Towards a Unified Qualification Framework for Digital Transformation in Education in Latin America: The case of the EU-BEGP Project

Lourdes Socarrás-Mérida
Energy Resources Institute
Universidad Galileo
Ciudad de Guatemala, Guatemala
smerida@galileo.edu

Alex Villazón
Universidad Privada Boliviana (UPB)
Cochabamba, Bolivia
avillazon@upb.edu

Carlos Armando Lemus Montepeque
Energy Resources Institute
Universidad Galileo
Ciudad de Guatemala, Guatemala
carlos.lemus@galileo.edu

Cristian Fernando Guzman
Energy Resources Institute
Universidad Galileo
Ciudad de Guatemala, Guatemala
crisfianfer@galileo.edu

Omar Ormachea
Universidad Privada Boliviana (UPB)
Optics and Energy Research Center
Cochabamba, Bolivia
oormachea@upb.edu

Sebastián Cabria Vissoni
Energy Resources Institute
Universidad Galileo
Ciudad de Guatemala, Guatemala
sebastian.cabria@galileo.edu

Torsten Fransson
EXPLORE Energy Sweden AB
Stockholm, Sweden
fransson.kth@outlook.com

***Abstract*— Digital transformation in education, particularly in Latin America, faces significant challenges due to the lack of standardized academic credit systems across universities. The EU-BEGP Project aims to address some of the challenges by developing a unified qualification framework that aligns with the European Credit Transfer and Accumulation System (ECTS) and an earlier proposed "Latin American Reference Credit" (CLAR) system. This paper presents the "EXPLORE Energy Digital Academy" (EEDA) concept, which supports global collaboration in the co-creation of digital learning materials, emphasizing quality assurance and innovative, student-centered educational models that are expanded into Latin America. This is done through the EU-sponsored "EU-BEGP" Project which involves partners from both Latin America and Europe and seeks to modernize courses and programs in the energy sector through digital tools and resources, while also proposing solutions for a standardized academic credit system that facilitates the recognition of qualifications across regions. This initiative is crucial for fostering educational collaboration and ensuring that digital education meets the diverse needs of students in emerging regions. The paper describes the background of such collaboration and focuses upon the necessity of (1) appropriate academic metadata, (2) educational quality process and (3) credit transfers between partners.**

Keywords — Academic Credits, Global Educational Collaboration, Latin America Higher Education, Digital Learning co-creation.

I. Introduction

Digital transformation makes education more accessible to a broader audience, including those in remote or underserved regions. Online platforms and digital resources allow students from diverse backgrounds to participate in higher education, breaking down traditional barriers such as geography and socio-economic status.

Following the COVID-19 pandemic, MOOCs (Massive Open Online Courses) have accelerated, offering a potential revolution in higher education by providing free, global access to courses from leading institutions [1]. MOOCs present both challenges and opportunities for universities, potentially reshaping traditional educational models and expanding access to global audiences [2]. While MOOCs may impact various aspects of higher education, including pedagogy, delivery methods, and business models, more systematic research is needed to evaluate their long-term disruptive potential. While several MOOC platforms enable co-creation of learning material between educators, two factors are still open issues in MOOC towards 2030: quality assurance of the learning material e.g., through peer-review between experts, and accreditation for a global student body [3].

Another of the core issues in educational collaboration is the lack of a generalized criterion for valuing academic credits. This problem is still present across Latin American universities at a national and international level, due to the lack of academic credit systems, which also includes differences in academic metadata such as the Intended Learning Outcomes (ILO), accreditation and assessment criteria, and others. For example, the Tuning Latin America project [4], concludes that there is no academic credit system shared by Latin American countries. In general, in those countries where there is a credit system, the criteria for quantifying the unit are diverse and make it difficult to homologate courses and programs.

According to Castells' concept of the "network society" [5], where social, economic, and political relations are organized in networks enabled by information and communication technologies (ICTs), digital technology should be adapted to educational processes through innovative strategies based on appropriate educational models, rather than merely introducing technology sporadically. Following this perspective, the EXPLORE

Energy Digital Academy (EEDA) [6], [7] aims at developing a global collaborative network of experts, to support the digital transformation, through the co-creation of digital learning material for innovative student-centered models, and active learning methodologies, such as Challenge-Driven Learning (CDL) [8], flipped-classrooms [9], and the use of remote laboratories [10]. EEDA addresses the prevailing educational needs of the energy sector and promotes clean and efficient energy solutions, while ensuring quality of the shared digital learning material through a complete self-review and peer-review process.

The European Commission supports digital transformation in education required in Higher Education Institutions (HEIs) from emerging regions through different projects within the Erasmus+ Programme. At the time of the writing, EEDA has more than 43 members in 21 countries from Latin America, Asia, Africa, and Europe, within 5 Erasmus+ Projects EUSL-Energy [11], EUBBC-Digital [12], EU-BEGP [13], EDU-ABCM [14], and EUZW [15].

In this article, we present in detail the EEDA concept and we give an overview of the EU-BEGP Project, which outlines the collaborative effort of HEIs from Latin America (Bolivia, Ecuador, Guatemala, and Peru) and from Europe (France and Spain), towards a unified criteria for creating a model of homologation that aligns with the different academic levels achieved by students. All the EU-BEGP partners collaborate to modernize courses and programs in the energy sector, using different digital tools and resources, within the EEDA concept.

We describe the challenges and potential solutions for creating a standardized academic credit system, comparing the European Credit Transfer and Accumulation System (ECTS) [16] with the academic credit systems in Latin America, emphasizing the need for a common Latin American space for higher education. We also highlight a key initiative working towards this goal, proposing the Latin American Reference Credit Objectives (CLAR) [17] (a proposed credit transfer system for Latin America by the Tuning Project [4]) to unify credit systems and promote student mobility. Finally, we describe the Stackable Master Credit Transfer System (SMCTS) that is used within EEDA.

We strongly believe in the importance of creating equivalence tables between universities in the EU-BEGP consortium (and indeed in the whole EEDA consortium) and reaching agreements to unify these criteria. This unification would facilitate double degrees and student mobility between universities, creating a model of homologation that aligns with the different academic levels achieved by students.

II. The EXPLORE Energy Digital Academy Concept

The EXPLORE Energy Digital Academy (EEDA) is an online educational concept dedicated towards educator-to-educator collaboration and promoting knowledge in the field of energy. Its mission is to provide high quality education on various aspects of the energy sector, including technologies, policies, sustainability and emerging trends.

