

D2.3: nZEBRA Assessment Strategy

WP2, Task 2.3

Author: Kavan Javanroodi (ULUND)



Document information

Project Acronym	nZEBRA
Project Title	Intensive blended course in Climate Neutral Buildings to address nZEB regulation and complex behavior of buildings
Project Coordinator	Heidi Norrström (Halmstad University) heidi.norrstrom@hh.se
Project Duration	1 st September 2023 – 31 st August 2026
Deliverable No.	D2.3
Dissemination level	PU – Public / SEN – Sensitive
Work Package	WP 2 – Methodological Framework
Task	T2.3 –nZEBRA assessment strategy
Lead beneficiary	# (ULUND)
Contributing beneficiary/ies	Partner number (partner short name), Partner number (partner short name), Partner number (partner short name)
Due date of deliverable	31.11.2024
Submission date	30.11.2024

Document history

Ver.	Date	Beneficiary	Author
1.0	25/11/2024	Lund University (ULUND)	Kavan Javanroodi
2.0	30/11/2024	All beneficiary review	All partners

Copyright notice

© nZEBRA. ALL RIGHTS RESERVED. ANY DUPLICATION OR USE OF OBJECTS SUCH AS DIAGRAMMES IN OTHER ELECTRONIC OR PRINTED PUBLICATIONS IS NOT PERMITTED WITHOUT THE AUTHOR'S AGREEMENT.

This Project is co-funded by the European Union under the ERASMUS + Programme with Grant Agreement Number:1435998. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Table of contents

1. Introduction	8
1.1. Purpose, scope and audience.....	8
1.2. Partners' contributions	8
1.3. Relation to other activities in the project	9
2. An overview of Pedagogical Approach in nZEBRA	10
2.1. Blended Learning.....	11
2.2. Collaborative and Student-Centered Learning approaches	11
2.3. nZEBRA Methodological Framework	13
2.3.1. Online Modules: Asynchronous Learning.....	13
2.3.2. In-Class Training: Synchronous Learning	13
3. Assessment Strategy in the blended learning structures	14
3.1. Assessment Strategies: A Focus on Flipped Models	14
3.1.1. Formative vs Summative Assessments.....	14
3.1.2. Collaborative Assessments and Peer Learning.....	15
3.1.3. Feedback Mechanisms	15
4. Module-Specific Objective learning in nZEBRA	17
5. Assessment Strategies and certificates.....	22
5.1. nZEBRA workflow	22
5.2. Certificates	23
5.2.1. Technische Universitat Hamburg (TUHH).....	24
5.2.2. Hogskolan I Halmstad (HH).....	25
6. Conclusions.....	29
□ References	30

List of Tables

Table 1: Abbreviations and acronyms.....	6
Table 2: Contribution of partners	8
Table 3: Relation to other activities in the project	9
Table 4. Methodological Framework.....	17
Table 5 the module-specific learning objective for each topic in nZEBRA	18
Table 6. Assessment criteria for credits certificate at TUHH.....	25
Table 7. Assessment criteria for credits certificate at HH.....	25

List of Figures

Figure 1. Blended learning structure11

Figure 2. Comparing formative and summative assessment methods15

Figure 3. nZEBRA workflow and assessment strategy23

Abbreviations and acronyms

Table 1: Abbreviations and acronyms

Acronym	Description
GA	Grant Agreement
EU	European Union
STEM	Science, technology, engineering, and mathematics

Executive summary

This document provides an overview of the assessment strategies to be used in the nZEBRA project. While the specific assessment methods for individual topics will be defined in Work Package 3 (WP3), this deliverable focuses on establishing the overall assessment strategy required for students to successfully complete the course and obtain their certification. D2.3 focuses on providing a consistent assessment strategy for the course, ensuring a balanced mix of individual and group assignments tailored to the course topics. This comprehensive approach aims to support students in developing both independent and collaborative skills, aligning with the project's educational objectives.

