EDUCATING AND TRAINING FOR A NEW EUROPEAN BAUHAUS: A PROPOSED RENOVATION WAVE FOR STUDENTS AND PROFESSIONAL AEC CURRICULA

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Summary [10 pt, Bold]

The challenges set up by the European Renovation Wave Strategy require a new mindset for professionals of Architecture, Engineering and Construction (AEC) Sector. Overcoming a silo mentality, seeking a life-long learning approach, and a multi-disciplinary knowledge is now recognised as an opportunity of competitive advantage rather than a mere obligation. By means of the qualitative methods of research in the form of thematic literature review the authors have investigated the theoretical background supporting the emergency for an overhaul of educational and training programmes for AEC professionals. Indeed, the new European Bauhaus is calling for a cultural rather than technical ecological transition in the field of built environment with challenging goals that should be equitable and socially just.

Starting from the Schön's Reflective Practitioner to the recent Evidence Based Designer as concept, the authors have identified the drivers, potential incentives, methodologies and case studies to improve learning outcomes of today's professionals and graduate students. The aim of this work is to map and identify a theoretical background as a reference for drafting future guidelines and critical reviews for educational and training programmes based on the Project Based Learning philosophy.

KEY WORDS. Postsecondary education, Project Based Learning, Blended Learning, AEC sector

1. ABBREVIATIONS AND DEFINITIONS

AEC, Architecture Engineering and Construction	GBRT, Green Building Rating Tools
EU, European Union	AIA, American Institute of Architects
GHG, Green House Gases	GPP, Green Public Procurement
IPCC, Intergovernmental Panel on Climate Change	MS, Member States
ESG, Environmental, Social and Governance Factors	EBD, Evidence Based Designer
EC, European Commission	RP, Reflective Practitioner
MIT. Massachusetts Institute of Technology	CE, Circular Economy
nZEB, nearly Zero Energy Building	CPD, Continuous Professional Development
BUS Build Up Skills	'Silo mentality', when employees in different departments refuse to share important team knowledge between them or with other departments.
EQF, European Qualification Framework	

1. Introduction

The European Renovation Wave (Crespo Parrondo & McPhie, 2020) is the most recent strategy proposed by the European Commission with aim of doubling the building renovation rate within ten years from now (2030). The main figures supporting the importance of achieving these ambitious targets are based on the reason that buildings are responsible up to 40% EU's energy consumption and up 36% of GHG (Crespo Parrondo & McPhie, 2020). Energy efficiency in building renovation as well as tackling Energy Poverty is a priority for EU and local Authorities because this could lead to an estimate 160000 new green jobs by focusing on 35 million obsolete buildings both public and private.

Another recent report from UNEP states that in G7 countries, material efficiency strategy could reduce the direct GHG emissions up to 50% and 60% indirect coming from buildings sector by 2050 (United Nations Environment Programme, 2020).

The Renovation Wave is applying a paradigm shift with one of the founding pillars being the cultural aspect. The New European Bauhaus (European Commission, 2021) is a creative and interdisciplinary initiative where the design of the future the built environment is situated at the crossroads between art, culture, social inclusion, science and technology (ACE, 2021; Bris, 2019) rather than a mere technical target. Because of thi

(Kilkelly, 2009) s, a cooperation among stakeholder, any forms of risk sharing (e.g. overcoming a silo mentality), seeking life-long learning approach, and multidisciplinary knowledge is now recognised (Bris, 2019) as an opportunity of competitive advantage rather than a mere obligation (Bahram & Hussein, 2014). This is especially valid for the AEC stakeholders working in an industry lacking in innovation as well as productivity (The Economist, 2017). For example, The United Kingdom's Office of Government Commerce (OGC, 2007) estimated that savings of up to 30% in the cost of construction can be achieved where integrated teams promote continuous improvement over a series of construction projects. UKOGC further estimates that single projects employing integrated supply teams can achieve savings of 2-10% in the cost of construction.

However, to date interdisciplinary approaches sometimes find barriers, such as technical, economical and conflicting interest in urban developments (Ginsberg, 2020) as well as building project. Some of the reasons can be found in the way AEC professionals are educated and trained.

With the findings of this publication, the authors are proposing a Renovation Wave to overhaul educational and training programme for AEC professionals and students. This will enable them to cope with the new exigencies of today's society facing an ongoing biodiversity loss at an unprecedent rates (Bradshaw et al., 2021) and the transition from the current resource efficiency sustainability paradigm towards an ecological view so called Regenerative sustainability paradigm (Brown et al., 2018). Although ambitious this first attempt will map the themes that are justifying an ongoing paradigm-shift towards multidisciplinary mindset, better cooperation and risk sharing among stakeholders.

Strong reasons for this change can be found besides the EU goals. They are coming from across the industries and society: we mentioned a few of them. In the Fifth Assessment Report from IPCC (IPCC, 2015) is stating that human activity influences the climate system with the highest anthropogenic emissions of GHG recorded in history as well as confirming that warming of the climate system is unequivocal. An updated version, the Sixth Assessment Report is expected in 2022. In the religious field Pope Francis encyclical letter "*Laudato Si: On the care of our common home*" (Pope Francis, 2015), is echoing the reflections of scientists, philosophers, theologians and civic groups expressing the need to seek for sustainable and integral development. From the financial sector, in 2020 BlackRock's CEO letter to stakeholders (Fink, 2021) has pledged to make sustainability an integral component to the way they manage risks; it claimed that 100% of their active and advisory portfolios are Environmental, Social and Governance Factors (ESG-integrated).