A. Co-creation of Learning Material

The EEDA concept is based on global, voluntary collaboration between educators and universities to share and co-create educational resources through Creative Commons licenses [18]. This enables a higher quality of individual learning units (and entire courses and programs), as well as a significantly increased ability of educators to create mutually supportive resources for students.

EEDA uses learning material stored in a globally available repository containing learning information structured in “Modules”, “Lessons”, “Topics” and “Subject Areas”. Each piece of content in the repository is referred to as a "Learning Resource". Educators can use, re-use, share, adapt, or translate those learning resources, to build their courses and programs “lego-wise”. A Module is the smallest learning resource in the concept and corresponds from 0.5 to a maximum of 5 Estimated Learning Hours (ELH)[1]. It constitutes educational content that a teacher can use as classroom material. Teachers can also join other teachers from an existing Module to create a network of teachers to help create complete material for a Lesson, which constitutes several Modules. Within the continuous learning structure, the same network of teachers or a single teacher can put together several Lessons to form a Topic. The set of topics within the repository constitutes a Subject Area.

Within EEDA, educators from different parts of the world can co-create Modules, using a modern digital Authoring Tool, that are later stored in the Repository. Both the Authoring Tool and the Repository are based on the Learnify platform [19]. The EEDA repository is key for educators around the world to share knowledge and experiences through educational Modules forming networks of teachers and evolving the way in which education is done today. In this way educators can, locally or globally join forces and create “courses” of any length, from short professional to full academic courses for the benefit of “local as well as global” students, putting their own “personal touch” wherever appropriate while freely using material from colleagues globally.

It should be emphasized that the EEDA repository does not replace the educator; it is a digital tool that educators use to enable the student to do independent work. This refers to the concept of "flipped classroom" [9], in which the student is self-taught, using the material provided to study and have the necessary complement from the educator in form of instructor-guided discussions to finish an academic course. Modules include a completion certificate, that is generated once the learner has completed all the activities in the module (reading of text, documents, visualization of videos, practical exercises, self-assessment questionnaires, etc.). The educator can request these certificates to be shown before the synchronous session, but the actual assessment about the knowledge acquired using the Modules is chosen by the educator (e.g., through tests, quizzes, presentations, or reports). Educators are free to use any Learning Management System (LMS), since Modules are shared as simple URLs.

Thus, EEDA goes beyond the concept of Massive Open Online Course (MOOC) [20], where interactions with the educator are basically non-existent or very limited, and there

[1] ELH (Estimated Learning Hours) refer to approximate time required to acquire specific knowledge or skills in a subject, encompassing both teacher-led and individual study hours. More details in Section V with their correlation with academic programs.

is no “educator-to-educator” collaborative co-creation of learning material.

In EEDA, educators can select the educational resources they consider appropriate for the course being developed or implement it in an existing course. Within the repository there is a vast number of Modules, Lessons, Topics, and Subject Areas from which they can choose. The advantage of using this repository is that it is constantly being updated with the help of networks of teachers who have specialized in specific Topics or Subject Areas and new Modules are added or updated containing other resources that facilitate the creation of more educational material in the future.

The key to an effective collaboration, and reuse of learning resources goes of course through an assured quality of the material, including peer reviews. To this end, rach educational resource in EEDA contains "academic metadata", which refers to the competencies that each student intends to develop with a Module, also the prerequisites to continue in a subject, as well as an evaluation criterion that fits the syllabus of the Module worked by the student. The Intended Learning Outcomes (ILOs) used in the EEDA are based upon the European Qualification Framework (EQF) 2017 [21] and are separated into “Knowledge”, “Skills” and “Responsibility & Autonomy”.

B. EEDA Quality Improvement Process (QIP)

One of the key elements in EEDA is the quality of the shared learning material. Each Module needs to pass a quality review process, which combines both a self-review done by the author of the Module, and then a peer-review done by educators within the EEDA global network or external reviewers. This Quality Improvement Process (QIP) was inspired by the peer-review process applied in research (e.g., in scientific publishing or grant proposal review), but that is unfortunately not commonly applied in educational content production.

Each educator creates a “Personal Module”, which includes metadata about the expertise and the areas of interest, in the form of “keywords”. These keywords are used by the QIP tool to generate a graph structure connecting educators and expertise. Thanks to this graph, the QIP can automatically propose a list of potential peer-reviewers for the Modules.

EEDA supports constant review of the content stored in the repository. The QIP tool performs a ``basic scan" to verify the correct structure and basic information such as the existence of author's data, the Intended Learning Outcomes (ILOs), the number of Estimated Learning Hours (ELH), and the keywords of the Module, among others. The keywords of the modules are used to match the Personal Modules for potential reviewers within the EEDA educator’s network.

During the development of the Modules, the Authoring Tool provides a “reviewer” mode, allowing co-authors or other educators to provide direct feedback at the level of individual activities of the Module. This is a first step in the quality process.

Once the module is ready for the quality assessment with the QIP tool, the author and/or co-author can start the **self-review** of the Module, which includes several quality “scans”, namely:

- Basic Scan: Measures the quality of the information about important parameters and metadata.
- Learning Content: Measures the quality of the content, such as alignment to the ILOs, realistic ELHs, accuracy in theory/formulas/figures, length of the text, prevention of plagiarism, and others.
- Multimedia Scan: Ensures the quality on the use of multimedia, such as the maximum length of videos, the why, how, and what of the multimedia, self-assessment questions about the media, audio and video quality, appropriate use of images to reflect the content of the Module, and others.
- Assessment Scan: Measures the quality of formative and summative assessments which are used to ensure correct understanding of the content, and others.
- Certificate Quality: Ensure that the certificate of completion contains all the required information
- Overall Quality: Ensure that the Module has all the general quality requirements, e.g,, follows web standards and guidelines, student-centered and flipped-classroom perspectives, and others. This includes also the technical/ humanity/ societal/ etc correctness.

Once the self-review is completed, a “Self Assessment Quality Compliance” badge that the author can download and include it in the Module’s description is automatically created. This badge ensures a minimum quality level, and can be published in the EEDA Repository.

The second quality validation is done through a **peer-review** process, using similar scans, where invited experts within the EEDA network or external ones, perform an in depth review, giving a final score, and also suggestions to improve the quality, in order to improve the Module, and the grade. A minimum of 3 peer-reviewers should review every Module, and a new badge is generated. The badge level goes from “Basic” to "Diamond" which is the highest quality rating. The quality badge is finally included in the Module description, so that other educators and students can use it having a clear quality level. This peer-review process is circular in the sense that once the developer has received comments, and improved, it is possible to send the module for further peer review. In this way the modules can be continuously improved, with a higher and higher “badge level”.

