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Work-Based Learning: Contributions to Professional Health Education

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Abstract

This article presents and discusses the principles of Work-Based Learning (WBL), a teaching strategy consolidated as a field of research in the education and health areas in Europe, the United States and Australia. Therefore, by presenting a background of the impacts and challenges on working conditions and professional training arising from the technologies that constitute Industry 4.0 and Health 4.0. The study seeks to contribute to the use and improvement of WBL in health teaching and professional education in Brazil.

Keywords: Work-Based Learning. Vocational Education. Education, Public Health Professional. Health 4.0.

Introduction

The International Labor Organization (INTERNATIONAL LABOUR ORGANIZATION, 2017) highlights that new Information and Communication Technologies (ICT) have revolutionized the work and daily lives of millions of people. Work and knowledge supported by the internet present opportunities and challenges for young people, adults and the elderly, as well as for governments, business groups and varied educational institutions, from basic education to post-doctorate periods. This argument is reinforced by the reality imposed by the Covid-19 pandemic, which forced several societal transformations, such as those concerning the education field and teaching and learning processes, focusing on certain aspects, such as e-learning, collaborative learning, and the massive use of social networking sites in teaching practices.

Economies such as those in European countries already significantly employ the so-called Industry 4.0 (known by the abbreviation I4.0). Also termed the 4th Industrial Revolution, I4.0 was announced for the first time in Germany in 2011 (LIAGKOU; STYLIOS; PAPPA; PETUNIN, 2021). This revolution portrays a model of autonomously organizing productive processes employing information technologies and devices connected by the internet. These authors report several digital technologies that make up I4.0, including sensors and the internet of things (IoT), advanced and collaborative robotics, the analyses of large amounts of data (Big Data), artificial intelligence, "Machine Learning" and augmented reality in virtual environments, among others. Thus, an essential issue arising particularly in developing and emerging countries, such as Brazil, is initial and continued worker training, enabling worker participation and insertion in I4.0 without, however, losing sight of the fundamental objective of worker training through omnilateral, humanistic, citizen and scientific education. These demands are also present in the training process of workers in the Public Health field, as the design principles of I4.0 may also be applied to the health domain (Health 4.0) (DA SILVEIRA; NETO; DOS SANTOS; GASPARETTO *et al.*, 2021; LHOTSKA, 2020).

Mitre et al. (2008) indicate that the vertiginous transformations of contemporary societies call into question professional training and health work processes, insofar as work performance depends on fundamentals such as the inseparability of theory and practice, an integral vision of the human being and adequate expansion of the health care concept. This reinforces the notion of Polytechnics in Professional and Technological Education (PTE), which moves towards overcoming the dichotomy between manual and intellectual work and between professional and general instructions, on the basis that human formation is centered at work, *i.e.,* in the process by which humans produce their own existence and transform nature (SAVIANI, 2003). Polytechnics also refers to mastering the scientific foundations of the different techniques that characterize the modern productive work process, as well as a training process that does not simply comprise adapting to changes in the production and work worlds.

Professional and Technological Education (PTE) in Brazil has increased presentations, discussions, experience reports, criticisms and proposal constructions based on the foundations of active teaching and learning methodologies, such as Problematization and Problem-Based Learning and Project-Based Learning (COTTA; REIS; CAMPOS; GOMES *et al.*, 2013; LOPES; FILHO; ALVES, 2019; LOPES; SILVA FILHO; MARSDEN; ALVES, 2011; MAGALHÃES; PEREIRA, 2019; SANTOS; JESUS, 2020). These methodologies have, as one of their assumptions in the PTE context, the valuation and use of real experiences and work activity scenarios, which will be or are already being faced by workers. Therefore, the workplace, work experience and work-based learning acquire increasing prominence during the vocational education learning process.

In this context, this article aims to present the fundamentals of Work-Based Learning, also seeking to contribute to and foster the debate on the use of WBL in PTE in Brazil, focusing on Professional Health Education. This is, therefore, a theoretical study that proposes to offer introductory and discussion subsidies, allowing for further insights into this topic. This study is justified, among others,

by a significant increase in scientific publications on WBL in the Education/Educational Research, Social Sciences and Health areas found in the Web of Science™ database in the last fifteen years (BEZERRA; MOTA; COMARU; BRAGA *et al.*, 2021). WBL is currently consolidating itself as a study field in research and teaching institutions in Europe, Australia and the United States of America.

