attitudes toward subsequent learning and, in turn, lead to further adult education participation (Heisig & Solga, 2017; Yamashita et al., 2019). Moreover, job-related skills proficiency and utilization are intertwined with labor market outcomes such as employment and labor force participation (Grotlüschen et al., 2016; OECD, 2016). The overarching assumption is that equipping more people with relevant skills and competencies is a proactive way to address the skills shortage, thereby, investment in human capital undoubtedly promises enhanced employability (European Union, 2016).

This statement has been supported by evidence of linearity that developing relevant skills throughout individuals' careers can ultimately contribute to improving the competitive power of the workplace, organizations, and countries. Therefore, in many countries, LLL opportunities for working adults have been extensively expanded based on a solid belief that human capital investment will help people advance and sustain their knowledge and skills in responding to the fast-changing world of work (OECD, 2019c). In this regard, the findings of this study provide supporting evidence and rationale for explaining the trajectory of LLL policy expansion that has been aligned with human capitalist perspectives. Skilling of working adults is still a major focus of AET; thus, this study advocates the current policy interventions – e.g., strengthening incentive mechanisms to promote continued investment in employees' skills acquisition (OECD, 2016).

Nevertheless, there has been vast criticism against the individualistic principle of the human capital theory that assumes the intimate association between skills development and adult educational pursuits. That is to say, an excessively individualistic approach to legitimate the investment in human development may yield various concerns, such as inequalities in learning opportunities and education participation and unfair consequences in sharing benefits among social groups (Brown et al., 2001; Rubenson & Sailing Olesen, 2007). In this sense, a great deal

of recent researchers seek to explore how the underlying notion of human capital has led to

inequitable access and participation in adult education and how it can be remedied.

Skills Mismatch and Adult Education Participation

Even though there has been comparatively scarce research attention in addressing the

interaction between adult education and *skills mismatch*, in essence, education and training can

be a potential response to any situation of qualifications and skills mismatch in the workforce

(Messinis & Olekalns, 2008). Empirical evidence suggests that similar levels of skills acquisition

may lead to divergent consequences in earnings when occupational classes and wages are

narrowly defined (Cawley et al., 1998). Most recently, as a result, recent studies have paid

particular attention to the idea of skills mismatch (Desjardins & Rubenson, 2011; McGowan &

Andrews, 2017; OECD, 2019c). In general, skills mismatch refers to a lack of matching between

the supplied skills and those in demand in the labor market (Palmer, 2017). Generally, the term

skills mismatch is used to explain a variety of scenarios: skill gap, skills shortage (or under-

skilling), and skills surplus (or over-skilling), to name a few (McGuinness et al., 2017).

Desjardins and Rubenson (2011) suggest that understanding skills mismatch within and

across various groups of employees is crucial; employers or organizations serve as the single and

the most important source of financing for adult education, and their decision-making that

determines who receives adult education is not always equal. More importantly, such inequitable

access and availability in adult education and unfair distribution of resources among employees

can lead to skill gaps and hence even income gaps. According to Desjardins and Rubenson

(2011), working adults who are high-skilled are more likely to participate in employer-sponsored

training programs (i.e., formal AET and non-formal AET) and also receive the most resources.

Suppose there is a tendency for adult education opportunities to be allocated primarily to those

who are highly skilled, thereby resulting in inclined investment for the continuation of learning and development for a certain group of workers. In that case, others will be left behind without any support. Furthermore, if this tendency continues, the skills foundation of the entire workforce will become increasingly bifurcated; high-skilled or matched individuals are more likely to possess higher levels of motivation and readiness to learn, and these individual-level characteristics and their human capital are more likely to be mutually reinforced – 'vicious circle' of skills formation and adult education access.

According to the results of this study, skills proficiency and/or utilization served as the most important variables in prediction models. In addition, in LCA results, skills proficiency was indicative of predicting working adults' participation in employer-sponsored training programs, and skills utilization was the most salient indicator that separates class membership – low-participation learners' skills use at work was the lowest among latent classes. The key findings of this study, thus repeat that both skills proficiency and utilization play an important role in overall access and participation in adult education and the likelihood of being under-skilled is higher for low-participation learners or those who are excluded from structured education and training opportunities. In this vein, the findings resonate with the possible Matthew effect on adult education participation (Boeren, 2009), where the skilled get more skilled, and their counterparts get further left behind.

Most recently, two ascendant terms, 'upskilling' and 'reskilling,' both of which are directed towards the competitiveness of the workforce, have drawn the enormous attention of researchers and policymakers. The two terms sound analogous, but there is a slight difference. *Upskilling* refers to the process of providing education and training with the goal of advancing the existing skill sets of employees to make them more competent and responsible for current

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and future roles in the same line of occupations. *Reskilling* means the process of learning and development with the aim of retraining employees with new skill sets or credentials, which may lead them to transition to new positions or different industries (Ash & Rahn, 2020; Monear, 2020). Some researchers have paid attention to the applicability of these two concepts, as both of which aim at tackling inequality in adult education participation by establishing government-industry partnerships that secure funds from diverse stakeholders, thereby improving access and quality of learning experiences of socially excluded groups of working adults (Lee & Desjardins, 2021). Especially for less-educated and low-skilled workers, reskilling and upskilling programs, which are not dependent upon employer sponsors and funds, therefore, can be vital opportunities to improve their employability and sustain employment in a rapidly changing economic landscape (Monear, 2020). Upskilling and reskilling notions not only became mainstream ideas in adult education, HRD, and organizational studies but also brought to the fore the future orientation of learning and development practices for working adults. Notably, principles of both upskilling and reskilling are tied to institutional responsibilities to support workers' equitable access and participation in adult education (Nylander et al., 2022; OECD, 2019b).

According to OECD (2019b), most adult learning systems across countries are not very inclusive. There are large discrepancies in adult education participation according to individuals' socioeconomic background, employment status, and levels of qualifications and skills. The recent statistics showed that only 20% of low-skilled adults participated in adult education, while 58% of their high-skilled counterparts did. To bridge this participation gap which may result in lower productivity and hold back growth, establishing more responsive adult learning systems is required (OECD, 2019a). For instance, many governments have encouraged companies to use job-retention schemes that offer employer-sponsored training programs to their workers as a

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means to ensure a sufficient supply of further education and training opportunities. Providing

such public support should become tied to the equitable provision of learning opportunities for

working adults' enhanced access and participation in adult education. Moreover, public policies

should shift toward active labor market measures to unleash job transitions and guarantee

displaced workers' re-employment (Salins & Sila, 2022). However, this will be a major

challenge for many adult learning systems, particularly given the international context of tight

government expenditures and substantially weakened finances in the public sector (OCED,

2020). This worrying trend leads us to a further discussion of the role of organizations in the

government-industry partnership, with stakeholders expecting organizations to be more socially

responsible to appease public concerns over the proper LLL policy interventions.

Learning Workers and Learning Organizations

In essence, the principle of human capital theory does not fully describe why the

education and skills gap arise; rather, regressive patterns of income distribution and inequitable

access and participation in further education and training can be seen as a consequence of

inequalities in power, wealth, and influence (Torres, 1996). More specifically, differences in

demands of the workplace (OECD, 2005), employers' decisions (Vignoles et al., 2004),

governments' policy interventions (Rubenson, 2006), and many other social structural contexts

exogenously determine the process of human capital investment. Hence, emphasized is

understanding the role of social and economic institutions and organizational structures, both of

which contribute to the reproduction of the prevailing class in society (Brown et al., 2001). The

adult learning system can be viewed as an integral element but simultaneously as a by-product

that is formed by imbalanced institutional and organizational power dynamics. Therefore, only a

few industries and companies are more likely to unleash accessible and quality education and

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training opportunities, elaborate internal labor markets, and tailor compensation packages to attract and retain a high-skilled workforce (Kalleberg et al.,1996).

The underlying assumption of this study is that participating in adult education is not solely dependent on individuals' human capital; instead, individuals' demand for learning is often intertwined with an organization's supply, and this reciprocal relationship then constructs working adults' intention and decision to participate in adult education (Boeren et al., 2010; Wang & Wang, 2004). Turning to organizational work-related features, the literature points to how the specific structure of organizational settings may facilitate or constrain adult education participation (Brown et al., 2001; Illeris, 2006). Herein both normative and coercive factors are included, such as union power, firm size, internal labor markets, the structure of wages, and other occupational systems (Rubenson & Sailing Olesen, 2007). The primary factors determining which individuals will receive employer-provided education and training lie not so much in personal resources or human capital but in employees' positions within those organizational conditions. With the interplay of factors at both individual- and organizational-level contexts, work-related characteristics become very strong and complex, with implicit or explicit rules and regulations that shape learning options and rewards, which employers make available to their employees (Rubenson & Sailing Olesen, 2007).

Ever since the concept of *learning organizations* began to emerge in the 1990s, many modern organizations have debated and deliberated on learning in organizations. To date, the most widespread idea is that learning occurs through the mutual relationship between an organization's collective learning processes and individual workers who are embedded in the organizational structure (Fenwick, 2008b). According to the human capital notion that is a principal productive force in human capitalism, *learning workers* have been understood as an

organization's intellectual capital, increased resources, and return on its educational investment (Merriam, 2008). The economic paradigm privileges financial values predominantly over other social priorities: in an organization where knowledge is treated as a commodity and employees focus largely on attaining specific skill sets, there is little room for self-reflection on what is the role of the organization in society (Fenwick, 2001). In this sense, Casey (2013) advocates the role of the organization that encourages workers' equitable participation in learning instead of selectively training them under utilitarian purposes. Focusing on the norm of social responsibilities of the organization may benefit in maximizing the potential of the workplace as a site of LLL or learning organizations under plural socio-cultural ends.