2. Research Methodology

The scientific methodology used deployed qualitative method of research such as the grounded theory. The authors have provided a theoretical background by means of a thematic literature review that could lead to drafting guidelines or recommendations for improving educational and training programmes. This research started with process of investigation that was rather tentative and explorative (Walliman, 2017) . The methodology started from Luca Caruso's personal interest for the work of American philosopher Donald A. Schön *The reflective practitioner (RP)*, a book published in 1983. Schön pioneered a new vision of professionals driven by an enquiry approach, acting more like a scientist rather than a technical person with a fixed set of knowledge to solve the client's briefs. Some similarities have been found in the work of Hamilton and Watkin arguing that the professional "Evidence Based Designer (EVB)" should be educated with intellectual framework that helps navigating the uncertainties of the professions toward better leadership skills. Also, when in working in integrated design teams and a life-long learning approach is required (Kirk Hamilton & Watkins, 2009).

Contrariwise to common sense, EVB and RP are described not as expert in one specific field but rather competent people with enhanced communication skills, problem solving skills, cooperative, self-learner and critical thinker (Schön, A., Donald, 1983). How to develop and improve these skills in an engaging way and by means of innovative teaching methods is currently debated among pedagogists , teachers, academics and researchers. The authors have mapped and listed the connections to the topic of gamification (Dicheva et al., 2015), blended learning (Khodeir, 2018; Kilkelly, 2009)and Project Based Learning (Davies et al., 2011) as an interesting methodologies to improve educational and training programmes for AEC students and professionals.

The selected case studies have shown that these are typically found in new ways of delivering teaching activities such as: In class, In tutorial, or Outdoor (Khodeir, 2018) as well as moving from a Teacher-controlled approach to a new pedagogical model focused on a learner-centred approach called Project Based Learning philosophy.

The traditional educational practices for a single profession now point to bridge cross-boundary disciplines. Therefore, today's already deviant professional practices already emphasize coaching and learning-by-doing. Hence the importance of CPD for veterans.

The research question authors tried to answer was: what is the theoretical background supporting a proposed "Renovation Wave" for educational and training programmes of AEC professionals towards a new European Bauhaus?

3. Building is an act of Culture for the Learning Society: investigating the theoretical background

In June 1995 European Council held in Cannes stated that *Training and apprenticeship policies, which are fundamental for improving employment and competitiveness, must be strengthened, especially continuing training"* (European Commission, 1996). Later in November 1995 European commission published a White Paper called "*Towards the Learning Society"* taking forward a precedent document stressing how relevant, were (and are nowadays) for Europe, intangible investments particularly in education and research. Hence, 1996 was chosen as the European Year of Life Long Learning.

In a knowledge economy, information is the currency of wealth (Kirk Hamilton & Watkins, 2009): one goal to achieve this is to bring together school and business sectors together. Indeed, this point was included in the manifesto. The investment in knowledge can be then translated in economic values as an essential role in employment, competitiveness and social cohesion. Some of these indicators shape what is currently called Human capital.

In 2013 in a conference held by the Italian Institute of Statistics, the topic of the economic value of human capital stock have been estimated on average as 342.000 Euro (ISTAT, 2014), relative to the period 1998-2008. The conference proceedings showed that this value increases every year due to level of education, investments in professional development, expenditure on personal health, transport costs as well as increased salary.

Building is an act of culture this statement stems from the rationale of Baukultur (Schmedding et al., 2015), a uniquely coined German word, meaning the 'culture of building', defined as 'the coordinated system of knowledge, rules, procedures, and habits that surrounds the building process in a given place and time (Howard, 2006)'. This word implies that good planning and building combine high design standards with a holistic view of social, economic and environmental aspects and it has an emotional and aesthetic dimension. Another evidence is found in the Italian code of professional conduct for Warranted Architects (CNAPPC, 2021). It describes the role of the architect as a professional with a fiduciary rapport with the society in which he/she operates. Architects must promote the concept of quality in architectural design and building construction in line with the 9th and 41th Article of Italian Constitution. Indeed, they play a major role in transformation of the built and natural environment as well as contributing to improve people's quality of life, thus the outcomes of their action is of public interest (CNAPPC, 2021).

4. The Reflective Practitioner

The philosophical underpinnings of the life-long learning approach and continuous professional development can be found in the work of the American philosophers John Dewey first and Donald A. Schön later.

The reflective practitioner is a term coined by Schön in 1982, a resident academic at the School of Architecture and Planning at MIT. Starting from Dewey's theories he developed his interests on the education and practical training process for professionals and the skills required for an effective performance. The architectural practices became the prototype to test the robustness of his thesis (Schön, 1983).

His point of departure started from the acknowledgment of the crisis of confidence in the professions where the acquired knowledge was not adequate to the needs and problems of society at that time. What he described as "technical rationality", or the body of knowledge they have to master in order to provide these services, was entering a phase of crisis because uncertain conditions, unusual and complex task could not be addressed with standardized and well-defined rules.