Fundamentals of Work Based Learning (WBL)

Work-Based Learning (WBL) emerged in the United Kingdom over 30 years ago, comprising a term with different meanings, whose definition involves a series of activities, concerns and research areas based on work (BEZERRA; MOTA; COMARU; BRAGA et al., 2021). This involves learning through work, learning for work and/or learning at work. Thus, the work itself and its environment are used as syllabus and as a "case" and learning methodology for the training of individuals and/or working adults, comprising an integral part of professional education (MURTAZIN; SHVETS; PIHO; IEEE, 2020).

Lester and Costley claim that WBL concerns any and all learning in the workplace or arising from its demands (LESTER; COSTLEY, 2010). It is also characterized as an educational device with the potential to fill gaps between acquired knowledge and the use/practical development of skills for work (CHRISTENSEN; HENRIKSEN; THOMSEN; LUND *et al.*, 2017; LESTER; COSTLEY, 2010). The Inter-Agency Group on Technical and Vocational Education and Training (IAG-TVET), established by UNESCO in 2008, states that

> Work-Based Learning refers to all forms of learning that take place in a real work environment. It provides individuals with the skills they need to successfully obtain and hold jobs and advance their professional development. (INTERNATIONAL LABOUR ORGANIZATION, 2017, p.2).

Non-profit organizations, such as the Center for Apprenticeship & Work-Based Learning, belonging to the American JFF (*Center for Apprenticeship & Work-Based Learning* / *Jobs for the future* - https://www.jff.org/), considers that WBL supports lifelong learning and continuous worker and student development. On the other hand, Advance Career Technical Education - USA (ADVANCE, 2016, p.1) defines WBL as follows:

> Work-Based Learning (WBL) comprises an educational strategy that offers students the opportunity to reinforce and deepen their classroom learning, explore future career fields, and demonstrate their skills in an authentic environment. It is a continuum of experiences that helps prepare students for post-secondary education and careers. High-quality work-based learning should start in the first grades, with activities that aid in making students aware of possible careers. This exploration continues throughout elementary and high school, with job tracking or mentoring to better inform student decision-making and culminates in more intensive career preparation activities such as school ventures, internships, and pre-apprenticeships as students advance their career path from high school to higher education.

Considering that this is an educational strategy that associates theory to professional practice and is relevant to occupational, professional, technological and higher education and training (BEZERRA; MOTA; COMARU; BRAGA *et al.*, 2021; FREIRE, 2020; LESTER; COSTLEY, 2010; TALBOT; COSTLEY; DREMINA; KOPNOV, 2017), it is possible to trace some of the fundamental WBL characteristics, promoted through the interaction between educational institutions and work environments and spaces, namely:

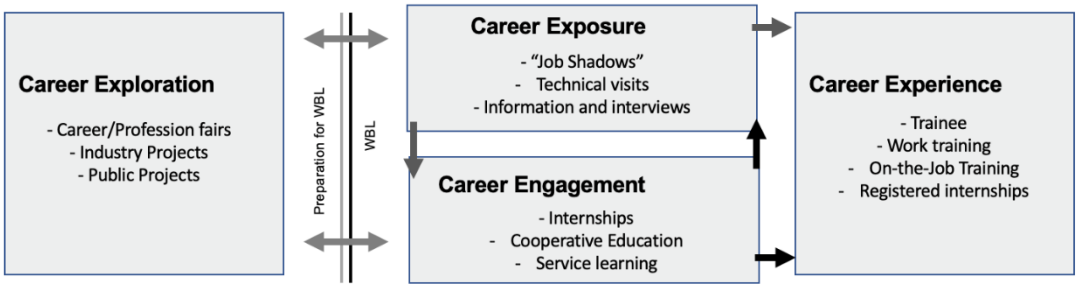
a) promotes possibilities for students to gain experience in a workplace or occupational environment, establishing connections from this experience to the classroom and academic environment.

b) aims, within an integrated teaching plan and curriculum organization, to develop student knowledge, skills, and professional competences.

c) establish a connection between the experience provided by WBL with the professional careers to be followed by students.