Learning organizations can be seen as organizations that promote employees' continuous learning and development through formal and non-formal means of learning experiences but, potentially and more importantly, also accompany everyday practices between individuals and collectives through the informal mode (Van Noy et al., 2016). According to Senge (1990), learning organizations are where individuals and teams possess core capabilities to understand complexity, engage in mutual interactions, and aspire to mastery, all of which contribute to a shared vision of the organization. The specific actions include providing continuous development opportunities, facilitating inquiry and dialogue, encouraging collaborative and team learning, building learning systems to capture and share ideas, and empowering employees to internalize a collective vision (Watkins & Marsick, 1993).

In this environment, noticeably, informal learning plays an imperative role not only in bridging the education and skills gap among employees but also in fostering the social responsibilities and initiatives of the organization, thereby allowing organizations to direct toward learning organizations (Van Noy et al., 2016). Herein learning workers serve as an

institutional asset cultivating LLL and thus increasing the learning capacity of organizations (Nyhan et al., 2003). Given the widespread inequalities of access and participation in education and training opportunities in the workplace, establishing learning organizations through nurturing informal learning must be given a much higher priority, in terms of what can serve as a basis for ameliorating power differences and conflicts within organizations. Above-described concrete theoretical reasoning and research evidence align with the key findings of this study – the crucial role of informal learning that accommodates less-educated and low-skilled. Therefore, it is reasonable to conclude that informal learning can be an integral part of social inclusion in adult education practices which has often been underestimated in human capitalist approaches.

Conclusion and Implications

The topic of adult education participation has long been studied and documented in relevant fields of study. However, it is evident that insufficient current scholarly endeavors have existed that would present a holistic picture of working adults' participation in adult education, under lack of consideration of the broader examination of multiple contexts and factors simultaneously within every type of adult education. In this sense, this closing section concludes with how the key findings of this study contribute to knowledge advancement in several ways.

First, this study yields important implications for policy and practice for adult education and HRD. In addition, some implications for theory and conceptual development are proposed, along with several recommendations for future studies. It is firmly believed that this dissertation will be a significant step toward a more comprehensive analysis of adult education participation phenomena, thereby deepening discourse and understanding among researchers, policymakers, and practitioners.

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Implications for Policy and Practice

Participation in adult education and its ramifications, such as inequitable access and outcomes, can be seen as a socially constructed phenomenon; thus, this issue has drawn increased policy attention in adult education arena (Lee & Desjardins, 2021; Rubenson, 2018). The factors involved in determining and patterning participation in adult education are multifaceted and complex. Notwithstanding that individual-level characteristics and human capital tended to determine adult education participation at large, it should be noted that organizational and structural circumstances far beyond individuals' control affect working adults' capacity to participate in adult education. According to Ioannidou and Parma (2022), while individual determinants of adult education participation appeared to be rather similar across countries, country-specific economic, institutional, and political conditions may play a substantial role in the provision of adult education and taking up of learning opportunities of working adults. This implies the necessity of a deeper understanding of how to recognize the need to tackle the individually and socially rooted obstacles from broader perspectives to remedy inequalities in adult education participation (Lee & Desjardins, 2021).

In this vein, this study holds several policy implications. Firstly, this study supports the importance of individual skilling strategies of working adults in determining adult education participation. As shown in the results, participating in formal AET and structured forms of adult education programs was influenced largely by personal dispositions and human capital. Given a linear connection between the stock of human capital in organizational productivity and competitiveness, as well as the rate of job creation and the wealth of a country, skills formation through adult education should be the prime focus of governmental policy (Desjardins, 2020). Also, there is a widespread belief that formal education in HEIs connotes age- and education

level-dependent; however, no matter the age and prior learning experience, formal qualifications and educational opportunities in HEIs are increasingly a major function of well-developed adult learning systems (Desjardins & Lee, 2016). This reiterates the criticality of a country's capabilities and its policy interventions that advance adult learning systems (e.g., government-industry-university partnerships) by accommodating a variety of stakeholders to strengthen the connectivity among the business, higher education, and LLL. Additionally, the findings suggest that a tailored approach to further education and training, directed toward foundational skills development based on reinforcement of financial support and resources, can facilitate adult education participation, especially among less-educated, low-skilled, and older workers.

Secondly but simultaneously, this study challenges traditional beliefs that consider adult education participation as an outcome of human capitalism. The analysis of not only access and participation in adult education at the individual-level but also various macro-level predictors is needed to identify a fuller range of potential interventions (Cummins et al., 2018). The findings of this study validated that the majority of working adults were engaged in informal learning at work which is a seemingly alternative to formal AET and non-formal AET. It directly indicates the pivotal role of HRD and organizational interventions that create a supportive atmosphere that facilitates employees' learning and improvement (Lim et al., 2020; Van Noy et al., 2016). It is important to note that elevating informal learning targeted educational programs represents enhanced organizational abilities that foster learning, which may lead to a smooth transition into learning organizations. Under such organizational circumstances, adult education is seen as an effective tool for vulnerable employees' second-chance education and validation of non-formally obtained skills and competencies (Kersh et al., 2021). From the perspective of learning organizations, informal and incidental learning can be viewed as a legitimate part of work –

education and training structures and informal learning practices in organizations can support the development of learning in a flexible manner, the advancement of technologies for learning, and value creation of learning as an articulated priority within the context of organizational goals and targets (Smith, 2003). Noticeably, providing adequate resources to support informal learning policies within organizations can promote the efficiency of learning at work, thereby contributing to mitigating direct and indirect forms of discrimination in access and participation in adult education (Billett, 2001; Lim et al., 2020).

Implications for Theory and Conceptual Development

First, this study is theoretically significant as it contributes to a novel understanding of working adults' adult education participation. This study comprehensively reviewed individual-level and work-related situational factors associated with adult education participation by applying the HRD LPT (Wang & Wang, 2004) and the CLLPM (Boeren et al., 2010). The effects of selected independent variables on adult education participation are well-documented; however, existing literature has been limited to presenting a holistic framework explaining adult education participation. This study revealed that working adults' participation in adult education could be explained mostly by individualistic human capital orientations. However, non-formal AET and informal learning participation tended to depend heavily on the extent to which organizations have learning capabilities and climate. Many researchers in the field of adult education and LLL contend that organizational structure and environments serve as barriers to adult learning substantially, based on the perspectives from human capital theory. Arguably, however, this study showed that adult education participation could be seen as a product of the individualism-collectivism trade-offs within organizational contexts. Furthermore, along with the examination of how adult education is intertwined with other relevant concepts of work-related

learning (see Figure 1), this study stresses the potentiality of WL that fully accommodates working adults' educational demands, indicating the need for further empirical evidence of how the workplace can be played as a hub that entails working adults' varying educational pursuits and aspirations.

Second, the significance of the study is not limited to the theoretical values but also to its methodological applicability. To address the proposed research questions, this study built prediction models by leveraging a machine learning technique – in this study, the RFCs algorithm. The RFCs method has been developed for accurate and reliable prediction and has been newly applied in various spheres of research, along with the surge of scholarly interests. The RFCs method is thus known to be exceedingly effective in handling non-linear and complex relationships among variables in the given dataset, and in determining the relative importance of target variables with high predictive accuracy. Moreover, as another analytic strategy, LCA was employed to obtain population-level information on diverged adult education participation patterns. The results from LCA empirically demonstrated how the typology of working adults could be characterized differently across individual-level and work-related factors, which may lead to further deeper investigations of learning workers and learning organizations. Accordingly and importantly, the methodological significance of the study is tied to the novelty of findings that revealed a holistic picture of determinants and patterns of adult education participation.

References

Adamuti-Trache, M., & Schuetze, H. G. (2009). Demand for university continuing education in Canada: Who participates and why? *Canadian Journal of University Continuing Education, 35*(2), 87–108. https://doi.org/10.21225/D5F598

Agbo, S. (2000). The United States: Heterogeneity of the student body and the meaning of 'non-traditional' in US higher education. In H. H. Schuetze, & M. Slowey (Eds.), *Higher education and lifelong learners: International perspectives on change.* Routledge Falmer.

Aldridge, F., & Hughes, D. (2012). *2012 NIACE adult participation in learning survey*. National Institute of Adult Continuing Education.

Allen, J., & van der Velden, R. (2012). *Skills for the 21st century: Implications for education* (ROA-RM-2012/11). Research Centre for Education and the Labour Market, Maastricht University.

Antikainen, A. (2001). Is lifelong learning becoming a reality? The case of Finland from a comparative perspective. *European Journal of Education, 36*(3), 379–394.

Ash, K., & Rahn, M. (2020). *Reimagining workforce policy in the age of disruption: A state guide for preparing the future workforce now*. National Governors Association. Retrieved from: https://files.eric.ed.gov/fulltext/ED609014.pdf

Asparouhov, T., & Muthén, B. (2014). Auxiliary variables in mixture modeling: A 3-step approach using Mplus. *Structural Equation Modeling: A Multidisciplinary Journal, 21*(3), 329–341. https://doi.org/10.1080/10705511.2014.915181

Aspin, D. N., & Chapman, Y. D. (2007). *Values education and lifelong learning: Principles, policies, programmes*. Springer.

Association of American Colleges and Universities. (2002). *Greater expectations: A new vision for learning as a national goes to college*. Author. Retrieved from: https://files.eric.ed.gov/fulltext/ED468787.pdf

Aud, S., Hussar, W., Kena, G., Bianco, K., Frohlich, L., Kemp, J., & Tahan, K. (2011). *The condition of education 2011* (NCES 2011-033). National Center for Education Statistics, U.S. Department of Education. U.S. Government Printing Office. Retrieved from: https://nces.ed.gov/pubs2011/2011033.pdf

Baert, H., De Rick, K., & Van Valckenborgh, K. (2006). Towards the conceptualisation of learning climate. In R. Vieira de Castro, A.V. Sancho, & P. Guimaraes (Eds.), *Adult education: New routes new landscapes* (pp. 87–111). University of Minho Press.