If professionals were performing tasks in which they were not educated could require unprecedented requirements for adaptability (Schön, 1983). Because of that some of them tended not to explore beyond what they already knew, fearing the loss of credibility in what they would have accomplished. These precautions of limiting their action were criticised as pursuing a personal interest rather the community or public interest as a result of their work (Penasa, 2020).

He proposed a new way of approaching professional practice based on the constant relation between theory and practice, were new habits could have transformed them as Reflective practitioners. According to Schön, the fear of unknown that generate anxiety, uncertainties was a good driver to research and generate new knowledge. Indeed, he argued the technical rationality is effective could be effective only when the problem was already known and well defined so then one would have needed to apply the technical knowledge already possessed.

In everyday situations the professionals have to understand the circumstances, defining hypothesis and potential means to answer client's brief. In fact, is more important pertinence rather than a rigorous rule valid in

all the cases. The professional has to build a case by decomposing all the issues in small meaningful pieces and then at the end coming with a solution where the acquired knowledge can be applied (Penasa, 2020).

This critical task of managing complexity is especially true in engineering as well as medicine, business management, and education. Again, Schön insisted that education of the RP should follow the concept of Reflection-in-action. He referred to an approach that was typically found in arts and design; these deviant traditions of education for practice emphasize coaching and learning-by-doing were different from was promoted at educational level at that time. The difference was that problem solving skills should have been learned through a coach in form of a training programme. (Penasa, 2020) The theoretical background of this training process constituted the main point of "*Educating the Reflective practitioner"* the sequel published in 1987 (Schön, D. A., 1987) .

The learning process should have been done in a risk-free environment where the learner was assisted by coach support in order to acquire as many as possible notions, knowledge, and experiences. During the training he had to reflect-in-action to develop a set of precedents to be used as a guide, not a general rule to be applied in future tasks (Penasa, 2020).

The balance between pertinence and rigorous technical solution was part of a scientific process where finding the hypothesis firsts, checking their relevance, retry and gain new knowledge would have made the RP operating more like a scientist rather than a conventional practitioner.

5. Evidence Based Professionals: overcoming the Traditional AEC curricula

Fast forwarding to 2008. D. Watkin and Wilkinson in their book Evidence-based design has emphasized the fact that *the practice of architecture is becoming more complex, demanding ever-increasing focused knowledge to better serve the needs of clients. Given the sizable costs of almost any building type and the large investment by the owner, it should not be surprising that many are demanding more predictable, dependable outcomes as a result of that investments* (Kirk Hamilton & Watkins, 2009).

The request for result-oriented outcomes of professional activity is achievable and requires a firm that possesses research capabilities, knowledge system, and expertise not common to most architectural practices. The problem is attributed, in part, to an architectural education model that has not changed significantly since the nineteenth-century days of the Ecole des Beaux-Arts. (Kirk Hamilton & Watkins, 2009)

According to them the education the most architects receive is ill-suited to providing the kind of knowledge that can consistently assist the clients in achieving goals that go beyond (1) aesthetics (2) efficiency, (3) schedule and budget compliance, (4) technical accuracy, and (5) functionality. (Kirk Hamilton & Watkins, 2009). In accord with these statements a recent survey (Gerada, 2020) looking for identifying the priorities of Maltese AEC professional demonstrated that utmost importance (72%) is given to functionality, 20% Aesthetic design, and only the remaining 8 % for tenants experience and environmental features (fig 1).

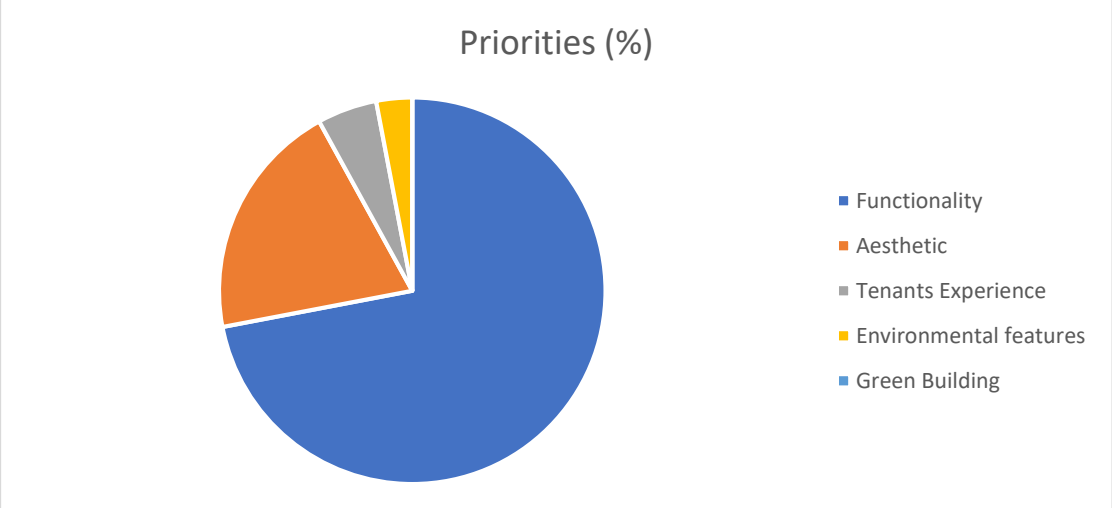


Fig. 1 Priorities of Design professionals.
Source: Reproduced from (Gerada, 2020)

Like Schön Watkin and Wilkinson that professionals prefer limitation of using the information already known or available to a design practitioner to answer a design question fearing that the admission of a limited understanding of design will damage their image (Kirk Hamilton & Watkins, 2009).