Figure 1 presents activities that fall into four categories related to the professional trajectory, namely exploration, exposure, involvement, and career experience. That means that students progress by learning about work, through work and for work on a continuum. It is noteworthy that career exploration or study do not take place in the workplace and do not effectively comprise WBL. On the other hand, in career exposure, participants, workers or students, for example, live together in the workplace for short periods of training time, while in career involvement an offer of extended time for participants to build knowledge and develop skills in a specific field or profession is noted. Finally, the experience is characterized by student or worker insertion in a particular occupation, professional service, or industry, receiving payments to develop specific skills and competences, combined with classroom education.

Figure 1 – Categories and activities that can be linked to a training process through Work-Based Learning.



Source: Adapted from "*Work-Based Learning Framework*", available at https://jfforg-prod-new.s3.amazonaws.com/media/documents/WBL_Continuum-06-30-20.pdf.

School program-integrated WBL is carried out at school and makes use of laboratories, workshops, restaurants, junior companies, simulations or even real attributions of a particular business or industrial project (EUROPEAN COMMISSION, 2013). Internships may also comprise Work-Based Learning experiences when developed through educational projects that meet their principles. However, when they are unpaid and become a pattern after formal

education, they aggravate the inequality issue concerning wealth distribution, and may instill the expectation that a certain amount of unpaid work "[...] is a necessity for the success in the contemporary economy" in younger workers [...] (SKUJINA; LOOTS, 2020). Consequently, this can imply an opportunity cost and generate obstacles to economic mobility that public education must alleviate (SKUJINA; LOOTS, 2020).

Other important aspects to be highlighted by the use of WBL comprises the relationship between practice and theory in worker training, as well as the development of professional and social skills and competences. Kenny et al. (2016) indicate that young black and low-income people in the United States face barriers in entering a job that offers decent wages and that provides opportunities for career advancement, which can be defined as decent work, essential for personal and family well-being concerning social and economic worker progress. These same authors highlight the importance of the WBL developed in a US high school to prepare young people from low-income and urban families to acquire a decent work and enter higher education (KENNY; CATRAIO; BEMPECHAT; MINOR *et al.*, 2016). Ali et al. (2017), when conducting a survey at Malaysian community colleges to identify the level of social skills among students who took WBL, reported significant student skill improvements, such as communication, critical thinking and problem solving, group work and leadership (ALI; MAHMOD, 2017). This skill and competence development supports the defense and reflections on the use of active teaching methodologies in professional training in different knowledge areas, such as health and the environment (DE PINHO; ALVES; COMARU; DA LUZ *et al.*, 2021; MCGIBBON; VAN BELLE, 2015; WOOD, 2003).

Industry and Health 4.0

As mentioned previously, digital technologies are increasingly transforming industries, products, processes, services, and operations. The nature of the workplace, its management, and the interfaces for connecting people are changing in organizations and institutions that have adopted and are working with contemporary technologies, such as embedded systems and the Internet of Things (IoT) (BRAHMA; TRIPATHI; SAHAY, 2021). The concept of Industry 4.0, also refers to the 4th Industrial Revolution or digital industry revolution, characterized by the convergence of innovative digital technologies through the integration of cyberphysical systems (CPS), the internet of things (IoT), artificial intelligence (AI), cloud and cognitive computing, intelligent robotics, virtual and augmented reality, and internet services (IoS) (BONFIELD; SALTER; LONGMUIR; BENSON *et al.*, 2020; SCHUH; GARTZEN; RODENHAUSER; MARKS, 2015; TOPOL, 2019).