Bailey, T., Leinbach, D., Scott, M., Alfonso, M., Kienzl, G., Kennedy, B., & Marcotte, D. (2003). *The characteristics of occupational sub-baccalaureate students entering the new millennium*. Community College Research Center at Teachers College, Columbia University. Retrieved from: https://ccrc.tc.columbia.edu/media/k2/attachments/characteristics-occupational-sub-baccalaureate-students.pdf

Bakk, Z., & Vermunt, J. K. (2016). Robustness of stepwise latent class modeling with continuous distal outcomes. *Structural Equation Modeling: A Multidisciplinary Journal, 23*(1), 20–31. https://doi.org/10.1080/10705511.2014.955104

Becker, G. (1964). *Human capital: A theoretical and empirical analysis with special reference to education*. Columbia University Press.

Berg, S. A., & Chyung, S. Y. (2008). Factors that influence informal learning in the workplace. *Journal of Workplace Learning, 20*(4), 229–244. https://doi.org/10.1108/13665620810871097

Bewick, V., Cheek, L. & Ball, J. (2005). Statistics review 14: Logistic regression. *Critical Care, 9*(1), 112–118. https://doi.org/10.1186/cc3045

Bierema, L. L., & Eraut, M. (2004). Workplace-focused learning: Perspective on continuing professional education and human resource development. *Advances in Developing Human Resources, 6*(1), 52–68. https://doi.org/10.1177/1523422303260859

Billett, S. (2001). Learning through work: Workplace affordances and individual engagement. *Journal of Workplace Learning, 13*(5), 209–214. https://doi.org/10.1108/EUM0000000005548

Billett, S. (2002a). Workplace pedagogic practices: Co-participation and learning. *British Journal of Educational Studies, 50*(4), 457–483. https://doi.org/10.1111/1467-8527.t01-2-00214

Billett, S. (2002b). Toward a workplace pedagogy: Guidance, participation, and engagement. *Adult Education Quarterly, 53*(1), 27–43. https://doi.org/10.1177/074171302237202

Billett, S. (2004). Workplace participatory practices: Conceptualizing workplaces as learning environments. *Journal of Workplace Learning, 16*(6), 312–324. https://doi.org/10.1108/13665620410550295

Billett, S. (2010). The perils of confusing lifelong learning with lifelong education. *International Journal of Lifelong Education, 29*, 401–413. https://doi.org/10.1080/02601370.2010.488803

Boeren, E. (2009). Adult education participation: The Matthew principle. *Filosofija- Sociologija, 20*(2), 154–161.

Boeren, E. (2011). Gender differences in formal, non-formal and informal adult learning. *Studies in Continuing Education, 33*(3), 333–346. https://doi.org/10.1080/0158037X.2011.610301

Boeren, E. (2016). *Lifelong learning participation in a changing policy context. An interdisciplinary theory*. Palgrave Macmillan.

Boeren, E. (2017). Understanding adult lifelong learning participation as a layered problem. *Studies in Continuing Education, 39*(2), 161–175. https://doi.org/10.1080/0158037X.2017.1310096

Boeren, E., Nicaise, I., & Baert, H. (2010). Theoretical models of participation in adult education: The need for an integrated model. *International Journal of Lifelong Learning, 29*(1), 45–61. https://doi.org/10.1080/02601370903471270

Booth, M., & Schwartz, H. L. (2012). We're all adults here: Clarifying and maintaining boundaries with adult learners. *New Directions for Teaching and Learning, 131*, 43–55. https://doi.org/10.1002/tl.20026

Boud, D., & Garrick, J. (1999). *Understanding learning at work*. Routledge.

Bourdieu, P. (1973). Cultural reproduction and social reproduction. In R. Brown (Ed.), *Knowledge, education, and cultural change* (pp. 71–84). Tavistock Publications.

Breiman, L. (2001). Random forests. *Machine Learning, 45*(1), 5–32. http://dx.doi.org/10.1023/A:1010933404324

Breiman, L. (2004). *Consistency for a simple model of random forests* (Technical Report 670). Statistics Department, University of California at Berkeley. Retrieved from: https://www.stat.berkeley.edu/~breiman/RandomForests/consistencyRFA.pdf

Breiman, L. (2017). *Classification and regression trees*. Routledge.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Harvard University Press.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology, 22*(6), 723–742. https://doi.org/10.1037/0012-1649.22.6.723

Brookfield, S. D. (1986). *Understanding and facilitating adult learning: A comprehensive analysis of principles and effective practices*. Jossey-Bass.

Brown, A., & Bimrose, J. (2018). Drivers of learning for the low-skilled. *International Journal of Lifelong Education, 37*(2), 151–167. https://doi.org/10.1080/02601370.2017.1378934

Brown, J. O. (2001). The portfolio: A reflective bridge connecting the learner, higher education, and the workplace. *The Journal of Continuing Higher Education, 49*(2), 2–13. https://doi.org/10.1080/07377366.2001.10400426

Brown, P., Green, A., & Lauder, H. (2001). *High skills: globalization, competitiveness, and skill formation*. Oxford University Press.

Burke, R. J., Cooper, C. L., & Antoniou, A. S. G. (2015). *The multi-generational and aging workforce: Challenges and opportunities*. Edward Elgar. https://doi.org/10.4337/9781783476589

Cacciattolo, K. (2015). Defining workplace learning. *European Scientific Journal, 11*(10), 243–250. Retrieved from: https://eujournal.org/index.php/esj/article/view/5559

Campbell, J., McKay, A., & Thomson, E. (2006). From gender blind to gender focus: Re-evaluating the Scottish modern apprenticeship programme, *Scottish Affairs, 57*(1), 70–89. https://doi.org/10.3366/scot.2006.0052

Casey, C. (2013). Learning organizations, learning workers: Toward enhanced employment relations. *International Journal of Continuing Education and Lifelong Learning, 5*(2), 121–137.

Cawley, J., Heckman, J., & Vytlacil, E. (1998). *Meritocracy in America: An examination of wages within and across occupations* (NBER Working Paper 6446). National Bureau of Economic Research. https://doi.org/10.3386/w6446

Celeux, G., & Soromenho, G. (1996). An entropy criterion for assessing the number of clusters in a mixture model. *Journal of Classification, 13*(2), 195–212. https://doi.org/10.1007/BF01246098

Chakraborty, D., Başağaoğlu, H., & Winterle, J. (2021). Interpretable vs. noninterpretable machine learning models for data-driven hydro-climatological process modeling. *Expert Systems with Applications, 170*, 114498. https://doi.org/10.1016/j.eswa.2020.114498

Chiţiba, C. A. (2012). Lifelong learning challenges and opportunities for traditional universities. *Procedia – Social and Behavioral Sciences, 46*, 1943–1947. https://doi.org/10.1016/j.sbspro.2012.05.408

Choi, J., Robinson, S., Maulik, R., & Wehde, W. (2020). What matters the most? Understanding individual tornado preparedness using machine learning. *Natural Hazards, 103*, 1183–1200. https://doi.org/10.1007/s11069-020-04029-1

Cieslik, M. (2006). Reflexivity, learning identities and adult basic skills in the United Kingdom. *British Journal of Sociology of Education, 27*(2), 237–250. https://doi.org/10.1080/01425690600556461

Clochard, A., & Westerman, G. (2020). *Understanding the incumbent worker's decision to train: The challenges facing less-educated workers* (MIT Work of the Future Working Paper 9-2020). MIT Industrial Performance Center. Retrieved from: https://jwel.mit.edu/sites/mit-jwel/files/assets/files/2020-working-paper-clochard-westerman.pdf

Colley, H., Hodkinson, P., & Malcolm, J. (2002). *Non-formal learning: Mapping the conceptual terrain: A consultation report*. University of Leeds Lifelong Learning Institute.

Commission of the European Communities. (2000). *A memorandum on lifelong learning* (Commission Staff Working Paper). Office for Official Publications of the European Communities. Retrieved from: https://uil.unesco.org/i/doc/lifelong-learning/policies/european-communities-a-memorandum-on-lifelong-learning.pdf

Commission of the European Communities. (2001). *Making a European area of lifelong learning a reality*. Office for Official Publications of the European Communities. Retrieved from: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2001:0678:FIN:EN:PDF

Conlon, T. J. (2004). A review of informal learning literature, theory and implications for practice in developing global professional competence. *Journal of European Industrial Training, 23*(2/3/4), 283–295. https://doi.org/10.1108/03090590410527663

Cook, B., & King, J. (2004). *Low-income adults in profile: Improving lives through higher education*. American Council on Education Center for Policy Analysis. Retrieved from: https://www.immagic.com/eLibrary/ARCHIVES/GENERAL/LUMINA/L040224C.pdf

Cookson, P. S. (1986). A framework for theory and research on adult education participation. *Adult Education Quarterly*, 36(3), 130–141. https://doi.org/10.1177/0001848186036003002

Coughlin, M. A., Laguilles, J. S., Kelly, H. A., & Walters, A. M. (2016). Postgraduate outcomes in American higher education. *New Directions for Institutional Research, 169*, 11–23. https://doi.org/10.1002/ir.20166

Craig, R. L. (1996). *The ASTD training and development handbook: A guide to human resource development*. McGraw-Hill.

Cranton, P. (2002). Teaching for transformation. *New Directions for Adult and Continuing Education, 93*, 63–71. https://doi.org/10.1002/ace.50

Creighton, S., & Hudson, L. (2002). *Participation trends and patterns in adult education: 1991 to 1999* (NCES 2002-119). National Center for Education Statistics, U.S. Department of Education. U.S. Government Printing Office. Retrieved from: https://nces.ed.gov/pubs2002/2002119.pdf

Cross, K. P. (1981). *Adults as learners: Increasing participation and facilitating learning*. Jossey-Bass.

Cseh, M., Watkins, K. E., & Marsick, V. J. (2000). Informal and incidental learning in the workplace. In G. A. Straka (Ed.), *Conceptions of self-directed learning: Theoretical and conceptual considerations* (pp. 59–74). Waxmann.