Nowadays, if the wealthy are those who know how to conduct research and thereby create new understanding previously unavailable and potentially of great worth it is logical that the design practitioner will become the agent of wealth creation in a knowledge economy, both for the client and for the design practice. (Kirk Hamilton & Watkins, 2009)

They have proposed to reshape competences towards the novel concept of evidence based professional. The greatest difference between a conventional project and an evidence-based one occurs in the predesign phase because they oversee a complicated process that could involve a diverse group of stakeholders from clients, other professionals involved, and the representatives of the public who would experience the completed project. (Kirk Hamilton & Watkins, 2009)

Below an example of Evidence based design process (tab.1) with a robust set of tasks to be carried out as a preparation before the design actually starts.

Table 1

WHR Architects' nine-step evidence-based design process.

Task		Activity
1	Identify client's goals	Note most important and facility-related global and project-based goals
2	Identify the firm's goals	Understand the firm's strategic, project and evidence-based design objectives
3	Identify the Top 3-5 Key Design Issues	Narrow the possible choices; work on high impact decisions
4	Convert Design Issues to Research Questions	Reframe statement of design issues to become research topics
5	Gather Information {Benchmark Examples, Literature Sources, Internal Studies)	Infinite possibilities must be narrowed; limited perspectives must be expanded
6	Critical Interpretation of the Evidence	No direct answers; requires open-minded creativity, balance, and critical thinking
7	Create Evidence-Based Design Concepts	Based on creative interpretation of the implications of research findings
8	Develop Hypotheses	Predict the expected results of the implementation of your design
9	Select Measures	Determine whether your hypothesis is supported

Source: Reproduced from (Kirk Hamilton & Watkins, 2009)

6. Moving From Sustainability to Regenerative. An ecological toolkit for professionals

Sustainability, as currently practised in the built environment, is primarily an exercise in efficiency. In other words, the use of environmental rating systems and other mechanisms allows a reduction in the damage caused by excessive resource use. (Du Plessis & Brandon, 2015)

For example (Sant, Rita, Borg, P. Ruben, 2016), have proposed the development of an holistic green building rating tool for the Maltese Islands called High Environment Efficient Assessment Rating Tool (HEEART). By means of interviews and applying Criteria Weighting system they concluded that 8 Criteria met the local context in terms of climate, available resources and cultural aspects. In a recent paper GBRT criteria currently being applied worldwide were reviewed with the aim of looking for categories that could establish a much-needed common language in sustainability applied in the construction sector (Asdrubali et al., 2019). Comparing the two researches (see Table 2) we can notice similar criteria in terms of site, energy, indoor environmental quality and materials. For Borg and Saint the topic of pollution, Integrated design process and Economic quality were more important than other aspects such as Outdoor quality (e.g. proximity to mass transports so on).

Table 2

Comparison of Green Building Rating tools and Living Building Challenge

Borg and Saint (2016)	Asrubali and alii (2018)	International Living Future Institute (2019)
HEEART tool for Malta	Main Green Building Rating Tools Criteria	Living Building Challenge (v.4) Petals
Site	Site	Place
Water	Water	Water
Energy	Energy	Energy
Indoor Environmental Quality (IEQ)	Comfort and Safety	Health+Happiness
Materials	Materials	Materials
Pollution	Outdoor Quality	Equity
Integrated Development Process (IDP)		Beauty
Economic Quality		

Source: Extracted from (Asdrubali et al., 2019; International Living Future Institute, 2019; Sant, Rita, Borg, P. Ruben, 2016)

As mentioned in the introduction, the age of Anthropocene is experiencing a rapid loss of biodiversity and, with it, Earth's ability to support complex life (Bradshaw et al., 2021). The same paper stemming from an extended literature review, found some reason for the urgency to enable the shift as listed hereunder in bullet points,

- disciplinary specialization and insularity encourage unfamiliarity with the complex adaptive systems in which problems and their potential solutions are embedded.
- Widespread ignorance of human behaviour and the incremental nature of socio-political processes that plan and implement solutions further delay effective action.
- Time delays between ecological deterioration and socio-economic penalties, impede recognition of the magnitude of the challenge and timely counteraction needed.