The iNDUCE 4.0 project was developed around this contemporary reality in Europe, establishing collaborations between Vocational Training and Companies to promote learning in work contexts, with a special focus on work placements through collaborations with social partners, companies and training entities (http://induce-project.eu/pt/). In Brazil, the Ministry of Development, Industry, Foreign Trade and Services created the Working Group on Industry 4.0 (GTI 4.0) in 2017, tasked with developing a proposal for a National Strategy for Industry 4.0 in the country. GTI 4.0 partners include the National Bank for Economic and

Social Development (BNDES), the Fund for the Financing of Project and Program Studies (Finep), the Brazilian Company for Industrial Research and Innovation (EMBRAPII), the National Council for Scientific Development and Technological (CNPq) and the Coordination for the Improvement of Higher Education Personnel (CAPES). In 2019, the Brazilian government presented an action plan to leverage Industry 4.0 from 2019 to 2022, proposing to respond to the competitiveness and productivity needs of small and medium-sized companies through advanced manufacturing. Therefore, over 30 government, private and academic institutions are now collaborating. The plan also aims to contribute to training human resources for Industry 4.0 through four initiatives, namely technological development and innovation, human capital, supply chains and supplier development, regulation, technical standardization, and infrastructure (https://camara40.com.br/).

Within the I4.0 scenario, the aim of Health 4.0 is to enable progressive virtualization in order to allow for real time health and care personalization for patients, professionals and formal and informal caregivers. This is directly reflected in processes such as precision medicine and the evolution of the production of intelligent pharmaceutical products for the treatment of chronic non-communicable diseases (THUEMMLER; BAI, 2017). The use of artificial intelligence in medicine is starting to impact three levels: physicians, through fast and accurate image interpretation, healthcare systems, improving workflow and the potential for reducing medical errors, and patients, allowing them to process their own data to promote health (TOPOL, 2019). Machine Learning and Big Data analytics, for example, can be extremely helpful in interpreting medical images, improving the speed and accuracy of disease diagnoses, thus improving patient care (DO NASCIMENTO; MARCOLINO; ABDULAZEEM; WEERASEKARA *et al.*, 2021; OBERMEYER; EMANUEL, 2016; TURKKI; BYCKHOV; LUNDIN; ISOLA *et al.*, 2019).

Associated with manufacturing and service delivery, Health 4.0 brings with it challenges and opportunities for governments, communities, institutions and service providers in this field. The World Health Organization (WHO) launched the Ethics and Governance of Artificial Intelligence for Health Report (WHO, 2021), establishing principles for artificial intelligence and Health 4.0 to work for the interest and benefit of all for health care and public health, comprising the following:

- Protect human autonomy.
- Promote human well-being and security and public interests.
- Ensure transparency, explainability and intelligibility.
- Promote responsibility and accountability.
- Ensure inclusion and equity.
- Promote responsive and sustainable artificial intelligence.

In Brazil, the Ministry of Health launched “The Health Strategy for Brazil for 2028” (ESD28) which establishes three lines of action, namely aiming to 1) enable the National Health Data Network (RNDS) to offer essential health services. Digital Health for the country; 2) build an organizational, legal, regulatory and governance framework that can enable effective collaboration in Digital Health between actors committed to this collaboration and 3) implement a conceptual,

normative, ***educational*** (our italics) and technological environment that favors collaboration (BRASIL, 2020a). Thus, the coordinated development of these axes has the potential to provide, among other aspects:

i) SUS computerization, by strengthening innovation, service models, applications and knowledge;

ii) human resource training resulting from collaborative efforts, positively affecting the development of the Digital Health Strategy and;

iii) the Collaboration Space as an instrument for economic and social development, for training human, organizational and methodological resources for Digital Health.

Digital technologies for and in health are being developed and deployed in high-income countries. They are also, however, being tested and used in low- and middle-income countries for data collection, health information dissemination via mobile phones, electronic medical record use and cloud computing. In addition, the potential for their use for diagnosis, morbidity or mortality risk assessment, disease outbreaks and surveillance, as well as health policy and planning is also noted (WHO, 2021). One example comprises the application of the internet of things (IoT) in the context of Health 4.0. IoT can be represented by scenarios in which network connectivity and computing power extends to physical devices not normally considered computers, allowing these goals to generate, exchange and consume data with minimal human intervention. This could be a fitness tracker (condition fitness), a thermostat, a lock, an appliance, or a light bulb. It can even be "smart shoes", which monitor individual heartbeat and indicate potential health problems (ROSE; ELDRIDGE; CHAPIN, 2015).