Cummins, P. A., Harrington, A. K., & Yamashita, T. (2022). Individual learning accounts: A comparison of implemented and proposed initiatives. *Adult Learning, 33*(4), 147–157. https://doi.org/10.1177/10451595211046971

Cummins, P. A., Yamashita, T., & Arbogast, A. (2018). *An examination of PIAAC data for unemployed adults aged 45–74*. Retrieved from PIAAC Gateway website: https://piaac.squarespace.com/s/Cummins-Yamashita-Arbogast_2018.pdf

Darkenwald, G. G., & Merriam, S. B. (1982). *Adult education: Foundations of practice*. Harper and Row.

Desjardins, R. (2011). Participation in adult learning. In P. Peterson, E. Baker, & B. McGaw (Eds.), *International encyclopedia of education* (pp. 240–250). Elsevier. https://doi.org/10.1016/B978-0-08-044894-7.00037-3

Desjardins, R. (2015). *Participation in adult education opportunities: Evidence from PIAAC and policy trends in selected countries* (Background paper for EFA Global Monitoring Report 2015). UNESCO. Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000232396_eng

Desjardins, R. (2017). *Political economy of adult learning systems: Comparative study of strategies, policies and constraints*. Bloomsbury.

Desjardins, R. (2019). The labor market benefits of adult education from a global perspective. *International Review of Education, 65*, 955–973. https://doi.org/10.1007/s11159-019-09813-1

Desjardins, R. (2020). *PIAAC thematic review on adult learning* (OECD Education Working Papers No. 223). OECD Publishing. https://doi.org/10.1787/864d2484-en

Desjardins, R., & Ederer, P. (2015). Socio-demographic and practice-oriented factors related to proficiency in problem solving: A lifelong learning perspective. *International Journal of Lifelong Education, 34*(4), 468–486. https://doi.org/10.1080/02601370.2015.1060027

Desjardins, R., & Lee, J. (2016). *Earnings and employment benefits of adult higher education in comparative perspective: Evidence based on the OECD Survey of Adults Skills (PIAAC)*. Retrieved from PIAAC Gateway website: https://static1.squarespace.com/static/51bb74b8e4b0139570ddf020/t/578d1dcc414fb589c6502f6b/1468865997731/Desjardins_Lee_PIAAC.pdf

Desjardins, R., & Rubenson, K. (2011). *An analysis of skill mismatch using direct measures of skills* (OECD Education Working Papers No. 63). OECD Publishing. https://doi.org/10.1787/5kg3nh9h52g5-en

Desjardins, R., & Warnke, A. (2012). *Aging and skills: A review and analysis of skill gain and skill loss over the lifespan and over time* (OECD Education Working Papers No. 72). OECD Publishing. https://doi.org/10.1787/5k9csvw87ckh-en

Desjardins, R., Milana, M., & Rubenson, K. (2006). *Unequal chances to participate in adult learning: International perspectives*. UNESCO. Retrieved from: https://files.eric.ed.gov/fulltext/ED499629.pdf

Dibra, G., Kashahu, L., Bushati, J., & Priku, M. (2014). Learning among adults. *European Scientific Journal, 10*(13), 498–506. https://doi.org/10.19044/esj.2014.v10n13p%25p

Dieckhoff, M., Jungblut, J.-M., & O'Connell, P. J. (2007). Job-related training in Europe: Do institutions matter? In D. Gallie (Ed.), *Employment regimes and the quality of work* (pp. 77–104). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199230105.003.0003

Doornbos, A. J., Bolhuis, S., & Simons, P. R. J. (2004). Modeling work-related learning on the basis of intentionality and developmental relatedness: A noneducational perspective.

Human Resource Development Review, 3(3), 250–274.

https://doi.org/10.1177/1534484304268107

Doornbos, A. J., Simons, R-J., & Denessen, E. (2008). Relations between characteristics of

workplace practices and types of informal work-related learning: A survey study among

Dutch Police. *Human Resource Development Quarterly, 19*(2), 129–151.

https://doi.org/10.1002/hrdq.1231

Egglestone, C., Stevens, C., Jones, E., & Aldridge, F. (2018). *Adult participation in learning*

survey 2017 (Learning and Work Institute Report). UK Department of Education.

Retrieved from:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_

data/file/735438/Participation_in_Learning_Survey_2017.pdf

Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal*

of Educational Psychology, 70(1), 113–136. https://doi.org/10.1348/000709900158001

Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education, 26*(2),

247–273. https://doi.org/10.1080/158037042000225245

Eurofound. (2012). *Fifth European working conditions survey*. Publications Office of the

European Union. Retrieved from:

https://www.eurofound.europa.eu/sites/default/files/ef_publication/field_ef_document/ef

1182en.pdf

European Centre for the Development of Vocational Training. (2015). *Job-related adult learning*

and continuing vocational training in Europe. A statistical picture (Research Paper No.

48). Publications Office of the European Union. Retrieved from:

https://data.europa.eu/doi/10.2801/392276

European Centre for the Development of Vocational Training. (2016). *Unequal access to job-related learning: Evidence from the adult education survey* (Research Paper No. 52). Publications Office of the European Union. Retrieved from: https://data.europa.eu/doi/10.2801/219228

European Commission. (2006). *Operational guide for clusters and peer learning activities in the context of the education and training 2010 work programme*. Author.

European Union. (2016). Council recommendation of 15 February 2016 on the integration of the long-term unemployed into the labour market (2016/C 67/01). Retrieved from: https://eurlex.europa.eu/legalcontent/EN/TXT/?uri=CELEX:32016H0220%2801%29&qid=1456753373365

Eurostat. (2016). *Classification of learning activities (CLA): Manual*. Publications Office of the European Union. Retrieved from: https://ec.europa.eu/eurostat/documents/3859598/7659750/KS-GQ-15-011-EN-N.pdf

Feinberg, I., Tighe, E. L., Talwar, A., & Greenberg, D. (2019). *Writing behaviors relation to literacy and problem solving in technology-rich environments: Results from the 2012 and 2014 U.S. PIAAC study*. Retrieved from PIAAC Gateway website: https://static1.squarespace.com/static/51bb74b8e4b0139570ddf020/t/5d3a210b5abd570001becd72/1564090635798/2019_Feinberg_Tighe_Talwar_Greenberg_WritingBehaviors.pdf

Feldman, D. C., & Ng, T. W. H. (2011). Participation in continuing education programs: Antecedents, consequences, and implications. In M. London (Ed.), *The Oxford handbook of lifelong learning* (pp. 180–194). Oxford University Press.

Fenwick, T. (2001). Tides of change: New themes and questions in workplace learning. *New Directions for Adult and Continuing Education, 92*, 3–18. https://doi.org/10.1002/ace.36

Fenwick, T. (2008a). Understanding relations of individual–collective learning in work: A review of research. *Management Learning, 39*(3), 227–243. https://doi.org/10.1177/1350507608090875

Fenwick, T. (2008b). Workplace learning: Emerging trends and new perspectives. *New Directions for Adult and Continuing Education, 119*, 17–26. https://doi.org/10.1002/ace.302

Fergusson, L., & van der Laan, L. (2021). Work + learning: Unpacking the agglomerated use of pedagogical terms. *Journal of Work-Applied Management, 13*(2), 302–314. https://doi.org/10.1108/JWAM-12-2020-0053

Findsen, B. (2006). Social institutions as sites of learning for older adults: Differential opportunities. *Journal of Transformative Education, 4*(1), 65–81. https://doi.org/10.1177/1541344605282429

Findsen, B., & Formosa, M. (2016). *International perspectives on older adult education: Research, policy and practice*. Springer. https://doi.org/10.1007/978-3-319-24939-1

Fouarge, D., Schils, T., & Grip, A. D. (2013). Why do low-educated workers invest less in further training? *Applied Economics, 45*(18), 2587–2601. https://doi.org/10.1080/00036846.2012.671926

Fouarge, D., & Schils, T. (2009). The effect of early retirement incentives on the training participation of older workers. *LABOUR: Review of Labour Economics and Industrial Relations, 23*(1), 85–109. https://doi.org/10.1111/j.1467-9914.2008.00441.x

Froehlich, D. E., Beausaert, S., Segers, M., & Gerken, M. (2014). Learning to stay employable. *Career Development International, 19*(5), 508–525. https://doi.org/10.1108/CDI-11-2013-0139

Gallagher, S. (2020). *The future of university credentials: New developments and the intersection of higher education and hiring*. Harvard Education Press.

Garavan, T. N., Morley, M., Gunigle, P., & McGuire, D. (2002). Human resource development and workplace learning: Emerging theoretical perspectives and organizational practices. *Journal of European Industrial Training, 26*(2/3/4), 60–71. https://doi.org/10.1108/03090590210428133

García, S., Ramírez-Gallego, S., Luengo, J., Benítez, J. M., & Herrera, F. (2016). Big data preprocessing: Methods and prospects. *Big Data Analytics, 1*, 9. https://doi.org/10.1186/s41044-016-0014-0

Geduld, B. (2014). Re-thinking the value of learning theories to develop self-directedness in open-distance students. *Journal of Educational and Social Research, 4*(6), 11–18. https://doi.org/10.5901/jesr.2014.v4n6p11

Gherardi, S. (2006). *Organizational knowledge: The texture of workplace learning*. Blackwell Publishing.

Gijbels, D., I. Raemdonck, I., & Vervecken. D. (2010). Influencing work-related learning: The role of job characteristics and self-directed learning orientation in part-time vocational education. *Vocations and Learning, 3*, 239–255. https://doi.org/10.1007/s12186-010-9041-6

Grinyer, P. H., & Yasai-Ardekani, M. (1981). Strategy, structure, size and bureaucracy. *Academy of Management Journal, 24*, 471–486. https://doi.org/10.5465/255569

Grotlüschen, A. (2016). Literacy level I and below versus literacy level IV and above. *Zeitschrift für Weiterbildungsforschung – Report, 39*, 255–270. https://doi.org/10.1007/s40955-016-0068-7

Grotlüschen, A., Mallows, D., Reder, S., & Sabatini, J. (2016). *Adults with low proficiency in literacy or numeracy* (OECD Education Working Papers No. 131). OECD Publishing. https://doi.org/10.1787/5jm0v44bnmnx-en

Hagenaars, J. A., & McCutcheon, A. L. (2002). *Applied latent class analysis*. Cambridge University Press.