Instead of doing less damage to the environment, it is necessary to learn how one can participate with the environment by using the health of ecological systems as a basis for the design. To this regards (Du Plessis & Brandon, 2015) are questioning whether or not we can change the way the built environment because RESTORE promoters (Brown et al., 2018), states that currently built environment sustainability has a narrow focus on building energy performance, mitigation strategies and minimisation of environmental impacts. This approach is failing to address key issues such as having a socially just, ecologically restorative and culturally rich future while being economically viable at the same time. This complex leap toward Regenerative Sustainability is currently proposed through the Living Building Challenge ^{SM} (LBC) certification, consisting of seven performance categories, or "Petals": Place, Water, Energy, Health + Happiness, Materials, Equity and Beauty. Each Petal is subdivided into Imperatives, for a total of twenty Imperatives in the Challenge (International Living Future Institute, 2019).

As we can see from the table 2 compared to HEEART and the other GBRT criteria the LBC has included a human centric aspect to cope with it in the form of social equity and the qualitative category of beauty. A recent publication by (Brown et al., 2018) is showing that, in general, there is a lack of regenerative sustainability criteria in Europe, especially in the southern countries. Most countries rely on traditional materials and technologies rather than advanced and emerging materials and techniques. The below infographic image is showing the various categories of sustainability and the categories currently being discusses among experts in the field of regenerative

sustainability.

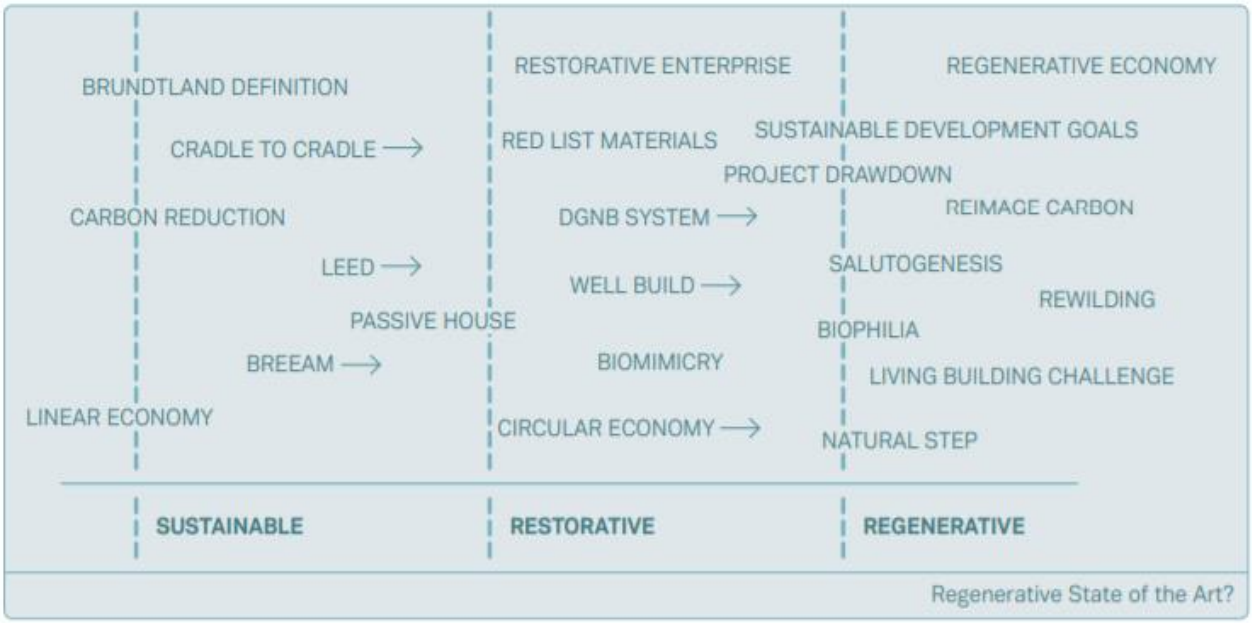


Fig. 2 Sustainability, Restorative to Regenerative State of Art
Source: Reproduced from (Brown et al., 2018)

7. Drivers for paradigm and market shift: from public to private

The EC in 2008 received mandate to provide guidance on how to reduce the environmental impact caused by public sector due to procurements of goods, services and works. A deadline was set up that by 2010 50% of all the public tendering procedures should have been compliant with common core EU GPP Criteria. The EU Member states were encouraged to draw up voluntary National Action Plans (NAPs) envisaging their implementation in each European countries and the GPP criteria for "Office Building Design, Construction and Management" were included (Ganassali et al., 2018) because is the most of the buildings occupied by public authorities falls in this category.

Although, GPP is a voluntary instrument, it aims at stimulating the market demand for more sustainable goods and services. In 2017 the Italian public procurement code (*Codice degli Appalti*) has introduced mandatory environmental GPP criteria (*Criteri Ambientali Minimi–CAMs*) to enhance the sustainability of construction products, for new public and refurbished buildings, and sites management (Governo Italiano, 2017). CAMs criteria were set on three design reference steps: the sustainable site analysis, surrounding area where the building is located; the buildings technical specifications (including the necessity to carry out dynamic energy simulations, the use of renewable energy sources, indoor environmental quality requirements) and the materials technical specifications. For some material categories a minimum recycled content was imposed.