In the Health Industry, digital solutions cover hospitals and clinics infrastructures, internal information systems and patient interactions and diagnostics, including remotely. They also incorporate Health Information Technology and devices connected to Health Services. In 3D Printing advances, additive manufacturing technologies have transformed the way of designing, developing, manufacturing and distributing products. In the Health field, the customized production of several items, such as hearing implants, dental prostheses, and human limbs, is already a reality (EUROPEAN COMMISSION, 2017). Virtual and Augmented Reality, for example, can be applied in immersive distance learning, in the improvement of local training, in distance education enhanced by virtual elements, as well as in enabling medical simulations that do not pose risks to patients (EUROPEAN COMMISSION, 2017).

The set of information and interrelationships between Industry and Health 4.0 requires further development in future studies. These data were presented to the reader herein because we understand that the health work innovation scenario must be inserted in the context and processes linked to professional health education.

Associations between Professional and Technological Education in Health and Work-Based Learning

Professional and Technological Education, as an educational modality provided for in the Brazilian Law of Guidelines and Bases of National Education (LDB), is

integrated into the different education levels and modes, as well as the work, science and technology dimensions, with the main purpose of preparing individuals for the work and citizenship world, including student improvement as humans, which includes ethical training and the development of intellectual autonomy and critical thinking (BRASIL, 2020b). On the other hand, Technical and Vocational Education and Training (TVET) is a broad concept instrumentalized by various governmental and organizational policies and practices that seek to connect education and the work world to help youth and adults in developing skills for work, obtaining jobs and decent work, as well as in exercising citizenship in promoting equity, gender equality and economic and social development, facilitating the transition to green economies and sustainable societies (UNESCO, 2016).

In this scenario, the idea that learning in the workplace or arising directly from concerns about the workplace (LESTER; COSTLEY, 2010; MESSMANN; MULDER, 2015) it is a useful strategy in a PTE context. In this regard, the articulation between Basic Education and Professional and Technological Education stands out as guiding principles for technical professional education at secondary level, the relationship between theory and practice in the teaching and learning process, and the interdisciplinarity ensured both in the curriculum and in pedagogical practice (ARROYO, 2019; LOPES; PINHO; FILHO; ALVES *et al.*, 2015) and also the view that the role of professional and health education should be to recover the relationship between knowledge and work practice (PEREIRA; LIMA, 2008). This means explaining how science becomes material power in the process of producing goods and health services, providing students with the mastery of scientific foundations, and not only training in production techniques in a purely technical perspective. As mentioned by Arroyo (2019), one of the merits of EPT is its awareness of training professionals through critical analyses of science and technology concepts and their impacts on society, politics, and social inequalities.

Whether in school activity or in health area professional training, it is noteworthy that WBL should be understood as a transdisciplinary field and not as a way of learning within a specific study area, with influences that originate from reflective practice, learning and researching through action (COSTLEY; LESTER, 2012). The need to maintain WBL within a formative conception of work as an educational principle is also highlighted herein, *i.e.,* through the integration of not only of work dimensions, but also of science and culture (FRIGOTTO; CIAVATTA, 2011). Consequently, an omnilateral formation is sought out, not restricted to a single professional branch, that promotes the development of subjects and citizens in “all directions” (RAMOS, 2017). It is, therefore, a different worker training development from “unilateral” training caused by the social division of labor and alienated work. In omnilateral training, all aspects of human life, *i.e.,* physical, mental, cultural, aesthetic, moral, political, scientific and technological, are considered (CIAVATTA, 2014).