Han, S., Chae, C., & Passmore, D. L. (2019). Social network analysis and social capital in human resource development research: A practical introduction to R use. *Human Resource Development Quarterly, 30*, 219–243. https://doi.org/10.1002/hrdq.21341

Hämäläinen, R., De Wever, B., Nissinen, K., & Cincinnato, S. (2019). What makes the difference – PIAAC as a resource for understanding the problem-solving skills of Europe's higher-education adults. *Computers & Education, 129*, 27–36. https://doi.org/10.1016/j.compedu.2018.10.013

Heisig, J. P., & Solga, H. (2017). *How returns to skills depend on formal qualifications: Evidence from PIAAC* (OECD Education Working Papers No. 163). OECD Publishing. https://doi.org/10.1787/332a43d7-en

Hogan, A., & Roberts, B. (2015, December). *Occupational employment projections to 2024. Monthly Labor Review*. U.S. Bureau of Labor Statistics. https://doi.org/10.21916/mlr.2015.49

Horn, L., & Li, X. (2009). *Changes in postsecondary awards below the bachelor's degree: 1997 to 2007* (NCES 2010-167). National Center for Education Statistics, U.S. Department of

Education. U.S. Government Printing Office. Retrieved from:

https://nces.ed.gov/pubs2010/2010167.pdf

Illeris, K. (2003). Workplace learning and learning theory. *Journal of Workplace Learning,
15*(4), 167–178. https://doi.org/10.1108/13665620310474615

Illeris, K. (2006). Lifelong learning and low-skilled. *International Journal of Lifelong Education,
25*(1), 15–28. https://doi.org/10.1080/02601370500309451

Illeris, K. (2007). *How we learn: Learning and non-learning in school and beyond*. Routledge.

Ioannidou, A., & Parma, A. (2022). Risk of job automation and participation in adult education
and training: Do welfare regimes matter? *Adult Education Quarterly, 72*(1), 84–109.

https://doi.org/10.1177/07417136211026635

Ivy, J. (2008). A new higher education marketing mix: the 7Ps for MBA marketing.

International Journal of Educational Management, 22(4), 288–299.

https://doi.org/10.1108/09513540810875635

Jacobs, R. L., & Park, Y. (2009). A proposed conceptual framework of workplace learning:

Implications for theory development and research in human resource development.

Human Resource Development Review, 8(2), 133–150.

https://doi.org/10.1177/1534484309334269

Jarvis, P. (2006). *Towards a comprehensive theory of human learning*. Routledge.

Jarvis, P. (2010). *Adult education and lifelong learning: Theory and practice* (4th ed.).

Routledge. https://doi.org/10.4324/9780203718100

Jarvis, P. (2011). Adult education and the changing international scene: Theoretical perspectives.

PAACE Journal of Lifelong Learning, 20, 37–50.

Jeon, K. S., & Kim, K.-N. (2012). How do organizational and task factors influence informal

    learning in the workplace? *Human Resource Development International, 15*(2), 209–226.

    https://doi.org/10.1080/13678868.2011.647463

Jyung, C.-Y., Lee, Y., Park, S., Cho, E., & Choi, R. (2020). Factors affecting employees'

    problem-solving skills in technology-rich environments in Japan and Korea.

    Sustainability, 12, 7079. https://doi.org/10.3390/su12177079

Kalenda, J., & Kočvarová, I. (2022). "Why don't they participate?" Reasons for nonparticipation

    in adult learning and education from the viewpoint of self-determination theory.

    European Journal for Research on the Education and Learning of Adults, 13(2), 193–

    208. https://doi.org/10.3384/rela.2000-7426.3535

Kalenda, J., Kočvarová, I., & Vaculíková., J. (2020). Determinants of participation in nonformal

    education in the Czech Republic. *Adult Education Quarterly, 70*(2), 99–118.

    https://doi.org/10.1177/0741713619878391

Kalleberg, A. L., Knoke, D., Marsden, P. V., & Spaeth, J. L. (1996). *Organizations in America:*

    Analyzing their structures and human resource practices. Sage Publications.

Kasworm, C. E. (2008). Emotional challenges of adult learners in higher education. *New*

    Directions for Adult and Continuing Education, 120, 27–34.

    https://doi.org/10/1002/ace.313

Kazis, R., Callahan, A., Davidson, C., McLeod, A., Bosworth, B., Choitz, V., & Hoops, J.

    (2007). *Adult learners in higher education: Barriers to success and strategies to improve*

    results (ETA Occupational Paper 2007-03). Employment and Training Administration,

    U.S. Department of Labor. Retrieved from:

    https://files.eric.ed.gov/fulltext/ED497801.pdf

Keeley, B. (2007). *Human capital: How what you know shapes your life*. OECD Publishing. https://doi.org/10.1787/9789264029095-en

Kersh, N., Toiviainen, H., Zarifis, G. K., & Pitkänen, P. (2021). *Young adults and active citizenship towards social inclusion through adult education*. Springer.

Killian, M. O., Cimino, A. N., Weller, B. E., & Seo, C. H. (2019). A systematic review of latent variable mixture modeling research in social work journals. *Journal of Evidence-Based Social Work, 16*(2), 192–210. https://doi.org/10.1080/23761407.2019.1577783

Kim, C., & Park, T. (2022). Predicting determinants of lifelong learning intention using gradient boosting machine (GBM) with grid search. *Sustainability, 14*, 5256. https://doi.org/10.3390/su14095256

Kim, D., Lee, I.-H., & Park, J.-H. (2019). Latent class analysis of non-formal learners' self-directed learning patterns in open educational resource repositories. *British Journal of Educational Technology, 50*(6), 3420–3436. https://doi.org/10.1111/bjet.12746

Kis, V. (2016). *Work, train, and win: Work-based learning design and management for productivity gains* (OECD Education Working Papers No. 135). OECD Publishing. https://doi.org/10.1787/5jlz6rbns1g1-en

Kleefstra, A., Altan, M., & Stoffers, J. (2020). Workplace learning and organizational performance in the hospitality industry. *International Hospitality Review, 34*(2), 173–186. https://doi.org/10.1108/IHR-12-2019-0025

Knapper, C. K., & Cropley, A. J. (2000). *Lifelong learning in higher education* (3rd ed.). Kogan Page.

Knipprath, H., & De Rick, K. (2015). How social and human capital predict participation in

    lifelong learning: A longitudinal data analysis. *Adult Education Quarterly, 65*(1), 50–66.

    https://doi.org/10.1177/0741713614561855

Knowles, M. (1975). *Self-directed learning: A guide for learners and teachers*. Englewood

    Cliffs.

Knowles, M. (1990). *The adult learner: A neglected species*. Gulf Publishing Co.

Knowles, M., Holton, E. F., & Swanson, R. A. (1998). *The adult learner: The definitive classic*

    in adult education and human resource development. Gulf Publishing Co.

Kohavi, R. (1995). A study of cross-validation and bootstrap for accuracy estimation and model

    selection. Proceedings of the 14th International Joint Conference on Artificial

    Intelligence. Montreal, Québec, Canada.

Kopka, T. L., & Peng., S. S. (1993). *Adult education: Main reasons for participating* (NCES 93-

    451). National Center for Education Statistics, U.S. Department of Education. U.S.

    Government Printing Office. Retrieved from:

    https://files.eric.ed.gov/fulltext/ED358365.pdf

Kruskal, J. B. (1964). Multidimensional scaling by optimizing goodness of fit to a nonmetric

    hypothesis. *Psychometrika, 29*(1), 1–27. https://doi.org/10.1007/BF02289565

Kwiek, M. (2012). The public/private dynamics in Polish higher education. Demand-absorbing

    private sector growth and its implications. In M. Kwiek, & P. Maassen (Eds.), *National*

    higher education reforms in a European context: Comparative reflections on Poland and

    Norway (pp. 127–154). Peter Lang.

Kwon, K. (2019). The long-term effect of training and development investment on financial performance in Korean companies. *International Journal of Manpower, 40*(6), 1092–1109. https://doi.org/10.1108/IJM-10-2017-0286

Kyeong, S., & Shin, J. (2022). Two-stage credit scoring using Bayesian approach. *Journal of Big Data, 9*, 106. https://doi.org/10.1186/s40537-022-00665-5

Kyndt, E., & Baert, H. (2013). Antecedents of employees' involvement in work-related learning: a systematic review. *Review of Educational Research, 83*(2), 273–313. https://doi.org/10.3102/0034654313478021

Kyndt, E., Dochy, F., & Nijs, H. (2009). Learning conditions for non-formal and informal workplace learning. *Journal of Workplace Learning, 21*(5), 369–383. https://doi.org/10.1108/13665620910966785

Kyndt, E., Govaerts, N., Claes, T., de la Marche, J., & Dochy, F. (2013a). What motivates low-qualified employees to participate in training and development? A mixed-method study on their learning intentions. *Studies in Continuing Education, 35*, 315–336. https://doi.org/10.1080/0158037X.2013.764282

Kyndt, E., Govaerts, N., Keunen, L., & Dochy, F. (2013b). Examining the learning intentions of low-qualified employees: A mixed method study. *Journal of Workplace Learning, 25*(3), 178–197. https://doi.org/10.1108/13665621311306556

Kyndt, E., Govaerts, N., Dochy, F., & Baert, H. (2011). The learning intention of low-qualified employees: A key for participation in lifelong learning and continuous training. *Vocations and Learning, 4*, 211–229. https://doi.org/10.1007/s12186-011-9058-5

Laal, M., & Salamati, P. (2012). Lifelong learning; why do we need it? *Procedia – Social and Behavioral Sciences, 31*, 399–403. https://doi.org/10.1016/j.sbspro.2011.12.073

Lavrijsen, J., & Nicaise, I. (2015). *Systemic obstacles to participation in lifelong learning*. Steunpunt Studie- en Schoolloopbanen.