III. Overview of the EU-BEGP Project

The EU-BEGP[2] Project "Modernising Digital Education in Energy Transition for Circular Economy in Latin America", is a 3 years Erasmus+ Project (2023-2026) funded by the European Commission [13]. EU-BEGP is a Capacity Building Project for Digital Transformation in Education that aims at modernizing courses and programs in a digital environment around energy with emphasis on the principles of the Circular Economy based on the EEDA concept and collaboration network.

The project is based on six pillars: (1) planning courses and academic programs taking into account the differences between HEIs but at the same time unify planning in the search for globalizing educational processes; (2) strengthen collaboration for the development of digital learning material among experts; (3) peer-review to ensure the quality of the content of the material developed, strengthen invested learning considering the student as the center of the educational process; (4) develop Challenge Driven Learning (CDL) oriented to solve specific situations in the industry; (5) the development of remote laboratories with the purpose of sharing educational resources to enrich the experiences with other HEIs and not only laboratories that have the purpose of satisfying local needs; and finally (6) the implementation of different educational "programs" using the resources developed inside the repository. The remote laboratories are such that they can be run remotely by learners from any EEDA partner.

The EU-BEGP consortium is working on 5 synergy areas to strengthen the collaboration between all the partners:

- Energy Transition and Circular Economy
- Renewable Electricity Generation and Energy Storage
- Energy from Biomass
- Energy Management, Innovation, and Business
- Circular Economy in other sectors

Within these areas 6 MSc Programs and 1 Diplomado Program are being updated, and 1 MSc Program and 1 Diplomado are being newly created. In addition, 13 courses from all the MSc Programs, 7 courses from all Diplomado Programs, 4 expert courses, and 10 short courses are under development (all following the EEDA philosophy of student-centered, flipped classroom, challenged-driven entrepreneurial digital education), with new and adapted Modules that will be peer-reviewed and published in the EEDA repository.

Each Latin America partner is implementing and will deploy at least one Remote Laboratory, together with all the corresponding theoretical and practical learning Modules, made available through the EEDA repository. Also, each Remote Laboratory will be part of the different courses and programs, ensuring efficient sharing of resources among the partners.

During the first year of the EU-BEGP Project, the consortium has run 17 round tables with 42 industrial stakeholders from the energy sector, in all the 4 Latin American countries. These stakeholders expressed their interest to collaborate in the application of the Challenge Drive Learning (CDL) methodology that will be developed in the Project, and also in the courses and programs.

IV. Regional Academic Credit Systems

Globalization and the demands of economic, social, and digital innovation in today's world necessitate reflecting on the strategic importance of a unified Latin American Higher Education space. Unfortunately, there is still no common regional academic credit system in Latin America. Some efforts have been made to define some recommendations to implement such a system, based on the European successful experience.

In this section, we shortly describe the European academic credit system (ECTS), the reference credit system for Latin America (CLAR) and their correspondence, and finally an informal credit system within EEDA (SMCTS), used as a global and intermediate equivalence system.

A. ECTS - The European Academic Credit System

The European Credit Transfer and Accumulation System (ECTS) is a tool of the European Higher Education Area (EHEA) and is formally established in the countries of the European Union signatories of the Bologna Declaration [22].

ECTS credits are based on the amount of work students are expected to do to achieve the learning objectives associated with a given course or program and are related to both learning outcomes and hours of actual work. Workload is an estimate of the time an individual typically needs to complete all work activities such as lectures, seminars, projects, practical work, internships and independent learning to achieve the learning outcomes in formal education settings [16].

Because of its approach, the use of ECTS is useful for the EHEA as it facilitates student-centered learning, with emphasis on active rather than passive learning, delegating responsibility to the student and consequently greater autonomy and a reflective approach to the educational process on the part of both the student and the teacher. One of the important elements is that at the same time it establishes a close link between educational degrees and social needs, facilitates mobility from one institution to another country between different educational sectors and learning contexts. In this model, 60 credits are assigned as the total annual load of a full-time student, equivalent to 1500 - 1800 hours per year, so that each credit is associated with 25 - 30 hours of load that includes classroom time and individual work time.

[2] The project has 11 partners from Latin America and Europe: (a) Universidad Privada Boliviana (UPB), Universidad Mayor de San Simón (UMSS) and Universidad Mayor de San Andrés (UMSA) from Bolivia; (b) Escuela Politécnica Nacional (EPN) and Escuela Superior Politécnica del Litoral (ESPOL) from Ecuador; (c) Universidad Galileo (UGAL) and Universidad San Pablo de Guatemala (USPG) from Guatemala; (d) Pontificia Universidad Católica del Perú (PUCP) and Universidad Nacional de Ingeniería (UNI) from Peru; (d) Universitat Politècnica de Catalunya (UPC) from Spain; and (e) Université de Bordeaux (UBx) from France. The consortium is coordinated by Universidad Privada Boliviana from Bolivia.

B. *CLAR - A proposal for a Latin American Credit System*

The Tuning Latin America Project [4], funded by the European Commission between 2004 and 2007, had the objective to align and enhance the quality of higher education across Latin American countries by developing a common framework for understanding and recognizing educational qualifications. This initiative aimed to harmonize curricula, learning outcomes, and competencies across different institutions and countries in the region, facilitating student mobility, improving employability, and ensuring that educational programs met the needs of society and the labor market. In this project, 196 universities from 18 Latin American countries participated in the study.

The project identified that within the Latin American context there is no system of academic credits applied in a generalized and uniform manner. In general, in Latin American countries where there is a credit system, the criteria for quantifying the unit are diverse and make it difficult to homologate them.

A key finding from the Tuning project's survey is the minimal or absent recognition of independent or non-face-to-face activities, such as internships, research, and practical work, as contributors to academic credits. Despite this, the diverse ways credits are conceptualized and applied across Latin America, and the inconsistency in their measurement, suggest that the concept and necessity of credits remain central to discussions about change in higher education institutions, prompting valuable reflections on their potential adoption.