In this context, deliverable 2.3 provides a literature review of prominent assessment strategies used in similar courses. They will also address the internal regulations and practices of partner organizations to ensure that the developed strategies are applicable and effective within the consortium. Particular attention will be given to Hogskolan i Halmstad (HH) in Sweden and Technische Universität Hamburg (TUHH) in Germany, as these institutions serve as the course demonstration sites. This focus will ensure that both universities can adhere to their internal regulations and are able to formally issue certifications to students.

As Deliverable 2.2, titled Pedagogical Approach and Course Syllabus, is closely connected to this document, an overview of the methodological framework and pedagogical approach will also be presented here to provide a cohesive understanding of the nZEBRA project.

Deliverable 2.3 is organized as follows:

- Section 1 introduces Deliverable 2.3, outlining its purpose, scope, target audience, and the contributions from project partners.
- Section 2 gives an overview of the methodological framework and pedagogical approach used in nZEBRA. It also details the course format, which includes both in-class and online training components.
- Section 3 reviews the literature on assessment strategies in comparable educational settings with a focus on blending learning structure.
- Section 4 outlines the topics covered in the nZEBRA course, along with expected outcomes and learning objectives.
- Section 5 provides a summary of the assessment strategies, with a particular focus on Halmstad University (HH) and TUHH.
- Section 6 concludes with a summary of the main outcomes of Deliverable

Keywords

Assessment strategy, Syllabus, Methodological framework, Learning methods

1. Introduction

1.1. Purpose, scope and audience

Task 2.3 and Deliverable 2.3 focus on developing a comprehensive assessment strategy for the nZEBRA project. The main aim is to create a unified approach to evaluating student performance, ensuring successful course completion and certification. The assessment strategy will consider the course's intensive blended, challenge-based learning format, which incorporates Building Information Modeling (BIM) and Building Energy Modeling (BEM).

The activity will result in a two-level system for assessing learner performance. This includes specific criteria for evaluating both individual and group performance within the course topics, validated in WP3, as well as the overall demonstration of acquired skills and competencies to interpret and solve problems related to sustainable building. The partners will collectively agree on the ECTS credits (ranging from 5 to 7.5) and the scoring system. The course assessment strategy will detail methods such as pitch presentations, assignment reports, and tests, along with their respective weightings. Criteria for assessing both individual and group work, as well as the final assessment format, will be summarized in Deliverable 2.3.

The two major objectives of Deliverable 2.3 are:

- **Define a Comprehensive Assessment Strategy:** Develop an overarching assessment framework that ensures students can successfully complete the course and receive certification. This includes establishing clear criteria for evaluating both individual and group performance, tailored to the course's challenge-based and blended learning format, which integrates BIM and BEM.
- **Outline Detailed Assessment Methods:** Describe specific assessment methods such as pitch presentations, assignment reports, and tests, along with their associated weightings. This objective also involves harmonizing the assessment practices from partner institutions to ensure consistency and alignment with each HEI's regulations and practices, creating a fair and transparent assessment process.

1.2. Partners' contributions

ULUND will lead the development of the overall assessment strategy, working closely with all partner HEIs to ensure a well-rounded approach. Högscholan i Halmstad (HH) in Sweden and Technische Universität Hamburg (TUHH) in Germany, serving as the course demonstration sites, will play a key role in making sure the assessment strategies align with their internal regulations and allow for the formal certification of students. Table 2 below highlights the main contributions from each project partner for this deliverable.

Table 2: Contribution of partners

Beneficiary name	Contribution
LUNDS UNIVERSITET (E10209141 - SE)	ULUND lead task 2.3 and prepare the dedicated deliverable 2.3.
HOGSKOLAN I HALMSTAD (E10200676 - SE)	Review the document
TECHNISCHE UNIVERSITAT	Review the document

HAMBURG (E10208607
- DE)

ALBERT-LUDWIGS- Review the document
UNIVERSITAET

FREIBURG (E10208635
- DE)

HEP - ESCO DOO ZA Review the document
VODENJE I

1.3.Relation to other activities in the project

Table 3 below lists how this deliverable relates to other activities in task 2.3 in the project, and which should be considered for further understanding.