Lee, J., & Desjardins, R. (2019). Inequality in adult learning and education participation: The effects of social origins and social inequality. *International Journal of Lifelong Education, 38*(3), 339–359. https://doi.org/10.1080/02601370.2019.1618402

Lee, J., & Desjardins, R. (2021). Changes to adult learning and education (ALE) policy environment in Finland, Korea and the United States: Implications for addressing inequality in ALE participation. *Compare: A Journal of Comparative and International Education, 51*(2), 221–239. https://doi.org/10.1080/03057925.2019.1610356

Liaw, A. & Wiener, M. (2002). *Classification and regression by randomForest. R News, 2*, 18–22. Retrieved from: https://cogns.northwestern.edu/cbmg/LiawAndWiener2002.pdf

Liaw, A., & Wiener, M. (2015). *randomForest: Breiman and cutler's random forests for classification and regression* [R Package]. Retrieved from: https://cran.r-project.org/web/packages/randomForest/randomForest.pdf

Lim, D. H., Jeong, S. H., Yoo, S., & Yoo, M. H. (2018). Older workers' education and earnings among OECD countries. *European Journal of Training and Development, 42*(3/4), 170–190. https://doi.org/10.1108/EJTD-08-2017-0069

Lim, D. H., Ryu, H., & Jin, B. (2020). A latent class analysis of older workers' skill proficiency and skill utilization in South Korea. *Asia Pacific Education Review, 21*, 365–378. https://doi.org/10.1007/s12564-020-09632-2

Lin, Y., Cai, Y., Gong, Y., Kang, M., & Li, L. (2019). Extracting urban landmarks from geographical datasets using a random forests classifier. *International Journal of*

Geographical Information Science, 33(12), 2406–2423.
https://doi.org/10.1080/13658816.2019.1620238

Livingstone, D. W. (1999). *Exploring the icebergs of adult learning: Findings of the first Canadian survey of informal learning practices* (WALL Working Paper No. 10). Centre for the Study of Education and Work, OSIE/UT. Retrieved from:
https://hdl.handle.net/1807/2724

Livingstone, D. W. (2008). Mapping the field of lifelong (formal and informal) learning and (paid and unpaid) work. In D. W. Livingstone, K. Mirchandani, & P. H. Sawchuck. (Eds.), *The future of lifelong learning and work: Critical perspectives* (pp. 13–30). Sense.

Livingston, A., & Wirt, J. (2004). *The condition of education 2004 in brief* (NCES 2004-076). National Center for Education Statistics, U.S. Department of Education. U.S. Government Printing Office. Retrieved from: https://nces.ed.gov/pubs2004/2004076.pdf

Loh, W.-Y. (2011). Classification and regression trees. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 1*(1), 14–23. https://doi.org/10.1002/widm.8

Longworth, N. (2003). *Lifelong learning in action: Transforming education in the 21st century*. Kogan Page.

Longworth, N., & Davies, W. K. (1996). *Lifelong learning: New vision, new implications, new role for people, organizations, nations and communities in the 21st century*. Kogan Page.

Lorenz, E., Lundvall, B.-Å., Kraemer-Mbula, E., & Rasmussen, P. (2016). Work organisation, forms of employee learning and national systems of education and training. *European Journal of Education, 51*(2), 154–175. https://doi.org/10.1111/ejed.12177

Lundgren, H., Bang, A., Justice, S. B., Marsick, V. J., Poell, R. F., Yorks, L., Clark, M., & Sung, S. (2017). Conceptualizing reflection in experience-based workplace learning. *Human*

Resource Development International, 20(4), 305–326.

https://doi.org/10.1080/13678868.2017.1308717

Marsick, V. J. (2009). Toward a unifying framework to support informal learning theory,

research and practice. *Journal of Workplace Learning, 21*(4), 265–275.

https://doi.org/10.1108/13665620910954184

Marsick, V. J., & Volpe, M. (1999). The nature and need for informal learning. *Advances in*

Developing Human Resources, 1(3), 1–9. https://doi.org/10.1177/152342239900100302

Marsick, V. J., & Watkins, K. E. (1990). *Informal and incidental learning in the workplace*.

Routledge.

Marsick, V. J., & Watkins, K. E. (1999). Looking again at learning in the learning organization:

a tool that can turn into a weapon! *The Learning Organization, 6*(5), 207–211.

https://doi.org/10.1108/09696479910299820

Marsick, V. J., & Watkins, K. E. (2001). Informal and incidental learning. *New Directions for*

Adult and Continuing Education, 89, 25–34. https://doi.org/10.1002/ace.5

Marsick, V. J., & Watkins, K. E. (2015). Informal learning in learning organizations. In R. F.

Poell, T. S. Rocco, & G. L. Roth (Eds.), *The Routledge companion to human resource*

development (pp. 236–248). Routledge.

Massing, N., & Gauly, B. (2017). Training participation and gender: Analyzing individual

barriers across different welfare state regimes. *Adult Education Quarterly, 67*(4), 266–

285. https://doi.org/10.1177/0741713617715706

Maurer, T. J., Weiss, E. M., & Barbeite, F. G. (2003). A model of involvement in work-related

learning and development activity: The effects of individual, situational, motivational,

and age variables. *The Journal of Applied Psychology, 88*(4), 707–724.

https://doi.org/10.1037/0021-9010.88.4.707

McGivney, V. (1999). *Informal learning in the community: A trigger for change and development*. National Institute of Adult Continuing Education.

McGowan, M. A., & Andrews, D. (2017). *Skills mismatch, productivity and policies: Evidence from the second wave of PIAAC* (OECD Economics Department Working Papers No. 1403). OECD Publishing. https://doi.org/10.1787/65dab7c6-en

McGuinness, S., Pouliakas, K., & Redmond, P. (2017a). *How useful is the concept of skills mismatch?* International Labour Organization Publications. Retrieved from:

https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_552798.pdf

Melacarne, C., & Nicolaides, A. (2019). Developing professional capability: Growing capacity and competencies to meet complex workplace demands. *New Directions for Adult and Continuing Education, 163*, 37–51. https://doi.org/10.1002/ace.20340

Merriam, S. B. (2001). Something old, something new: Adult learning theory for the twenty-first century. In S. B. Merriam (Ed.), *The new update on adult learning theory, new directions for adult and continuing education* (pp. 93–96). Jossey-Bass.

Merriam, S. B. (2008). *Third update on adult learning theory*. Jossey-Bass.

Merriam, S. B., Caffarella, R. S., & Baumgartner, L. M. (2007). *Learning in adulthood: A comprehensive guide*. Jossey-Bass.

Messinis, G., & Olekalns, N. (2008). *Returns to training and skill mismatch: Evidence from Australia* (CSES Working Paper No. 40). Centre for Strategic Economic Studies, Victoria University. Retrieved from:

https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=a3de87db4dbb77335b06d3709a9269c64694cf7b

Mezirow, J. (2000). Learning to think like an adult: Core concepts in transformation theory. In J. Mezirow (Ed.), *Learning as transformation: Critical perspectives on a theory in progress* (pp. 3–34). Jossey-Bass.

Milheim, K. L. (2005). Identifying and addressing the needs of adult students in higher education. *Australian Journal of Adult Learning, 45*(1), 119–128.

Mincer, J. (1989). Human capital and the labor market: A review of current research. *Educational Researcher, 18*(4), 27–34. https://doi.org/10.3102/0013189X018004027

Monear, D. (2020). *Strategies for a changing labor market: Reskilling and upskilling for career advancement in the post-COVID-19 economy*. Higher Education and the Labor Market. Washington Student Achievement Council. Retrieved from: https://files.eric.ed.gov/fulltext/ED613337.pdf

Munnell, A. H., Sass, S. A., & Soto, M. (2006). *Employer attitudes toward older workers: Survey results* (Work Opportunities for Older Americans Series 3). Center for Retirement Research at Boston College. Retrieved from: https://crr.bc.edu/wp-content/uploads/2006/07/wob_3.pdf

Muthén, B., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical & Experimental Research, 24*(6), 882–891. https://doi.org/10.1111/j.1530-0277.2000.tb02070.x

Nakamura, Y., & Yorks, L. (2011). The role of reflective practices in building social capital in organizations from an HRD perspective. *Human Resource Development Review, 10*(3), 222–245. https://doi.org/10.1177/1534484311411076

Narushima, M., Liu, J., & Diestelkamp, N. (2018). I learn, therefore I am: A phenomenological analysis of meanings of lifelong learning for vulnerable older adults. *The Gerontologist, 58*(4), 696–705. https://doi.org/10.1093/geront/gnx044

Nyhan, B., Kelleher, M., Cressey, P., Poell, R. F. (2003). *Facing up to the learning organisation challenge: Selected European writings volume II* (CEDEFOP Reference Series 41-II). Office for Official Publications of the European Communities. Retrieved from: https://www.cedefop.europa.eu/files/3028_II_en.pdf

Nylander, E., Fejes, A., & Milana, M. (2022). Exploring the themes of the territory: A topic modelling approach to 40 years of publications in International Journal of Lifelong Education (1982–2021). *International Journal of Lifelong Education, 41*(1), 27–44. https://doi.org/10.1080/02601370.2021.2015636

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling, 14*(4), 535–569. https://doi.org/10.1080/10705510701575396

Organization for Economic Cooperation and Development. (1996). *Lifelong learning for all*. Meeting of the Education Committee at Ministerial Level, 16–17 January 1996. Author.