As mentioned in the introduction the EU goal of creating new green jobs is ambitious because it confronts itself with the barriers of insufficient technical skills from the public authorities that now needs a robust upskilling process. In an article (Lavagna et al., 2019) are viewing favourably the decision of making GPP criteria mandatory to stimulate construction market transition towards sustainability criteria, because public procurement consists in a relevant expenditure for EU Member Stated, in Italy 10,7% of GDP equivalent to 250 billion Euro circa (Albano & Antellini Russo, 2009). This mechanism being driven by the spending power of public authorities can stimulate the private sector and competitiveness due to the increased availability of greener services and goods. Additionally, CAMs are awarding bidders who employ GBRT accredited professional aligned with ISO/IEC 17024:2004: from one side the private initiative can consider achieving green certifications because now are available and at competitive price, on the other side, contracting authorities are awarding professionals and contractors willing to update their skillset with new knowledge (Lavagna et al., 2019).

Furthermore, is worth mentioning another initiative that is influencing the financial markets. BlackRock's commitment for 100% ESG compliant investments portfolios, not surprisingly, is voluntary aligned with the recent EU taxonomy (Naser et al., 2021), that has the aim of creating a classification framework to facilitate sustainable investment. Investments that comply with technical screening criteria can be communicated as sustainable. In particular for the building sector the following criteria apply.

Table 3

Technical Screening Criteria of EU Taxonomy

Type of economic activity	**Technical Screening Criteria**
Construction of new buildings	Primary Energy Demand of new construction is at least 10% lower than nearly zero energy building requirements in national measures. Energy performance certified by energy performance certificate. For buildings > 5000m2: life cycle global warming potential calculated, and level of performance is tested post construction, both disclosed to investors and clients
Renovation of existing buildings	As applicable in national regulations for major renovations Reduction of primary energy demand of at least 30%.
Acquisition and ownership	Buildings built before 12/2020: at least EPC class A, or within top 15% of national building stock expressed in primary energy demand Buildings built after 12/2020: meet criteria for "construction of new buildings" Large non-residential building with HVAC output >290kW: operated efficiently through energy performance monitoring and assessment.

Source: Reproduced from (Naser et al., 2021)

In conclusion from the field of Behavioural Economics Nudge economics (Thaler & Sustain, 2009), a popular 2008 best seller about improving people's decision making, we can find an interesting tactic on how to increase interest on CPD and wider acceptance in making it mandatory requirement for professionals. According to the authors people naturally tends to choose whatever option requires the least effort (path of the least resistance). Thus, the authors view positively that any policy mandating CPD as an obligation should be accompanied by nudges in form of incentives to drive acceptance: an interesting example is the Get Qualified scheme set up by the Maltese Government. This measure in form of tax credit up to 70% of the costs is applicable to individuals following a course of studies leading to a certification, diploma, degree or post-graduate degree courses to recover part of cost incurred with a reduction on personal income tax.

8. An example of multidisciplinary Education. The case of MSc in Environmental Design at the University of Malta

With the introduction of the mandatory EPBD in 2009 and a greater energy awareness, most established professionals were feeling the need to update themselves and rise up to the tide. In response to this new demand the Department of Environmental Design, at the Faculty for the Built Environment (University of Malta) designed a new specialisation Master's degree. This exposed architects and engineers to a broad range of topics generally related to the Architectural Science aspects of buildings. Topics covered include Lighting, Acoustics, Thermal Comfort, Ventilation and Energy use among others. Three cohorts of students went through the course, who were awarded an MSc in Environmental Design. This saw most of them climbing higher in the echelons of their established posts, while others sought new pastures in the field of energy auditing and energy efficiency.

Considering the latest trends towards retrofitting buildings with greater accent now placed on a circular green economy, the Masters programme was tweaked to become an MSc in Sustainable Building Design. This time more practical hands-on study units were introduced in order to expose mature students to the existing building stock and its potential for refurbishment, even if to a new use, with minimal drastic interventions, thus curtailing waste generation and embodied energy disposal. Both courses were subjected to rigorous reviews by EU and British academic institutions prior to their launch. This is in the light of the European Green Deal and the Long term retrofit strategy for Europe.

9. Training the future proof Evidence Based designer: three case studies

First case study is Cost Action CA16114 RESTORE (namely REthinking Sustainability TOwards a Regenerative Economy) (Brown et al., 2018). It has been funded by European Cooperation in Science and Technology (COST) with the aim of creating networks among scientist across Europe (and beyond). RESTORE

Action was 4-years project Horizon 2020 funded project recently concluded, focused on giving impetus to research advancements and innovation in the field of Regenerative Economy for the built environment. Cost Actions and thus CA 16114 has involved private sector, policy makers as well as civil society in collaboration activities such as workshops, conferences, working group meetings, training schools. This has corroborated the overall aim of pursuing a multi-stakeholder approach.

Luca Caruso attended the last Training School held in Wien in September 2020 being part of the 16 trainees selected to contribute to the Working Group 5 called Scale Jump delivered in a hybrid mode due to the current Covid-19 Pandemic. Lectures were performed online whilst open air site visits and small group projects were carried out. The Workshop intended to conceptualize a holistic vision for the BrigittenPlatz/Hannovermarket.