Table 3: Relation to other activities in the project

Related WP / task / deliverable	Relation
WP2/Task 2.2/Deliverable 2.2	Definition of course syllabus and pedagogical approach, blended format, learning pre-requisites, and learning outcomes.
WP2/Task 2.4/Deliverable 2.4	Consolidating the course methodological framework using deliverables 2.2. and 2.3

2. An overview of Pedagogical Approach in nZEBRA

The nZEBRA project adopts an integrated pedagogical approach that combines blended learning, collaborative learning, and student-centered methodologies, providing a dynamic and adaptive educational experience. This approach is strategically designed to cater to the diverse needs and expertise within the course while preparing students to effectively address the complexities of climate-neutral building design.

Recognizing the multidisciplinary nature of the course, nZEBRA allows flexibility in both teaching and learning methods. Each topic covered within the course is adaptable, permitting instructors to implement their own teaching models and strategies, as long as they adhere to the overarching framework and principles of nZEBRA. This flexibility ensures that the course remains relevant and adaptable to a wide range of expertise, enabling educators to customize their teaching to best convey their subject matter.

Similarly, students also benefit from this flexible structure. Working in collaborative groups, they have the autonomy to select one specific course topic for their final project, allowing them to focus deeply on an area that aligns with their interests and career aspirations. This student-centered approach not only promotes engagement and ownership of the learning process but also ensures that students can explore their chosen topic in depth. The culmination of their work will be presented as a poster presentation, encouraging students to synthesize and communicate their findings effectively.

By integrating these models, nZEBRA fosters a comprehensive and engaging learning environment. Blended learning provides the flexibility needed for both theoretical and applied understanding, while the collaborative learning model develops critical teamwork and problem-solving skills. The student-centered approach empowers learners to take charge of their education, making the experience meaningful and directly relevant to their future careers in climate-neutral building design. This thoughtful and adaptable pedagogical framework ensures that all participants are equipped with the knowledge, skills, and confidence to contribute meaningfully to sustainable building practices.

For a more detailed description of the methodological framework of nZEBRA, readers are referred to **deliverables 2.2 and 2.4**.

2.1. Blended Learning

nZEBRA adopts a blended learning structure (Sharma, 2022), strategically integrating face-to-face learning with e-learning to deliver a comprehensive and flexible educational experience for the intensive course on climate-neutral buildings (Figure 1). By leveraging the strengths of both modalities, nZEBRA ensures that theoretical concepts and practical applications are covered effectively, creating an engaging and adaptive learning environment.