The Tuning Latin America project highlighted the proposal of an academic credit system as a key component, underscoring the need to design a reference credit system for regional universities. This led to the creation of the Latin American Reference Credit (CLAR) [17] within the project's framework, laying the groundwork for a common academic credit system in the region. The definition and adoption of CLAR will contribute to the construction of a commonspace for Higher Education in the Latin America region. So far, this is a proposal that must have continuity for the official establishment in the region which requires institutional and political efforts. At the time of the writing, CLAR is still not widely adopted, and some HEIs in Argentina, Chile, Colombia, Mexico, Brazil and Peru are using or have adopted CLAR. These include both of the EU-BEGP partners from Peru.

The main objectives of CLAR are to favor the development of a curricular form that considers the credit system as an element of improvement of a curriculum focused on the student as the center of learning. These credits recognize the qualifications or capacities achieved and promote student mobility among Latin American universities. According to the Tuning project research, CLAR considers an annual full-time workload equivalent to 60 credits with an estimated 36 weeks. Student work time is associated with a range of 40 and 55 hours, so that the annual range would be equivalent to 1440 and 1980 hours. By performing the calculations and obtaining the hour/credit ratio, the following results are obtained, expressed in Table I.

Thus, a CLAR credit does not (as is the case also for ECTS) have a unique value. It recognizes the diversity and uniqueness of the systems, the forms of administration, and the extension of the educational programs of each country, in such a way that they recognize local and institutional autonomy. For this reason, it is considered that the student load ranges between 24 and 33 chronological hours per credit.

The most common measure is that one credit is equivalent to 1 class hour for 15 or 16 weeks per semester, and that for each classroom hour, two hours of independent work are estimated (between 45 and 48 hours per credit).

TABLE I. CLAR CORRESPONDENCE TO HOURS/YEAR, CREDITS/YEAR, AND HOURS/CREDIT

CLAR	*Hours/year*	*Credits/year*	*Hours/credit*
Hours/credit ratio	1440	60	24
	1980	60	33

C. *SMCTS - Intermediate Global Credit System in EEDA*

One of the best ways to ensure long-term educational collaboration between HEIs and to establish exchanges of "best practices" is to aim for collaboration of common programs at different levels, and various dual or joint degrees. In EEDA, an informal system has been established, based on the ECTS. This system has been designated as the Stackable Master Credit Transfer System (SMCTS). Whereas one ECTS credit corresponds to 25-30 Estimated Learning Hours (ELH) for the student, one SMCTS has been defined as 27.5 ELH. For such a collaboration to be initiated, HEIs must deliver courses in collaboration and co-creation and must recognize academic credits from other partners.

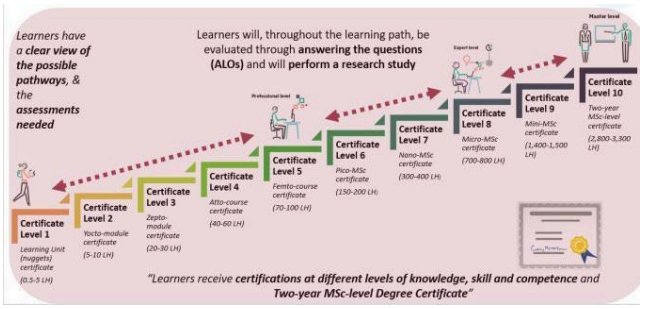

Fig. 1. Illustration of progression in different Certificate levels within EEDA, based on the number of ELH and SMCTS

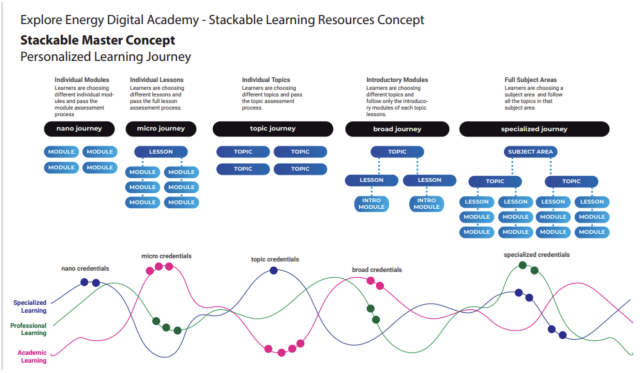

Fig. 2. The Stackable Master Concept with an informal collaboration system based on SMCTS, based on a "stack" of learning resources to create different personalized "learning journeys".

Figures 1 and 2 illustrate the progression within EEDA and the connection to the SMCTS credit system. This allows separate "stacking" of individual learning resources to create specific "learning journeys" of predetermined academic duration. Note that even though the concept allows customized journeys up to a Master level degree certificate, the concept can be adapted to different levels of programs within HEI, such as Short Courses, Expert Courses, Diplomado[3], and others.

The SMCTS informal credit system within EEDA serves as an intermediary between different academic credit systems, which can then later implement translation tables between the ELH and the actual academic hours. Since EEDA aims to be a global collaboration framework, it is possible to define equivalence between different countries and continents, for individual or joint courses and programs. Such a table exists within EEDA, clearly identifying the relationship between ELH, SMCTS and the university credits for all the partners in the EEDA project. The correlation is established with two decimals in the informal SMCTS for each learning resource, thus also allowing a "stacking" of "small" towards "large" learning resources as well as "rounded off" national credits.

To summarize, the use of ECTS, CLAR, and SMCTS as reference academic credit systems for Latin America provides a flexible framework towards cooperation between HEIs for the region and abroad.

V. Academic Credits of HEI Participating in the EU-BEGP Project

Although formal official recognition of programs is of major importance among universities, it is even more important for the quality of education in the pursuit of a new open university paradigm that there is good collaboration and exchange between the faculty developing and delivering the courses and programs. Therefore, one of the most important challenges is to ensure that partners agree on the expected number of learning hours for any specific learning resource, as well as agreeing on the progression of expected learning outcomes as a learner progresses.

A. Academic Hours Reference

As a first step towards a complete analysis of the academic credits, the EU-BEGP consortium has established a common understanding on the concepts of learning hours, with the following reference terms:

ELH - Estimated Learning Hours: The *Estimated Learning Hours* refers to the approximate time needed to acquire a certain level of knowledge or skill in each area, discipline, or subject. This estimate can vary depending on several factors, such as the complexity of the subject, the learner's prior experience, the quality of the educational resources available, and the learning approach used. The ELH is commonly used in educational planning and in defining learning objectives. Generally, the ELH has some relationship to Academic Credits, and in many universities define the academic level of the program being developed (undergraduate or postgraduate programs). The ELH typically comprises direct learning hours provided by the instructor and the individual learning hours undertaken by the student, which within the EU-BEGP consortium we refer to 'Hours of Direct Instruction - HDI' and 'Student Independent Learning Hours - SILH', respectively.