Organization for Economic Cooperation and Development. (2005). *Learning a living: First results of the Adult Literacy and Life Skills Survey*. OECD Publishing. https://doi.org/10.1787/9789264010390-en

Organization for Economic Cooperation and Development. (2008). *Tertiary education for the knowledge society: Volume 1 and Volume 2*. OECD publishing. https://doi.org/10.1787/9789264046535-en

Organization for Economic Cooperation and Development. (2012a). *Literacy, numeracy, and problem solving in technology-rich environments: Framework for the OECD survey of adult skills*. OECD publishing. https://doi.org/10.1787/9789264128859-en

Organization for Economic Cooperation and Development. (2012b). *PISA 2012 results: Ready to learn (volume III): Students' engagement, drive and self-beliefs*. OECD Publishing. https://doi.org/10.1787/9789264201170-en

Organization for Economic Cooperation and Development. (2013). *OECD skills outlook 2013: First results from the survey of adult skills*. OECD Publishing. http://dx.doi.org/10.1787/9789264204256-en

Organization for Economic Cooperation and Development. (2016). *Skills matter: Further results from the survey of adult skills*. OECD Publishing. http://dx.doi.org/10.1787/9789264258051-en

Organization for Economic Cooperation and Development. (2019a). *Getting skills right: Creating responsive adult learning systems*. OECD Publishing. Retrieved from: https://www.oecd.org/els/emp/adult-learning-systems-2019.pdf

Organization for Economic Cooperation and Development. (2019b). *Getting skills right: Engaging low-skilled adults in learning*. OECD Publishing. Retrieved from: https://www.oecd.org/els/emp/engaging-low-skilled-adults-2019.pdf

Organization for Economic Cooperation and Development. (2019c). *Getting skills right: Future-ready adult learning systems*. OECD Publishing. https://doi.org/10.1787/9789264311756-en

Openjuru, G. L. (2011). Lifelong learning, lifelong education and adult education in higher institutions of learning in Eastern Africa: The case of Makerere University Institute of Adult and Continuing Education. *International Journal of Lifelong Learning, 30*(1), 55–69. https://doi.org/10.1080/02601370.2011.538182

Palmer, R. (2017). *Jobs and skills mismatch in the informal economy*. International Labour Organization Publications. Retrieved from: http://www.oit.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_629018.pdf

Park, Y., & Jacobs, R. L. (2011). The influence of investment in workplace learning on learning outcomes and organizational performance. *Human Resource Development Quarterly, 22*(4), 437–458. https://doi.org/10.1002/hrdq.20085

Pate, J., Martin, G., Beaumont, P., & McGoldrick, J. (2000). Company-based lifelong learning: What's the pay-off for employers? *Journal of European Industrial Training, 24*(2/3/4), 149–157. https://doi.org/10.1108/03090590010321115

Patterson, M. B. (2018). The forgotten 90%: Adult nonparticipation in education. *Adult Education Quarterly, 68*(1), 41–62. https://doi.org/10.1177/0741713617731810

Patterson, M. B., & Paulson, U. G. (2016). Adult transitions to learning in the USA: What do PIAAC survey results tell us? *Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education, 5*(1), 5–27.

Pullman, A., & Chen, M. Y. (2020). Varieties of employment: A comparison of skill-based

  activities at work among youth and young adults in Canada. *International Journal of

  Lifelong Education, 39*(5-6), 576–590. https://doi.org/10.1080/02601370.2020.1836052

Punksungka, W., Yamashita, T., Helsinger, A., Karam, R., Cummins, P., & Kramer, J. (2021).

  Re-examining adult education and training participation by education, literacy, gender,

  and race/ethnicity in the U.S. *Journal of Adult and Continuing Education*.

  https://doi.org/10.1177/14779714211049261

Rainbird, H. (2010). Skilling the unskilled: Access to work-based learning and the lifelong

  learning agenda. *Journal of Education and Work, 13*(2), 183–197.

  https://doi.org/10.1080/713676988

Ripley, B. (2023). *Tree: Classification and regression trees* [R Package]. Retrieved from:

  https://cran.r-project.org/web/packages/tree/tree.pdf

Roberts, S. E., & Côté, J. E. (2014). The identity issues inventory: Identity stage resolution in the

  prolonged transition to adulthood. *Journal of Adult Development, 21*(4), 225–238.

  https://doi.org/10.1007/s10804-014-9194-x

Roosmaa, E.-L., & Saar, E. (2017). Adults who do not want to participate in learning: A cross-

  national European analysis of their perceived barriers. *International Journal of Lifelong

  Education, 36*(3), 254–277. https://doi.org/10.1080/02601370.2016.1246485

Rose, A. D., Smith, T. J., Ross-Gordon, J. M., Zarestky, J., Lopes, T., Smith, M C., Grotlüschen,

  A., & Fleige, M. (2019). *Adults' civic engagement in the U.S. and Germany: Evidence

  from the PIAAC survey*. Retrieved from PIAAC Gateway website:

  https://static1.squarespace.com/static/51bb74b8e4b0139570ddf020/t/5df93f5d87540752b

  2721d36/1576615774386/2019_Rose_Adults_Civic_Engagement_US_Germany.pdf

Ross-Gordon, J. M., Rose, A. D., & Kasworm, C. E. (2017). *Foundations of adult and continuing education*. Jossey-Bass.

Rowden, R. W., & Conine, C. T. (2005). The impact of workplace learning on job satisfaction in small US commercial banks. *Journal of Workplace Learning, 17*(4), 215–230. https://doi.org/10.1108/13665620510597176

Röbken, H. (2009). Continuing higher education in the United States of America (USA). In M. Knust, & A. Hanft (Eds.), *Continuing higher education and lifelong learning. An international comparative study on structures, organization and provisions* (pp. 287–322). Springer. https://doi.org/10.1007/978-1-4020-9676-1_9

Rubenson, K. (1977). *Participation in recurrent education: A research review*. Paper presented at the Meeting of National delegates on Developments in Recurrent Education. Paris.

Rubenson, K. (2006). The Nordic model of lifelong learning. *Compare: A Journal of Comparartive Education and International Education, 36*(3), 327–341. https://doi.org/10.1080/03057920600872472

Rubenson, K. (2011). Barriers to participation in adult education. In K. Rubenson (Ed.), *Adult learning and education* (pp. 216–224). Elsevier.

Rubenson, K. (2018). Conceptualizing participation in adult learning and education. Equity issues. In M. Milana, S. Webb, J. Holford, R. Waller, & P. Jarvis, (Eds.), *The Palgrave international handbook on adult and lifelong education and learning* (pp. 337–357). Palgrave Macmillan.

Rubenson, K., & Desjardins, R. (2009). The impact of welfare state regimes on barriers to participation in adult education: A bounded agency model. *Adult Education Quarterly, 59*(3), 187–207. https://doi.org/10.1177/0741713609331548

Rubenson, K., & Sailing Olesen, H. (2007). Theorizing participation in adult education and

    training. Paper presented at The Second Nordic Conference on Adult Learning.

    Linköping University, SE.

Rüber, I. E., Rees, S.-L., & Schmidt-Hertha, B. (2018). Lifelong learning - lifelong returns? A

    new theoretical framework for the analysis of civic returns on adult learning.

    International Review of Education, 64(5), 543–562. https://doi.org/10.1007/s11159-018-

    9738-6

R Core Team. (2021). *R: A language and environment for statistical computing* (Version 4.1)

    [Computer Software]. R Foundation for Statistical Computing. https://www.r-

    project.org/index.html

Salins, V., & Sila, U. (2022). *Fostering a strong labour market to support the recovery and

    sustain growth in Switzerland* (OECD Economics Department Working Papers No.

    1720). OECD Publishing. https://doi.org/10.1787/aefe5c44-en

Salthouse, T. A. (2006). Mental exercise and mental aging: Evaluating the validity of the "use it

    or lose it" hypothesis. *Perspectives on Psychological Science, 1*(1), 68–87.

    https://doi.org/10.1111/j.1745-6916.2006.00005.x

Sandmann, L. R. (2010). Adults in four-year colleges and universities: Moving from the margin

    to mainstream? In C. E. Kasworm, A. D. Rose, & J. M. Ross-Gordon (Eds.), *Handbook

    of adult and continuing education* (pp. 221–230). Sage.

Shanahan, L., Copeland, W. E., Worthman, C. M., Erkanli, A., Angold, A., & Costello, E. J.

    (2013). Sex-differentiated changes in C-reactive protein from ages 9 to 21: The

    contributions of BMI and physical/sexual maturation. *Psychoneuroendocrinology,

    38*(10), 2209–2217. https://doi.org/10.1016/j.psyneuen.2013.04.010

Schapire, R. E., Freund, Y., Bartlett, P., & Lee, W. S. (1998). Boosting the margin: A new

    explanation for the effectiveness of voting methods. *The Annals of Statists, 26*(5), 1651–

    1686. https://doi.org/10.1214/aos/1024691352

Schmidt, S. W. (2007). The relationship between satisfaction with workplace training and overall

    job satisfaction. *Human Resource Development Quarterly, 18*(4), 481–498.

    https://doi.org/10.1002/hrdq.1216

Schuetze, H. G., & Slowey, M. (2000). *Higher education and lifelong learners: International*

    perspectives on change. Routledge Falmer.

Schuller, T., & Desjardins, R. (2010). Wider benefits of adult education. In P. Peterson, E.

    Baker, & B. McGaw (Eds.), *International encyclopedia of education* (pp. 294–298).

    Elsevier. https://doi.org/10.1016/B978-0-08-044894-7.00045-2

Schuller, T., Desjardins, R., Peterson, P., Baker, E., & McGaw, B. (2010). Wider benefits of

    adult education. In P. Peterson, E. Baker, & B. McGaw (Eds.), *International*

    encyclopedia of education (pp. 229–233). Elsevier. https://doi.org/10.1016/B978-0-08-

    044894-7.00045-2

Scott, J. (2000). Rational choice theory. In G. Browning, A. Halcli, & F. Webster (Eds.),

    Understanding contemporary society: Theories of the present (pp. 126–138). Sage.

Shukla, G., Garg, R. D., Srivastava, H. S., & Garg, P. K. (2018). Performance analysis of

    different predictive models for crop classification across an aridic to ustic area of Indian

    states. *Geocarto International, 33*(3), 240–259.

    https://doi.org/10.1080/10106049.2016.1240721

Schürmann, E., & Beausaert, S. (2016). What are drivers for informal learning? *European Journal of Training and Development, 40*(3), 130–154. https://doi.org/10.1108/EJTD-06-2015-0044

Senge, P. M. (1990). *The fifth discipline* (1st ed.). Doubleday Business.