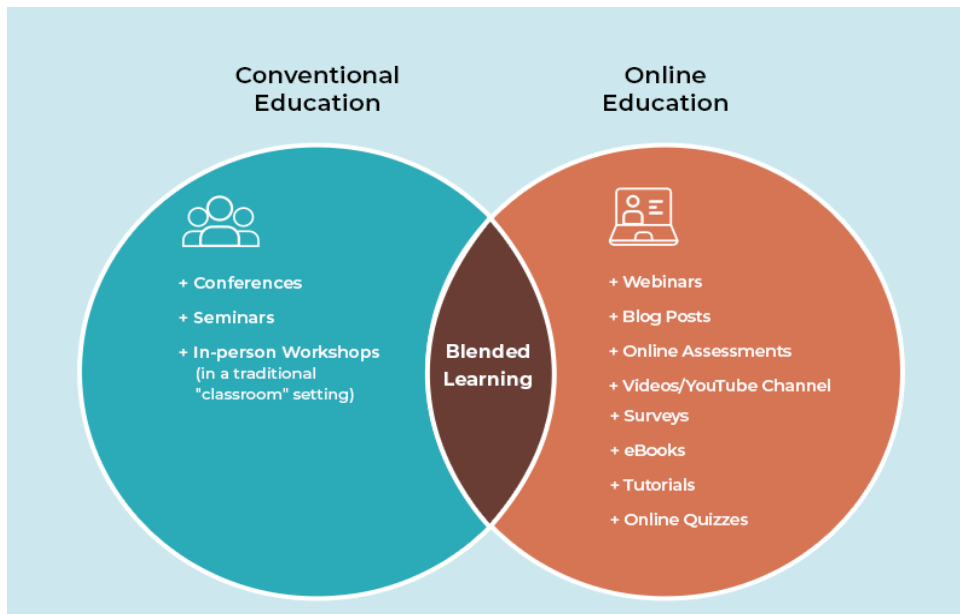


Figure 1. Blended learning structure (Sharma, 2022)

The nZEBRA project specifically utilizes the flipped model, a learner-centered approach that enhances engagement and deepens understanding. In this model, students interact with core content outside of the classroom through video lectures, readings, or e-learning modules. This pre-class preparation equips students with the foundational knowledge they need before participating in active learning sessions. During face-to-face interactions, students engage in collaborative discussions, hands-on projects, and problem-solving activities, allowing for richer and more personalized learning experiences.

The flipped model provides several advantages that justify its implementation in nZEBRA. It maximizes classroom time for active engagement, where learners can clarify doubts, apply their knowledge, and receive immediate feedback. This model also empowers students to learn at their own pace, revisiting complex material as needed, which can be particularly beneficial for a diverse group of learners with varying levels of expertise. Additionally, the increased focus on active, application-based learning in face-to-face sessions can help students better retain information and understand how theoretical principles apply to real-world challenges in climate-neutral building design.

2.2. Collaborative and Student-Centered Learning approaches

Collaborative learning is central to nZEBRA, employing the group-problem solving model. In this approach, students work in teams to tackle real-world challenges related to climate-neutral building design. Groups are responsible for selecting their own topics from the course themes, giving them

significant control over their learning focus. This method encourages effective communication, critical thinking, and peer-to-peer learning.

The group-problem solving model is particularly valuable in fostering active engagement and deeper understanding. It allows students to collaboratively explore complex problems, share diverse perspectives, and develop practical solutions. This model also reflects the collaborative nature of professional work environments, making it ideal for preparing students for real-world challenges. By working together, students benefit from shared knowledge and learn to navigate different viewpoints, which enhances both their individual and collective learning experiences.

The nZEBRA project emphasizes student-centered learning, where students have substantial autonomy and choice in their educational journey. They select their own project topics, aligning their learning experiences with personal interests and career goals. This approach fosters self-motivation, critical thinking, and a sense of ownership over their education. The teacher's role shifts to that of a facilitator, guiding and supporting students as they actively engage with and apply course content.

This student-centered approach is highly effective because it caters to diverse learning styles and needs, allowing for personalized education. By empowering students to take charge of their learning, nZEBRA promotes deeper engagement and encourages learners to think critically and independently. This methodology ensures that the learning process is meaningful and relevant, which is essential for developing the practical skills required in climate-neutral building design.

2.3. nZEBRA Methodological Framework

The nZEBRA course is structured to include both online modules and in-class training, following a flipped model to maximize the efficiency of in-person interactions. This format provides a flexible and engaging learning experience tailored to the needs of a diverse group of students, including early researchers and professionals, while also accommodating the multidisciplinary nature of the course topics.

2.3.1. Online Modules: Asynchronous Learning

The online component of nZEBRA is based on an Online Courseware (OC) approach, designed to give students the flexibility to engage with course materials at their own pace. Each topic has an online module that includes 3-5 hours of pre-recorded lectures, online content, assignments, and a self-paced test, which vary according to the topic. These modules are essential for building foundational knowledge and are a prerequisite for participating in the in-class training. The benefits of the adopted approach are:

- **Flexibility and Accessibility:** Students can engage with materials whenever it suits them, making it easier to balance the course with other responsibilities.
- **Self-Paced Learning:** Learners have the opportunity to revisit lectures and spend more time on complex concepts, ensuring a thorough understanding.
- **Skills Development:** Asynchronous learning fosters self-discipline and time management, valuable skills for both academic and professional settings.