HDI - Hours of Direct Instruction: The *Hours of Direct Instruction* refer to the number of hours for direct teaching or supervision and tutoring, in synchronous activities where the teacher is directly involved through:

- Theoretical classes: Lectures delivered by the teacher, either in person or online.
- Practical activities: Includes exercises, discussion workshops, worksheets and debate, all involving the direct participation of the teacher.
- Laboratories: Sessions focussed on developing technical skills, conducted in a laboratory setting with the teacher's direct involvement, either in person or online.

SILH - Student Independent Learning Hours: The *Student Independent Learning Hours* refer to the time students spend on self-directed learning in asynchronous activities, guided by the teacher, including individual or group work, often in preparation for a 'flipped classroom', such as:

- Careful studying of the digital learning resources, and answering all the questions posed.
- Gathering and comparing information from bibliographies, readings, audiovisual material, and other sources.
- Completing assignments, such as writing essays, preparing presentations, worksheets, and exercises.
- Engaging in activities in Remote Laboratories or independent preparation, such as reviewing theoretical materials or learning how to operate Remote Laboratories.
- Participating in forums, conducting field research, working in groups, or attending technical visits.
- Preparing for exams.

Please note that within EEDA, all the estimation of the time required to complete the activities of the learning Modules are expressed in ELH, for all the SILH self-learning with asynchronous activities as well as any direct HDI contact hours.

B. Survey on Academic Credits within EU-BEGP

Once all the EU-BEGP Latin American partners have agreed in the common definition of ELH, HDI, and SILH, and to know the valuation of the academic credits of each Latin American partner participating in the EU-BEGP consortium, a survey was applied, with the following outcomes:

- There is no system of academic credits applied in a generalized and uniform way by Latin American countries.
- Even within the same country, the methodology for applying academic credits is

[3] Diplomado Programs are common short-term academic programs in Latin America designed for professional development and continuing education. Diplomados usually involve a series of courses and completion may take from a few months to a year. The equivalent in Europe are Postgraduate Certificates or Diplomas.

different for each university.

- Not all HEIs have regulations governing the allocation of academic credits for undergraduate and postgraduate studies; in some cases, this is left to the discretion of individual HEIs, deanships, and program directors.
- In some universities the HDI are linked to the payment of fees of the educator, because several HEIs in Latin America (typically private universities), cannot cover all the teaching activities with their staff, and rely on external faculty.
- Some universities do not account for SILH
- There are different time ratings for the HDI e.g. 45 min, 50 min, 60 min, or even 120 min.
- Most universities are not aware of the existence of the Latin American Reference Credit CLAR.
- Among the 196 universities that participated in the Tuning Project that defined CLAR, 4 EU-BEGP partners[4] were part of the study.
- Only two of the EU-BEGP universities ('Universidad Nacional de Ingeniería' and 'Pontificia Universidad Católica del Perú', both in Peru) apply the CLAR concept in their universities.

The implementation of an academic credit system in Latin America, similar to the European ECTS system or the proposed CLAR credit system, requires a joint commitment from governments, educational institutions and educational stakeholders to ensure its effectiveness and success. In contrast, the SMCTS credit system is an informal collaboration transfer system that can be used to estimate the equivalences between different academic levels, programs, based on the number of ELHs. This requires "translation tables" between the credit systems, and the HEIs and countries academic credits.

Table II shows the comparison between each individual Latin American HEI in EU-BEPG, for both undergraduate and postgraduate categories, to the CLAR, ECTS and SMCTS systems. For each partner, the individual credit is expressed as the total of ELH, but normalized to 60 minutes, since as mentioned before, the HDI may vary among the different HEIs. Note that the credit is defined individually according to the national or institutional regulations.

First, it is noteworthy that two Bolivian HEIs do not define credits for one of their academic categories: 'Universidad Privada Boliviana' lacks a credit system for its postgraduate programs, and 'Universidad Mayor de San Andrés' for its undergraduate programs. In contrast, 'Universidad Mayor de San Simón,' the other Bolivian partner, defines credits for both categories. Interestingly, the institutions without a comprehensive credit system represent both the private and public sectors, whereas the third institution is from the public sector. This indicates that there is not a common credit system even between public universities. On the positive side and as part of the benefits from the EU-BEGP, the Postgraduate School at 'Universidad Privada Boliviana' is now considering implementing a credit system based on the CLAR reference framework as a strategic measure to address this gap

The second observation is that for only 2 universities in Guatemala and Peru ('Universidad Galileo' and 'Pontificia Universidad Católica del Perú, respectively), out of the 7 institutions with a complete credit system, there is a difference in the number of hours per credit between undergraduate and postgraduate studies. The third observation is that only one institution in all the consortium ('Universidad San Pablo de Guatemala' from Guatemala) has a one-to-one equivalence with the ECTS system. This simplifies of course their implementation of exchange programs with European institutions. Finally, the 2 universities from Peru that apply the recommendations from the CLAR credit system, have a different range in the number of credits between them.

TABLE II. TRANSLATION TABLE BETWEEN CLAR, ECTS, AND SMCTS FOR EACH EU-BEGP LATIN AMERICA PARTNER

Name Acronym (Country)	*Academic Category*	*Hours (60 min) per partner credit*	*Equivalence*		
			with ECTS (25 ELH)	*with SMCTS (27.5 ELH)*	*with CLAR (30 ELH)*
Universidad Privada Boliviana UPB (Bolivia)	Undergraduate	32	1.28	1.16	1.07
	Postgraduate	N/A	N/A	N/A	N/A
Universidad Mayor de San Simón UMSS (Bolivia)	Undergraduate	40	1.60	1.45	1.33
	Postgraduate	40	1.60	1.45	1.33
Universidad Mayor de San Andrés UMSA (Bolivia)	Undergraduate	N/A	N/A	N/A	N/A
	Postgraduate	40	1.60	1.45	1.33
Escuela Politécnica Nacional EPN (Ecuador)	Undergraduate	32	1.28	1.16	1.07
	Postgraduate	32	1.28	1.16	1.07
Escuela Superior Politécnica del Litoral ESPOL (Ecuador)	Undergraduate	48	1.92	1.75	1.60
	Postgraduate	48	1.92	1.75	1.60
Universidad Galileo UGAL (Guatemala)	Undergraduate	45	1.80	1.64	1.50
	Postgraduate	48	1.92	1.75	1.60
Universidad San Pablo de Guatemala USPG (Guatemala)	Undergraduate	25	1.00	0.91	0.83
	Postgraduate	25	1.00	0.91	0.83
Pontificia Universidad Católica del Perú PUCP (Peru)	Undergraduate	37.5	1.5	1.36	1.25
	Postgraduate	62.5	2.5	2.27	2.08
Universidad Nacional de Ingeniería UNI (Perú)	Undergraduate	48	1.92	1.75	1.60
	Postgraduate	48	1.92	1.75	1.60