The second is the Build Up Skills initiative. In the report Agenda for new Skills and jobs (Lang, 2018) the EU Commission recognized a persistent skills mismatch in the EU labour market especially in AEC. As a consequence, investments in education and training systems were funding national roadmaps for qualifying the building workforce. The Build-up skills (BUS) was a strategic initiative started in 2011 under Intelligent Energy Europe (IEE) programme to boost continuing or further education, training of craftsmen, other on -site construction workers, and system installers. Regular exchange activities have been organised to foster learning between 30 Eu countries (28 EU, the Republic of Macedonia and Norway). More qualified workers are needed across Europe to deliver building renovations towards nZEB status. Horizon 2020 has continued to support the BUS initiative with 5 transnational construction skill projects. All of the following project were carried out from 2015 till 2018.

- **ing RES**, (EU Cordis, 2018a) for middle and senior level professionals, focused on Energy Efficiency and Use of Renewable Energy Sources in buildings. coordinated by Slovakian and Czech Republic applicants. Workshop and e-learning modes were deployed.
- **BUILD Up Skills to Business**, (Lang, 2018) developed a new qualification scheme in the Netherlands with training materials equivalent to EQF level 2 to 4 for building workers as a foundational courses including the basic knowledge of sustainable building practices to understand the consequences of their work for the sustainability of the building.
- **MEnS⁻**(EU Cordis, 2018b)has developed 30 integrated and interdisciplinary training programmes in partnership along with universities and private partners. The project aim was to produce training videos, webinars and live broadcasts on social media of the conferences and documenting case studies. Focus retrofitting of housing to nZEB standard. Also special care was given to developing professional skills of women and unemployed in Architecture and Engineering.
- **PROF-TRAC,** (EU Cordis, 2018c) starting from gap analysis in the nZEB skills, this project was specifically funded to develop and maintain an educational open access platform for dedicated training and continuous development related to new and existing nZEB. It is also an online repository of all the previous projects brought forward by IEE initiative. To date more than 280 documents regarding nZEB are available. The most ambitious aspect is to have mapped nZEB skill in an harmonized way across work fields because defining and targeting specific professions at the European level is a difficult task due to a very fragmented panorama of the professional qualifications.
- **Train To nZEB,** (EU Cordis, 2018d) was a project designed to establish a functioning network of training and consultation centres, called Building Knowledge Hubs, providing practical training, demonstration and complex consulting services for the implementation of nZEBS.

The third one is the recent framework proposed by (Çetin et al., 2021). Being Circular economy a policy in EU and China the author investigated what could be feasible and promising digital technologies to facilitate a circular economy in the built environment. These include: (1) additive/robotic manufacturing, (2) artificial intelligence, (3) big data and analytics, (4) blockchain technology, (5) building information modelling, (6) digital platforms/marketplaces, (7) digital twins, (8) the geographical information system, (9) material passports/databanks, and (10) the internet of things.

10. Exploring alternative learning methods for AEC professionals: Blended learning

There are some researches showing that traditional schooling is facing major problems around student motivation and engagement (Dicheva et al., 2015; Khodeir, 2018). The perception is that they are considered ineffective and boring by many students. Some teachers are exploring novel instructional approaches and gamification is one them. Games utilize motivational mechanism to engage with them often without reward just for the joy of playing and possibly win (Dicheva et al., 2015). The same authors consider educational games as learning tools to be promising because it reinforce pupils abilities and skills in problem solving, collaboration and communication.

(Khodeir, 2018) instead has explored several ways on how to enhance the teaching experience of Project Management Education among architecture students because that learning process was considered unattractive. In the case of training project managers in construction (Khodeir, 2018) has tested various combination of learning method in the form of blended learning where virtual and physical resources are used. In his paper he has presented a matrix of blended teaching methods examined for delivering Project Management Courses in 2 architectural school in Egypt.

The learning method tested were

Table 4

Various learning methods deployed by Khodeir

In class blended teaching methods	**In tutorial**	**Outdoor**
Direct lecturing	Role play	Interviewing managers
Open Discussion	Team Building	Designing Audio visual presentation
Self-learning presentation	Real-life project (stakeholder identification/scheduling/Budgeting / Risk Analysis	
Self-learning posters	Group Presentation	
Story telling	Decision Making	
Audio visual	Brainstorming	
Real life case studies		
Game based		

Source Adapted from (Khodeir, 2018),

It is interesting seeing game-based learning method included in the above list, as a new form of learning experience currently being used in other sectors like Business, Marketing, corporate management, wellness and ecology initiatives (Dicheva et al., 2015). The use of blended method should be encouraged and further investigated because (Khodeir, 2018) observed has been beneficial to PM courses delivery as well as higher student performance along the years.

On the topic of PM education (Kilkelly, 2009) also noted that while e-learning is good for imparting knowledge only, where people can learn at their own pace and study specific topics they like, it still requires the practical application of knowledge in order to become skill. So blended learning is considered ideal for these reasons (Khodeir, 2018).