The asynchronous format ensures that students are well-prepared and have a strong understanding of core concepts before attending in-person sessions. Additionally, students are flexible to choose and focus on at least one module that aligns with their interests, which allows them to tailor their learning experience to their career goals.

2.3.2. In-Class Training: Synchronous Learning

Upon successfully completing the e-test for their selected online module, students become eligible to attend the in-class training sessions, which are a part of the nZEBRA summer school. These sessions follow the flipped model, allowing students to apply and deepen their understanding through active and collaborative learning. During the in-class training, students work on group projects related to their chosen topic, guided by instructors who design activities and projects specifically for their area of expertise. The benefits of the adopted approach are:

- **Real-Time Interaction:** In-person sessions enable immediate feedback from instructors and lively discussions among peers, promoting a deeper understanding of the material.
- **Community Building:** Working in groups fosters collaboration and a sense of community, essential for tackling the complexities of climate-neutral building design.
- **Engagement and Support:** The presence of instructors provides structure and support, helping students apply theoretical knowledge to practical projects effectively.

The group projects, which are developed and defined by the instructors for each specific topic, allow students to focus on real-world applications. These projects will be presented as poster presentations, giving students the opportunity to communicate their findings clearly and engage with feedback from both peers and experts.

3. Assessment Strategy in the blended learning structures

3.1. Assessment Strategies: A Focus on Flipped Models

Assessment strategies are crucial in course development, especially for master's students and professionals, to ensure that learning objectives are effectively met. In blended learning courses—where online materials are complemented by in-class training—the assessment methods must be carefully designed to evaluate both theoretical understanding and practical application. This review explores various assessment strategies, methods, and models used in blended learning environments, particularly focusing on flipped classroom models that emphasize online modules followed by in-class training centred around final projects.

A fundamental principle in effective assessment is the alignment between learning objectives and assessment methods. Proper linkage between these elements is essential for meaningful student learning, guiding both teaching and evaluation processes (Sewagegn, 2020). When assessments are well-aligned with learning objectives, students tend to perform better and are more motivated to engage with the material (Kickert et al., 2022). For instance, Bae et al. (Bae et al., 2019) demonstrated that in a quantitative literacy course, the mapping of assessment items to operationalized learning objectives significantly influenced students' course grades.

3.1.1. Formative vs Summative Assessments

Formative assessments play a crucial role in blended learning environments by providing ongoing feedback that informs both teaching and learning adjustments (Kausar & Haroon, 2022). These assessments are integrated into the learning process, allowing students to continuously practice and demonstrate their understanding. Techniques such as quizzes, assignments, and reflective activities are effective in promoting student engagement and self-regulation. For example, Kingston et al. (Kingston et al., 2023) highlighted that designing formative assessments with higher cognitive demands can lead to deeper learning outcomes.

In flipped classrooms, formative assessments are particularly important as students engage with content online before attending in-class sessions. Online quizzes and assignments ensure students have grasped foundational concepts before face-to-face interactions. Bulut et al. (Bulut et al., 2023) found that the use of online formative assessments motivated students to engage more thoroughly with the material, improving their performance and confidence.

Summative assessments, such as exams and projects, evaluate students' overall understanding and application of course content. In blended learning courses, especially those employing flipped classroom models, summative assessments often take the form of final projects or presentations that synthesize online and in-class learning. The design of these assessments should reflect the complexity of the learning objectives and the skills students are expected to demonstrate.

Project-based assessments are particularly effective in this context. Hu et al. (Hu et al., 2019) noted that integrating project-based learning in flipped classrooms enhances critical thinking and problem-solving skills, as students apply their knowledge to real-world challenges. Similarly, Rapi et al. (Rapi et al., 2022) reported that flipped classroom-based project assessments improved concept understanding and critical thinking skills in physics learning.