[4] 'Universidad Nacional de Ingeniería' and 'Pontificia Universidad Católica del Perú' from Peru, 'Escuela Escuela Superior Politécnica del Litoral' from Ecuador, and 'Universidad San Pablo de Guatemala' from Guatemala

Another important result of the survey was that, even without all partners defining comprehensive academic credits, all partners do have a clear distribution of academic load between HDI and SILH. For example, 'Universidad Privada Boliviana' does this distribution based on the ELH of a complete course within a Diplomado or MSc program. Similarly, 'Universidad Mayor de San Andrés' for undergraduate programs defines the distribution of academic load based on the ELH of a full per semester. Figure 3 shows the distribution in percentage of HDI and SILH for each institution, for both undergraduate and postgraduate programs (right and left, respectively). We can observe that 'Universidad Mayor de San Simón' considers for undergraduate studies one academic credit of 40 ELH, but 100% dedicated to HDI, without planning individual student workload. Another interesting observation is the case of the HEIs in Ecuador: at 'Escuela Politécnica Nacional' more hours of direct learning with the teacher are devoted (of 67%), compared to the independent work by the student (of 33%). In contrast, at 'Escuela Superior Politécnica del Litoral', the roles are reversed, with the student being the protagonist in the learning process.

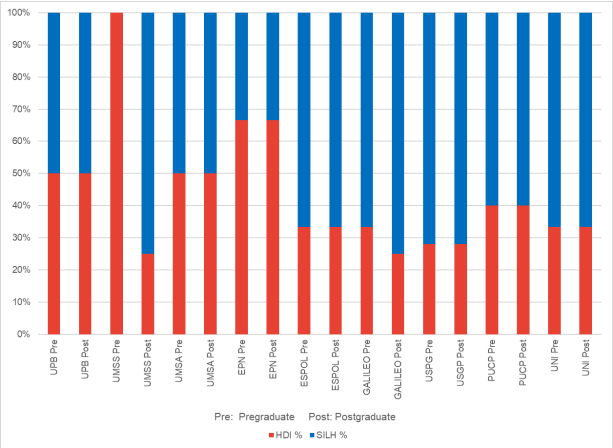

Fig. 3. Comparison of Hours of Direct Instruction (HDI) and Student Independent Learning Hours (SILH) for undergraduate and graduate programs, per EU-BEGP partner.

VI. Academic Credits of Equivalents and Agreements in The EU-BEGP Consortium

Academic credit in Latin America plays a crucial role in the higher education system for a standardized measure of students' academic progress. Due to the lack of a unified credit system in the region, it is important to at least have a unified criterion and internal agreement between the HEIs that are collaborating in jointly defined learning material, courses and programs.

With the objective of seeking such a common reference among all the academic programs, it was agreed between all the Latin American EU-BEGP partners, to use CLAR as the common reference for both the ELH and the academic credits of each course and program to be developed within the project. The conversion of credits to ECTS and SMCTS becomes straightforward but requires identifying the correct equivalence from each HEIs ELH to CLAR. This can also benefit the consortium, when running joint programs with European institutions.

For all Latin America partners in EU-BEGP, to work with the CLAR reference, the following points must be considered:

- Each partner must homogenize courses or programs that will be implemented within EU-BEGP to CLAR.
- One CLAR credit is equivalent to 30 ELH.
- According to each university regulations, the hours that are accountable for the payment of the instructor, i.e., involving the teacher's direct teaching hours (direct theoretical/practical teaching time and laboratories), should be considered.
- The remaining hours should be planned for independent student learning time.
- The planning, dosage and orientation of the student's independent learning activities are the responsibility of the teacher.
- Each learning Module developed within EU-BEGP should include the CLAR equivalence (in addition to ECTS and SMCTS) in the EEDA repository, and the QIP tool should be updated accordingly.
- Each partner should coordinate with its academic and administrative area to consider using CLAR as an institutional reference (we are aware that HEIs cannot go against the national regulations, and implementing CLAR as an official reference credit system goes beyond the scope of the project).

Let's consider the following example that illustrated the ELH distribution and academic credit equivalency (TABLE III):

A course on "Distributed Generation with Renewable Solar and Wind Energy", in a 10-week academic term, defined both the HDI (for both theoretical and practical and laboratory activities with the educator) and SILH (for autonomous learning in a flipped-classroom perspective, typically using EEDA learning Modules, exercises with Remote Lab, and others). The total amount of ELH for the course is the sum of both hours for HDI and SILH. Table III shows the example of equivalence of the ELH, to CLAR, ECTS and SMCTS.

Similar to this example, all the courses and programs within the EU-BEGP clearly define the distribution of ELH, so that it is simple to use the conversion table shown in Table II, for each individual HEI. This ensures that the courses and programs, jointly developed, can be rapidly converted to each individual credit system.

TABLE III. EXAMPLE OF EQUIVALENCE BETWEEN ELH, SMCTS, AND CLAR OF A COURSE

Course	*Hours of Direct Instruction - HDI*		*Student Independent Learning Hours (SILH)*			*ELH*	*CLAR (30 h)*	*ECTS(*) (25 h)*	*SMCTS (27.5 h)*
	Theoretical	*Practical/Laboratory*	*Flipped Classroom*	*Remote Lab*	*Other*				
Distributed Microgeneration with Renewable Solar and Wind Power	30	18	32	20	20	120	4	4.80	4.36

(*) Note: The ECTS is in the range of 25-30 ELH. We are taking the minimum value as reference.

VII. PLANNING OF COURSES OR PROGRAMS IN THE EU-BEGP UNDER COMPARABLE CREDIT REFERENCE SYSTEM

Since the academic offerings of Latin American HEIs with respect to the homologation of academic credits show an important diversity, it has been considered to respect each context but at the same time to reach agreement on the equivalences between CLAR, SMCTS and ECTS.

At this point it is necessary to integrate the double relationship between the workload in student hours with their respective equivalent academic credits and the Intended Learning Outcomes (ILOs) which are defined as statements about what a student will achieve upon successful completion of a unit of study.