The shortage of professions in the health area is a global problem, which has highlighted the need to establish effective learning from practice, which means that WBL is widely practiced in health organizations, although it is not always recognized and valued as such (ATTENBOROUGH; ABBOTT; BROOK; KNIGHT, 2019). At this juncture, different models can be explored, developed, and offered to meet the goals and needs of learning for or on the job. Workplace

valuation for the development of professional health skills, through practice internships or Work-Based Learning (also known as service learning, clinical internships, or internships), are recognized and relevant for the development of health professional skills (PALERMO; CAPRA; BECK; ASH *et al.*, 2016; PALERMO; CHUNG; BECK; ASH *et al.*, 2015). On the other hand, mobile devices and technology artifacts are being increasingly used in mobile learning and learning in work contexts, demanding research and reflection on mobile learning (m-learning) and Work -Based Mobile Learning – WBML (GIKAS; GRANT, 2013; HWANG; CHOU; HUANG, 2021; PIMMER; PACHLER; ATTWELL, 2010; YUAN; TAN; OOI; LIM, 2021). Some examples of WBML development are Canadian studies that explore the use of mobile devices by nurses for individual and collaborative informal learning based on a health workplace environment context (FAHLMAN, 2014; 2017).

Exploratory studies and understanding on how to align the school-work relationship are also essential, as this alignment refers to content coherence, teaching methods, assessment techniques and guidance forms characteristic of learning processes developed in the school and work environments (MESSMANN; MULDER, 2015; VIRTANEN; TYNJALA; COLLIN, 2009). Other examples in this regard include the importance of sequencing educational experiences that meet what practitioners of a given health profession are expected to know, do and value (BILIETT, 2015), or verifying the perception of students and professionals about how work-based interprofessional education in community health service environments promotes increased knowledge and the development of skills such as professional communication, understanding on the specific activities of other health professionals, health and collaborative practice (BREWER; FLAVELL; JORDON, 2017; GUM; SWEET; GREENHILL; PRIDEAUX, 2020).

Convergently, studies that assess and address the ways in which employers perceive the contribution of WBL at work, as well as how participating employees and/or students experience the granted offer, are extremely important in understanding how aspects like organizational culture, user identity and the offered learning opportunities affect knowledge and skill acquisitions (AHLGREN; TETT, 2010; AKKERMAN; BAKKER, 2012; ALGERS; LINDSTRM; SVENSSON, 2016).

Although there is growing interest from the scientific community in WBL as a teaching strategy and curricular practice (BEZERRA; MOTA; COMARU; BRAGA et al., 2021), at the moment, this study does not intend to exhaust the presentation of the research potential of WBL in professional health education. However, different demands for research on WBL are noted, in areas such as corporate governance reform, inclusive workplaces, flexible working and disadvantaged groups, investment in skills, lifelong learning and well-being, and rebalancing work practices and rights (BEZERRA; MOTA; COMARU; BRAGA et al., 2021; WALL, 2017). Thus, a wide niche of research, teaching and extension activities to be built in this field within teaching and professional education is observed.

Final considerations

In the field of Brazilian Health Education, the focus of this article, we seek to bring a contribution concerning the potential of Work-Based Learning as an educational strategy that can aid in the short, medium and long termss, in decision-making and the improvement and construction of public policies, programs and/or projects involving different actors interested in civic education and qualification of public health workers. In this sense, some future perspectives concerning studies reside in Comparative Education research between countries and educational institutions, Work-Based Learning associated with Health 4.0 and Professional Health Education in Health and, finally, the transition to Industry 5.0 and the Health Economic-Industrial Complex (HEIC) in Brazil. Several approaches in this regard are noted, such curriculum development, student or worker action/acting alongside teachers and managers/mentors in the workplace, applied pedagogical approaches applied and evaluative learning processes.

As highlighted by Ronaldo Mota (2013), the existing links between education and the work world have never exhibited the dimension and relevance observed today. Therefore, they demand extremely cautious and in-depth research and reflection (MOTA, 2013). Furthermore, the worsening of social and economic conditions generated by Covid-19 mean that the opportunities for stable employment have decreased significantly in several countries, including in Brazil. This complex panorama requires the State, business organizations and educational institutions to dialogue and propose policies, programs and actions that can mitigate and reverse this serious situation. Therefore, it is essential to increase theoretical reflections and practical actions about contemporary work and the challenges imposed by technological advances in the 21st century for and in Professional Education.

Conflict of interest

The authors declare no conflict of interest.

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