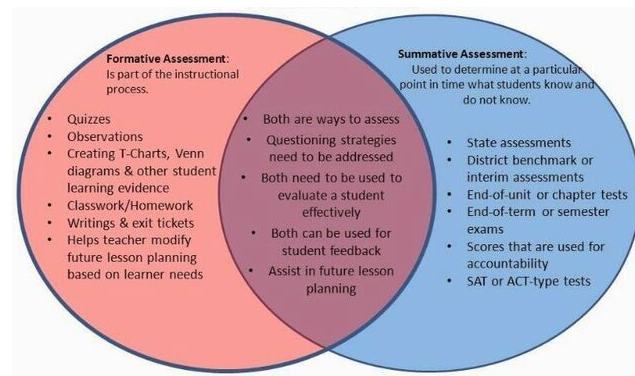


Figure 2. Comparing formative and summative assessment methods (Mahmud et al., 2019)

3.1.2. Collaborative Assessments and Peer Learning

Collaborative assessments enhance learning by promoting teamwork and communication skills among students. A sociocultural approach to assessment emphasizes the importance of social interactions in the learning process, suggesting that collaborative design activities can lead to better reflective skills and knowledge externalization (Tessier & Zahedi, 2019). In blended learning environments, group projects and peer reviews are effective methods for fostering collaborative learning.

However, implementing collaborative assessments comes with challenges. Ensuring equitable participation and accurately assessing individual contributions can be difficult. Olumorin (Olumorin et al., 2023) cautioned that peer and self-assessment techniques must be carefully designed to ensure fairness and effectiveness.

3.1.3. Feedback Mechanisms

Effective feedback is essential in both formative and summative assessments. Timely and constructive feedback helps students identify areas for improvement and reinforces their learning. Rapi et al. (Rapi et al., 2022) emphasized the importance of ongoing feedback in flipped classrooms to support the development of critical thinking skills. Technology can facilitate feedback through automated grading and personalized comments on online platforms. Nasir et al. (Nasir et al., 2020) found that students valued the combination of immediate feedback from online quizzes and detailed feedback from instructors on project-based work.

Blended learning, particularly the flipped classroom model, offers several benefits in terms of assessment:

- **Enhanced Engagement:** The flexibility of blended learning allows students to engage with materials at their own pace, leading to deeper understanding (Liu et al., 2016).
- **Improved Knowledge Retention:** Combining online learning with face-to-face interactions helps reinforce concepts (Bock et al., 2021).
- **Development of Practical Skills:** Project-based assessments in flipped classrooms promote the application of knowledge to real-world scenarios (Ramzan et al., 2023).

However, there are disadvantages to consider:

- **Student Motivation:** The self-paced nature of online modules requires self-discipline, and some students may struggle with motivation (Vaughan, 2014).

- **Assessment Design Complexity:** Creating assessments that accurately measure learning objectives and accommodate diverse learning styles can be challenging (Bentri et al., 2019).
- **Technology Access:** Not all students may have reliable access to the necessary technology for online components (Dziuban et al., 2018).

4. Module-Specific Objective learning in nZEBRA

The nZEBRA course consists of six modules, each developed by a partner institution and equal to 1.5 ECTS, totaling 7.5 ECTS credits. Each module features both an online learning component and in-class training, designed to provide a well-rounded educational experience. nZEBRA is structured to be flexible, granting significant autonomy to both students and instructors. Instructors can adapt their teaching methods while adhering to the core principles of the course, and students have the option to focus deeply on one topic for their final project. This flexibility is essential for accommodating the course's multidisciplinary scope, which spans a wide range of expertise in climate-neutral building design. By offering a customizable learning path, nZEBRA ensures it caters to the diverse needs and interests of its participants. shows the modules, corresponding institution, and their ECTS (Table 4).