A clear definition of ILOs provide:

- Focus on what the student should be able to achieve at the end of a course.
- Clarity for students on what is expected of them.
- Facilitate overall course progression with the entire program and clear connection between ILOs of different levels.
- Set clear and practical expectations for both students and teachers, ensuring students understand exactly what they need to accomplish and the level of performance required to successfully complete a unit of work.

In the EU-BEGP Project, we agreed upon the adoption of the definition of ILOs used within EEDA, that are based on the European Qualification Framework (EQF) 2017 [21]. The ILOs are defined in 3 learning domains: Knowledge, Skills, and Responsibility and Autonomy (KSRA).

- Knowledge is described as theoretical and/or factual,
- Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and use of methods, materials, tools and instruments), and
- Responsibility and Autonomy are described as the learner's ability to apply knowledge and skills autonomously and responsibly.

The EU-BEGP achieved a unified criteria for writing ILOs and linking them to comparable academic credits. The specification of the ILOs should be expressed using the 6 levels of Bloom's taxonomy [23] of the 2001 revision (i.e., remember, understand, apply, analyze, evaluate, and create).

The example shown in Table IV, shows the ILOs for the course taken as an example previously, considering the three learning domains.

TABLE IV. EXAMPLE OF A COURSE ILOS WITH THE THREE (KSRA) LEARNING DOMAINS USED IN EEDA

Course	*ILOs*		
	Knowledge	*Skills*	*Responsibility & Autonomy*
Distributed Microgeneration with Renewable Solar and Wind Power	Explain the technical characteristics and operation of a solar photovoltaic and wind energy microgeneration system for rural communities without access to electricity distributed by the national grid	To design a stand-alone solar photovoltaic microgeneration system and vertical axis wind turbine with energy storage to meet the electricity demand in the range of 1000W up to 300 KWh in a residential area of rural communities	Disseminate the need to install renewable energy microgeneration systems to rural communities with little or no access to electricity and with a lower average human development index bellow 0.55 according to the UNDP program
Bloom's level	2 - Understand	6 - Create	3 - Apply

As shown in Table IV, it is important to consider that each ILO in a course can have a different level in the Bloom's taxonomy. This does not mean that the course will have the average of the level of its ILOs. The Bloom's level of the course should reflect the highest and most emphasized cognitive tasks required of the students throughout the course. It is an integrative assessment that considers not just the learning outcomes but also the teaching strategies, assessments, and student engagement at various cognitive levels. Each teacher is therefore required to carefully analyze and define the overall course level, according to the individual KSRA levels.

Similar observations must be made concerning the use of learning resources from the EEDA repository. Once each course and program has been defined with the corresponding KSRA level, several learning Modules can be created or re-used from the EEDA repository. As we described previously, each Module also defines the ILOs at the Module level (i.e., MILOs). Thus, following the EEDA concept, the ILOs can be defined at the level of Lessons (i.e., LILOs), and Topics (i.e., TILOs), each of them with their own KSRA level.

Therefore, when using different Modules for a given course, it is important to clearly identify if the Bloom's level of all the used Modules, correspond to the Bloom's level of the course. For example, if the **Course** Bloom's level is declared as 6 for the Skills ILO, and all the **Modules** used for the course have Skill ILO of level 1, clearly there will be a potential issue to ensure the expected level of quality of the course. Another important point to consider is the total number of ELHs of the Modules used for the course. The combination of ELHs and KRAS levels should also be an indication of the correct qualification level to achieve. The EU-BEGP consortium is working on an automated tool to calculate the different levels, depending on the ELHs and KRAS level, according to the required European Qualification Framework (EQF) level of the courses and programs. This work is performed within a more general EEDA Qualification Framework (EEDA-QF).

Finally, it is worth mentioning that the observations previously made regarding the learning material to build courses and programs within EEDA is not limited to theoretical Modules, but also for Remote Laboratories (i.e., to learn how to operate the Remote Lab platform and perform practical activities), Challenge-Driven Learning (e.g., to learn about the methodology), and even Modules for "train the trainer", i.e., for teachers to learn about the whole EEDA concept and the different tools.

VIII. Discussion

The EU-BEGP project represents a pivotal step toward the modernization of digital education in the energy sector within Latin America, addressing the urgent need for a unified academic credit system. The challenges faced by the consortium, such as the disparity in academic credit systems and the varying levels of digital infrastructure across participating countries, highlight the complexities of implementing a standardized framework in a region as diverse as Latin America.

One of the significant contributions of this project is the introduction and application of the CLAR system, which aims to harmonize academic credits across Latin American institutions and could be an opportunity to be adopted in those universities that currently do not have regulations for the reference of academic credits and their corresponding ELH. The differences in academic credit systems identified among the participating universities underscore the need for such a system. However, the adoption of CLAR and its alignment with European standards like ECTS and SMCTS is not without challenges. For instance, the variation in how independent learning hours are accounted for across institutions presents a potential barrier to the seamless integration of this system.

Furthermore, the EU-BEGP project's emphasis on co-creation and peer-review processes within the EEDA framework is a notable innovation in the context of global educational collaboration. The rigorous quality improvement process (QIP) embedded in the EEDA concept ensures that the educational materials developed are not only of high quality but also relevant and adaptable to the specific needs of the region. This approach addresses some of the traditional concerns associated with the implementation of digital learning resources, such as maintaining educational quality and ensuring alignment with local educational objectives.

However, the project's success also hinges on the willingness and capacity of participating institutions to adopt and integrate these new systems and methodologies into their existing frameworks. Institutional inertia, varying levels of faculty engagement, and the need for significant administrative support are potential obstacles that must be addressed. Additionally, the long-term sustainability of these initiatives will require ongoing support from both local governments and international bodies, particularly in the areas of training, infrastructure development, and policy alignment.

While the EU-BEGP project has made significant strides in addressing the challenges of digital transformation in education, its long-term impact will depend on the continued collaboration between the participating institutions, the refinement of the CLAR system, and the integration of these innovations into national education policies. The lessons learned from this project can serve as a model for other regions facing similar challenges, demonstrating the potential of collaborative, cross-border educational initiatives in driving systemic change.