Seol, H. (2022). *snowLatent: Latent class analysis for jamovi* [jamovi Module]. Retrieved from: https://github.com/hyunsooseol/snowLatent

Shadovitz, S., Helsinger, A., & Cummins, P. (2021). Challenges to engage low-skilled adults in education and training: An international perspective. *Innovation in Aging, 5*(S1), 387. https://doi.org/10.1093/geroni/igab046.1508

Sheather, S. J. (2009). *A modern approach to regression with R*. Springer.

Silverman, S. L., & Casazza, M. E. (2000). *Learning and development: Making connections to enhance teaching*. Jossey-Bass.

Simons, P. R. J., Germans, J., & Ruijters, M. (2003). Forum for organizational learning: Combining learning at work, organizational learning and training in new ways. *Journal of European Industrial Training, 27*(1), 41–48. https://doi.org/10.1108/03090590310456528

Singh, M. (2015). *Global perspectives on recognizing non-formal and informal learning: Why recognition matters*. UNESCO Institute for Lifelong Learning/Springer Open. https://doi.org/10.1007/978-3-319-15278-3

Smith, C. S., & Ferrier, F. (2002). *Lifelong learning and the world of work: CEET's survey for the OECD*. Paper presented at the Monash University – ACER Centre for the Economics of Education and Training, 6th National Conference. Ascot Vale, Victoria, Australia.

Smith, P. J. (2003). Workplace learning and flexible delivery. *Review of Educational Research,*
73(1), 53–88. https://doi.org/10.3102/00346543073001053

Soares, L. (2013). *Post-traditional learners and the transformation of postsecondary education:*
A manifesto for college leaders. American Council on Education. Retrieved from:
https://www.acenet.edu/Documents/Post-traditional-Learners.pdf

Støren, L. A. (2013). Who attends work-related training five years after graduation? A
comparison across European countries. *International Journal of Lifelong Education,*
32(2), 165–189. https://doi.org/10.1080/02601370.2012.733972

Strawn, C. L. (2003). *The influences of social capital on lifelong learning among adults who did*
not finish high school (NCSALL Occasional Paper). National Center for the Study of
Adult Learning and Literacy. Retrieved from:
https://files.eric.ed.gov/fulltext/ED508598.pdf

Strobl, C., Boulesteix, A.-L., Kneib, T., & Zeileis, A. (2008). Conditional variable importance
for random forests. *BMC Bioinformatics, 9*, 307. https://doi.org/10.1186/1471-2105-9-
307

Strobl, C., Boulesteix, A.-L., Zeileis, A., & Hothorn, T. (2007). Bias in random forest variable
importance measures: Illustrations, sources and a solution. *BMC Bioinformatics, 8*, 25.
https://doi.org/10.1186/1471-2105-8-25

Svensson, L., Ellström, P.-E., & Åberg, C. (2004). Integrating formal and informal learning at
work. *Journal of Workplace Learning, 16*(8), 479–491.
https://doi.org/10.1108/13665620410566441

Tharenou, P. (1997). Organisational, job, and personal predictors of employee participation in

    training and development. *Applied Psychology: An International Review, 46*(2), 111–134.

    https://doi.org/10.1111/j.1464-0597.1997.tb01220.x

Therneau, T., & Atkinson, B. (2022). *rpart: Recursive partitioning and regression trees* [R

    package]. Retrieved from https://cran.r-project.org/web/packages/rpart/rpart.pdf

The jamovi Project. (2022). *jamovi* (Version 2.3) [Computer Software]. https://www.jamovi.org

Thongmak, M. (2021). Inquiring into lifelong learning intention: Comparisons of gender,

    employment status, and media exposure. *International Journal of Lifelong Education,*

    40(1), 72–90. https://doi.org/10.1080/02601370.2021.1882594

Tikkanen, T. (2008). The learning society as a greying society: Perspectives to older workers and

    lifelong learning. In CEDEFOP. (Ed.), *Modernising vocational education and training.*

    Fourth report on vocational training research in Europe: Background report (Volume 2)

    (pp. 195–238). Office for Official Publications of the European Communities. Retrieved

    from: https://www.cedefop.europa.eu/files/04-Tikkanen.pdf

Tikkanen, T., & Nissinen, K. (2016). Participation in job-related lifelong learning among well-

    educated employees in the Nordic countries. *International Journal of Lifelong Education,*

    35(3), 216–234. https://doi.org/10.1080/02601370.2016.1165749

Tikkanen, T., & Nissinen, K. (2018). Drivers of job-related learning among low-educated

    employees in the Nordic countries. *International Journal of Lifelong Education, 37*(5),

    615–632. https://doi.org/10.1080/02601370.2018.1554720

Torres, C. A. (1996). Adult education for development. In A. Tuijnman (Ed.), *International*

    encyclopedia of adult education and training (2nd ed.) (pp. 213–221). Pergamon Oxford.

Tynjälä, P. (2008). Perspectives into learning at the workplace. *Educational Research Review, 3*(2), 130–154. https://doi.org/10.1016/j.edurev.2007.12.001

Tynjälä, P. (2013). Toward a 3-P model of workplace learning: A literature review. Vocations and Training, 6, 11–36. https://doi.org/10.1007/s12186-012-9091-z

UNESCO Institute for Lifelong Learning. (2016). *3rd global report on adult learning and education: The impact of adult learning and education on health and well-being, employment and the labor market, and social, civic and community life*. Author. Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000245913

U.S. Department of Labor, Employment and Training Administration. (2020). *Workforce Innovation and Opportunity Act (WIOA) and Wagner-Peyser Act statutory formulas for state allotments*. Author. Retrieved from: https://www.dol.gov/agencies/eta/budget/formula/state

van Merriënboer, J. J. G., Kirschner, P. A., Paas, F., Sloep, P. B., & Caniëls, M. C. J. (2009). Towards an integrated approach for research on lifelong learning. *Educational Technology, 49*(3), 3–14.

Van Noy, M., James, H., & Bedley, C. (2016). *Reconceptualizing learning: A review of the literature on informal learning*. Education and Employment Research Center, School of Management and Labor Relations, Rutgers, the State University of New Jersey. https://doi.org/10.7282/00000129

Vermunt, J. K. (2010). Latent class modeling with covariates: Two improved three-step approaches. *Political Analysis, 18*(4), 450–469. https://doi.org/10.1093/pan/mpq025

Vignoles, A., Galindo-Rueda, F., & Feinstein, L. (2004). The labour market impact of adult education and training: A cohort analysis. *Scottish Journal of Political Economy, 51*(2), 266–280. https://doi.org/10.1111/j.0036-9292.2004.00306.x

Wanberg, C. R. (2012). The individual experience of unemployment. *Annual Review of Psychology, 63*, 369–396. https://doi.org/10.1146/annurev-psych-120710-100500

Wang, G. G., & Wang, J. (2004). Toward a theory of human resource development learning participation. *Human Resource Development Review, 3*(4), 326–353. https://doi.org/10.1177/1534484304271152

Wang, M.-C., Deng, Q., Bi, X., Ye, H., & Yang, W. (2017). Performance of the entropy as an index of classification accuracy in latent profile analysis: A Monte Carlo simulation study. *Acta Psychologica Sinica, 49*(11), 1473–1482. https://doi.org/10.3724/SP.J.1041.2017.01473

Watkins, K., & Marsick, V. (1993). *Sculpting the learning organization: Lessons in the art and science of systematic knowledge*. Jossey-Bass.

Watkins, K. E., & Marsick, V. J. (2014). Adult education and human resource development: Overlapping and disparate fields. *New Horizons in Adult Education and Human Resource Development, 26*(1), 42–54. https://doi.org/10.1002/nha3.20052

Weller, B. E., Bowen, N. K., & Faubert, S. J. (2020). Latent class analysis: A guide to best practice. *Journal of Black Psychology, 46*(4), 287–311. https://doi.org/10.1177/0095798420930932

White, P. (2012). Modelling the 'learning divide': Predicting participation in adult learning and future learning intentions 2002 to 2010. *British Educational Research Journal, 38*(1), 153–175. https://doi.org/10.1080/01411926.2010.529871

Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis* [R Package]. Springer-Verlag. Retrieved from: https://ggplot2.tidyverse.org

Widany, S., Christ, J., Gauly, B., Massing, N., & Hoffmann, M. (2019). The quality of data on participation in adult education and training: An analysis of varying participation rates and patterns under consideration of survey design and measurement effects. *Frontiers in Sociology, 4*(71), 1–18. https://doi.org/10.3389/fsoc.2019.00071

Wolke, D., Copeland, W. E., Angold, A., & Costello, E. J. (2013). Impact of bullying in childhood on adult health, wealth, crime, and social outcomes. *Psychological Sciences, 24*(10), 1958–1970. https://doi.org/10.1177/0956797613481608

Xu, Z., Lian, J., Bin, L., Hua, K., Xu, K., & Chan, H. Y. (2019). Water price prediction for increasing market efficiency using random forest regression: A case study in the western United States. *Water, 11*(2), 228. https://doi.org/10.3390/w11020228

Yamashita, T., Cummins, P. A., Arbogast, A., & Millar, R. J. (2018). Adult competencies and employment outcomes among older workers in the United States: An analysis of the program for the International Assessment of Adult Competencies. *Adult Education Quarterly, 68*(3), 235–250. https://doi.org/10.1177/0741713618773496

Yamashita, T., Cummins, P. A., Millar, R. J., Sahoo, S., & Smith, T. J. (2019). Associations between motivation to learn, basic skills, and adult education and training participation among older adults in the USA. *International Journal of Lifelong Education, 38*(5), 538–552. https://doi.org/10.1080/02601370.2019.1666927

Zhong, S., Xie, X., & Lin, L. (2015). Two-layer random forests model for case reuse in case-based reasoning. *Expert Systems with Applications, 42*(24), 9412–9425. https://doi.org/10.1016/j.eswa.2015.08.005