Table 4. Methodological Framework

Partner	Module topic name	ECTS
Lunds Universitet	Climate resilience: Adapting buildings to climate change	1.5
Technische Universität Hamburg	Green construction: LCA of buildings	1.5
Hogskolan Halmstad	Circular economy: Resource efficient energy and materials for reduced carbon footprint Energy and Buildings: Indoor Climate; Heating-, Cooling- and Ventilation System	1.5
Hep - Esco	Smart buildings: Modern technologies and systems integration	1.5
Albert-Ludwigs-Universität Freiburg	Energy Building: Advanced Energy Management and Production	1.5

Expected overall learning outcome of nZEBRA are:

- The students will understand the basic concept of a smart building, LCA, climate change, energy building, etc.
- The students will gain a specific understanding and knowledge on the technological functionalities of the buildings, from an engineer's point of view.
- The students will specifically learn how to evaluate the building smart readiness in co-relation to the technical systems in the building
- The students will be able to recommend best way forward in making a building smarter
- The students will become familiar with energy management tool and its functionalities
- The students will gain basic knowledge on energy metering and technologies behind

The module-specific objectives of the nZEBRA course encompass a broad range of skills and knowledge areas. Students will gain a deep understanding of climate change adaptation and mitigation, climate modeling, and resilience strategies for urban energy systems and buildings. They will explore the challenges and opportunities of circular economy practices, including recycling and sustainability in construction. The course will cover innovative energy production technologies, building-integrated photovoltaics (BiPV), and energy storage solutions, emphasizing demand-side management for energy sustainability.

Additionally, students will learn about smart building technologies, ESG strategies in construction, and the principles of LCA, preparing them to critically assess and optimize resource efficiency, reduce carbon footprints, and understand the policy and market implications of sustainable building practices. A user-centered approach identifies barriers and drivers for behavioural change and designs educational content to address these factors, leading to more successful adoption of sustainable energy practices and technologies. Involving the target audience in the development process empowers them to take ownership and responsibility for training and further uptake of acquired competencies. By acknowledging the diversity of needs, learning journeys, and styles, this approach ensures that educational micro-credentials are inclusive and accessible to all segments of the population, promoting the widespread adoption of sustainable practices. Table 5 provides the module-specific learning objective for each topic in nZEBRA.

Table 5 the module-specific learning objective for each topic in nZEBRA

Institution	Module Objective/expected outcomes
Technische Universität Hamburg	<p>Objectives: The module "Green construction: LCA of Buildings" aims to provide Masters students in Architecture, Civil and Energy Engineering and related fields with the knowledge and skills to conduct Life Cycle Assessments (LCA) of buildings. The primary objective is to promote an in-depth understanding of the environmental impacts associated with building materials in different construction processes. Students will learn how to assess building materials in the construction process for sustainability and whether they meet carbon-neutral standards.</p> <p>Expected outcomes: Upon completion of the module, students will have gained knowledge of LCA methodologies specific to buildings, developed the ability to critically evaluate the environmental impacts of different construction materials, and acquired the skills to assess buildings with a strong focus on sustainability. It is expected that this module will enable graduates to develop their skills to contribute to the field of green construction and expand their knowledge dedicated to mitigating climate change through sustainable building practices.</p>
Hogskolan I Halmstad	<p>Objectives: The module will empower students with cutting-edge knowledge and technologies regarding energy efficiency in buildings. State-of-the-art research on energy-efficient buildings will be raised and discussed. The keywords of this module</p>

are HVAC, energy balance calculations, energy-efficient buildings, and indoor climate. Learning objectives include:

- Develop in-depth knowledge of energy-smart solutions in the built environment.
- Design heating-, cooling- and ventilation systems for various kinds of buildings.
- Calculate and account for energy in buildings and energy efficiency measures without negative impacts on the indoor climate. perform energy balances and carry out energy calculations.
- Account for the relationship between a building's indoor climate and the dweller's well-being.
- Critically analyze the energy efficiency from a holistic and sustainability perspective.