IX. Conclusions

The EU-BEGP project has shown that establishing a unified qualification framework for digital transformation in education across Latin America is both necessary and achievable. By integrating efforts from multiple universities across the region and aligning them with European standards, this project has created a foundation for standardized academic credit systems, enhancing student mobility and educational collaboration. The implementation of the CLAR credit system within the EEDA framework is a significant step forward in harmonizing education across diverse cultural and institutional contexts. This initiative not only addresses the immediate challenges of digital transformation in education but also sets the stage for sustained collaboration and innovation in the energy sector as well as a set of "academic metadata" that is the beginning of a Quality Framework. Moving forward, the focus should be on expanding this framework to include more institutions and regions, ensuring that the benefits of standardized, high-quality education are accessible to all students across Latin America. Continued commitment to peer-review processes, quality assurance, and the adoption of flexible yet robust credit systems will be crucial to the long-term success of this endeavor.

Acknowledgment

This work was partially funded by the Erasmus+ Project EU-BEGP (101081473). The authors want to thank all the EU-BEGP partners for their valuable feedback.

References

[1] B. S. Ong and A. Grigoryan, "MOOCs and Universities: Competitors or Partners?," *IJIET*, vol. 5, no. 5, pp. 373–376, 2015, doi: 10.7763/IJIET.2015.V5.533.

[2] J. Jacoby, "The disruptive potential of the Massive Open Online Course: A literature review," *Journal of Open, Flexible and Distance Learning*, vol. 18, no. 1, Art. no. 1, Aug. 2014, doi: 10.61468/jofdl.v18i1.214.

[3] R. Ferguson, M. Sharples, and R. Beale, "MOOCs 2030: A Future for Massive Online Learning," in *MOOCs and Open Education Around the World*, Routledge, 2015.

[4] T. Academy, "Tuning Latin America I (2004-2007)," Tuningacademy. Accessed: Aug. 09, 2024. [Online]. Available: https://tuningacademy.org/countries/france/tuning-latin-america-i/

[5] M. Castells, "The Network Society Revisited," *American Behavioral Scientist*, vol. 67, no. 7, pp. 940–946, Jun. 2023, doi: 10.1177/00027642221092803.

[6] "EEDA – EXPLORE Energy Digital Academy." Accessed: Mar. 11, 2024. [Online]. Available: https://eeda.academy/

[7] A. Villazón, "Plenary: Modernizing Collaborative Digital Education in Emerging Regions with Active Learning Methodologies," in *2024 IEEE World Engineering Education Conference (EDUNINE)*, Mar. 2024, pp. 1–2. doi: 10.1109/EDUNINE60625.2024.10500623.

[8] M. Leijon, P. Gudmundsson, P. Staaf, and C. Christersson, "Challenge based learning in higher education– A systematic literature review," *Innovations in Education and Teaching International*, vol. 59, no. 5, pp. 609–618, Sep. 2022, doi: 10.1080/14703297.2021.1892503.

[9] J. Bishop and M. A. Verleger, "The Flipped Classroom: A Survey of the Research," in *2013 ASEE Annual Conference & Exposition*, Jun. 2013, p. 23.1200.1-23.1200.18. doi: 10.18260/1-2–22585.

[10] T. Alkhaldi, I. Pranata, and R. I. Athauda, "A review of contemporary virtual and remote laboratory implementations: observations and findings," *Journal of Computers in Education*, vol. 3, no. 3, pp. 329–351, Sep. 2016, doi: 10.1007/s40692-016-0068-z.

[11] "EUSL-Energy: Europe Srl Lanka Capacity Building in Energy Circular Economy. Erasmus+ Project." Accessed: Mar. 09, 2024. [Online]. Available: https://euslenergy.com/

[12] "EUBBC-Digital: Europe-Brazil-Bolivia-Cuba Capacity Building Using Globally Available Digital Learning Modules. Erasmus+ Project." Accessed: Mar. 09, 2024. [Online]. Available: https://eubbcdigital.com/

[13] "EU-BEGP: Modernising Digital Education in Energy Transition from Circular Economy in Latin America. Erasmus+ Project." Accessed: Mar. 09, 2024. [Online]. Available: https://eu-begp.org/en/

[14] "EDU-ABCM: Capacity Building on Student-Centered Energy Education in Cameroon, Ethiopia, Mauritius and Mozambique. Erasmus+ Project." Accessed: Mar. 09, 2024. [Online]. Available: https://eduabcm.managewe.com/eduabcmweb/index.php

[15] "EUZW: Digital Challenge-Driven Circular Energy Transition Learning Collaboration Between EU and Zimbabwe. Erasmus+ Project." Accessed: Mar. 11, 2024. [Online]. Available: https://euzw.managewe.com/euzwweb/index.php

[16] Directorate-General for Education, Youth, Sport and Culture (European Commission), *ECTS users' guide 2015*. Publications Office of the European Union, 2015. Accessed: Aug. 06, 2024. [Online]. Available: https://data.europa.eu/doi/10.2766/87192

[17] Tuning Project, *CLAR Latin American Reference Credit: Tuning Latin America Project*. Bilbao, Spain: University of Deusto, 2013. Accessed: Aug. 06, 2024. [Online]. Available: https://tuningacademy.org/wp-content/uploads/2014/02/CLAR_EN.pdf

[18] Creative Commons, "Creative Commons Attribution 4.0 International Public License." 2013. [Online]. Available: https://creativecommons.org/licenses/by/4.0/

[19] "Top International Managers in Engineering (T.I.M.E.) Association and EXPLORE Energy Digital Academy (EEDA) Repository. Learnify AB, Sweden." Accessed: Mar. 08, 2024. [Online]. Available: https://time.learnify.se/

[20] the Universitas Negeri Jakarta Indonesia, Indonesia, I. Irwanto, D. Wahyudiati, A. D. Saputro, and I. R. Lukman, "Massive Open Online Courses (MOOCs) in Higher Education: A Bibliometric Analysis (2012-2022)," *IJIET*, vol. 13, no. 2, pp. 223–231, 2023, doi: 10.18178/ijiet.2023.13.2.1799.

[21] "The European Qualifications Framework (EQF) | Europass." Accessed: Aug. 09, 2024. [Online]. Available: https://europass.europa.eu/en/europass-digital-tools/european-qualifications-framework

[22] E. M. of Education, "The Bologna Declaration." Jun. 1999. [Online]. Available: https://www.ehea.info/page-ministerial-declarations-and-communiques

[23] M. Seaman, "Bloom's Taxonomy: Its Evolution, Revision, and Use in the Field of Education," *Curriculum and Teaching Dialogue*, 2011, Accessed: Aug. 11, 2024. [Online]. Available: https://api.semanticscholar.org/CorpusID:140530507