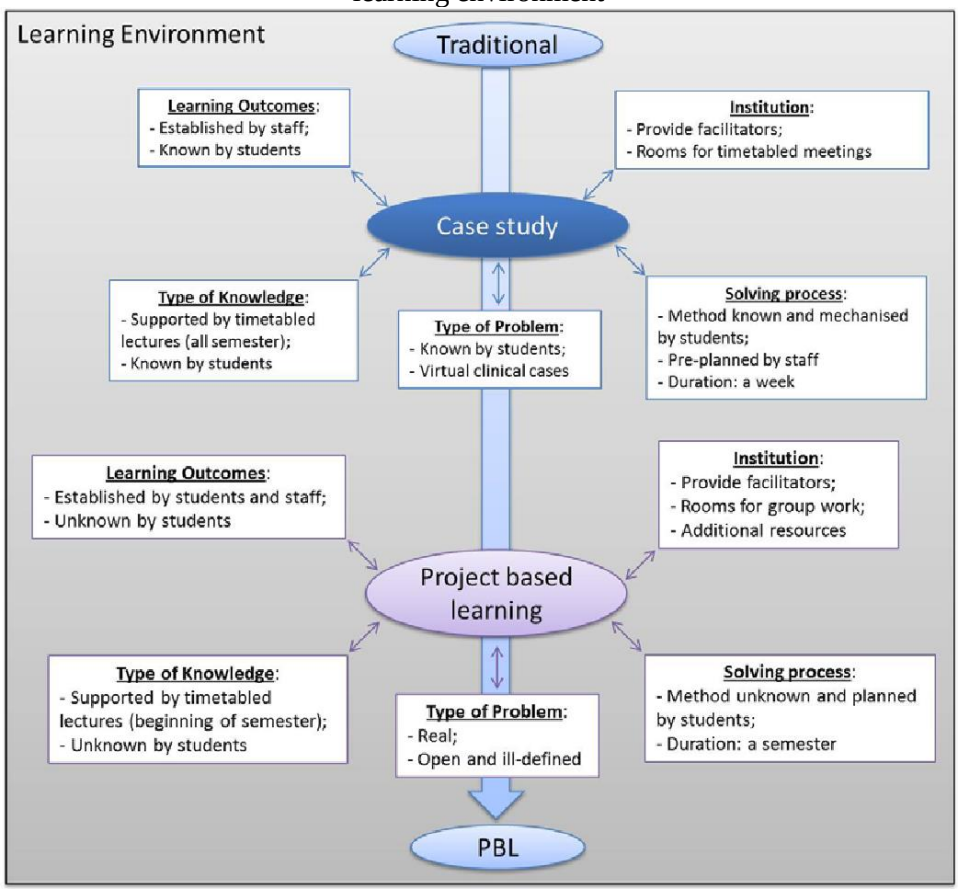
11. From teacher-controlled to Learner centred approach: The project-based learning as interesting way to improve education

As discussed in the previous paragraphs both the Reflective Practitioner and Evidence Based Designer concept requires a scientific enquiry mindset to cope with unusual and complex client's briefs. Since the new skillset requires to focus on problem scenarios rather than subject matters, Problem Based Learning (PBL) appeared to be an interesting case study.

Indeed, it derived from the student-centred pedagogy promoting active and life-long learning and is defined as a learning philosophy and with a set of learning principles (Graaff, E. and Kolmos, A., 2007). PBL is characterised by an enquiry process where problems – mostly from real and complex situations – are formulated and drive the whole learning process. Through an extensive literature review (Davies et al., 2011) has shown the advantage of Learning through PBL in promoting, critical thinking, self-learning skills, lifelong learning, self-achievement, self-regulation, self-efficacy, communication skills and interpersonal skills for students. It also increases the students' interest in a course (Davies et al., 2011)as one of the main motivations behind the necessity of moving from a traditional teaching method to explore new approaches. In the studies mentioned this methodology is being applied at the faculty for engineering in Aalborg since it's foundation in 1974 (Davies et al., 2011).

In order to understand the differences, the image attached shows the progression from the conventional learning outcomes of traditional teaching methods and the expected knowledge to be acquired thanks to project based methodology.

Fig. 2 Progression from a traditional teaching environment to a pure problem-based learning environment



Source: Reproduced from (Davies et al., 2011)

12. Conclusions

EBD and RP have in common the necessity to pursue quality and tangible results to clients. Evidence based design is already thriving in some areas of practice (most notably healthcare, sustainability and workplace design (Kirk Hamilton & Watkins, 2009).

The renovation wave of educational and training programmes cannot start if

1. We will rely on an educational model that is influenced by obsolete criteria of the teacher-controlled education
2. We are not aware that learner centred approach already exists.

We are concerned that without this shift we will be still having professionals with greater and greater knowledge of how buildings perform technically, but we would be less certain, however, whether we will similarly increase our ability to understand, predict, and better achieve preferred outcomes from all of these efforts. This is especially true when the outcomes relates to human behaviour and performance an area of knowledge that is least understood by most professionals in AEC.

13. Acknowledgement

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14. Limits of this study

The publication's aim was to identify a theoretical background and the related connections with philosophical perspectives while trying to provide some practical case studies of this ongoing paradigm shift. The authors acknowledge the need for a multidisciplinary co-authorship for drafting these future guidelines or critical reviews based on further deploying qualitative methods of research in more detail like questionnaires, surveys, or

focus groups with the scope of finding the more appropriate learning environment for educational and training programmes in AEC sector.

15. Author contribution

LC has developed all the paragraph except, paragraph 9 and conclusions provided by VB as well as revisions.

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