Expected Outcomes:

- Demonstrate understanding of basic principles of HVAC
- Understand energy use in buildings from a sustainability and holistic point of view
- Showing the ability of performing advanced calculation for energy in buildings and assess the impact on sustainability
- Demonstrate ability of designing HVAC-system

Lunds Universitet

Objectives

The module 'Climate resilience: Adapting buildings to Climate Change' provides an in-depth study of climate change adaptation, covering topics such as climate variation, multiscale climate modeling, extreme weather events, and their impact on building performance. Students will explore real-world examples, policies, and solutions, gaining insights into resilience, flexibility, and the use of climate data to assess building performance under various conditions. Practical assignments and hands-on training will equip students with the skills to navigate and address these challenges effectively. The specific aims are:

- To provide a comprehensive understanding of climate change adaptation in the context of nearly zero-energy buildings (nZEB), focusing on the factors influencing building performance under varying climate conditions and extreme weather events.
- To equip students with the knowledge to utilize climate data and assess the resilience and sustainability of building designs.

Expected Outcomes

Knowledge and Understanding

- Understand the principles of climate change adaptation and mitigation and their significance in sustainable urban development.
- Comprehend the impacts of climate change on building performance and energy systems, particularly during extreme weather events.
- Become familiar with climate modeling concepts, downscaling methodologies, and different types of climate files, including future climate files.
- Understand how to use climate data for assessing the impact of climate change on building performance and energy systems.
- Recognize the importance of resilience and flexibility in building technologies and renewable energy solutions in the face of climate change.

Competences and Skills

- Analyze different types of climate files understand their implications for building performance assessments, and evaluate the risks associated with climate change from the results.

- Conduct impact assessments of climate change on building performance using provided climate data.
- Evaluate how different buildings and their components will be affected by climate change and its associated risks.
- Collaborate effectively in group settings to analyze and present findings and communicate results and conclusions clearly and concisely.

HEP
ESCO

-Objectives:

The topic Smart Buildings: Modern technologies and systems integration will consist of a comprehensive learning set which will provide students with specific and practical knowledge on building “smartness”, entailing the building’s ability to sense, interpret, communicate and actively respond to changing internal and external conditions as well as building occupants’ behavior.

Expected Outcomes

- The students will understand the basic concept of a smart building
- The students will gain a specific understanding and knowledge of the technological functionalities of the buildings, from an engineer’s point of view.
- The students will specifically learn how to evaluate the building's smart readiness concerning the technical systems in the building
- The students will be able to recommend the best way forward in making a building smarter
- The students will become familiar with energy management tools and their functionalities
- The students will gain basic knowledge of energy metering and technologies behind
- The students will be able to understand how specific building systems improvement impacts greenhouse gas emissions

Albert-
Ludwigs-
Universitaet
Freiburg

Objectives:

The **Energy Building: Advanced Energy Management and Production** course aims to provide students in Engineering, Architecture, and related fields with comprehensive knowledge and practical skills in advanced energy management and production systems for buildings. The primary objective is to explore both renewable and non-renewable energy sources, their integration into building infrastructure, and the role of smart technologies in optimizing energy efficiency. Students will learn how to assess and design energy systems that incorporate Building-Integrated Photovoltaics (BiPV), energy storage solutions, and demand-side management (DSM) strategies. Through this course, students will develop the ability to evaluate energy production systems in buildings, optimize their performance for sustainability, and recommend improvements to meet carbon-neutral standards.

Expected Outcomes

Upon completion of the **Energy Building: Advanced Energy Management and Production** module, students will:

- Understand the key principles of energy production, supply, and renewable energy integration in smart buildings, developing the ability to critically analyze energy systems.
- Develop the ability to assess a building's smart readiness and recommend effective strategies for enhancing energy efficiency through advanced technologies and design improvements.
- Gain practical knowledge in the application of Building-Integrated Photovoltaics (BiPV) and Building-Applied Photovoltaics (BAPV) systems for seamless integration into building structures, optimizing both design and performance.

- Grasp the importance of demand-side management (DSM) and its role in improving energy sustainability, grid reliability, and overall energy performance in building systems.
- Understand the role and integration of energy storage systems in building energy management, enhancing their ability to optimize energy efficiency, resilience, and sustainability in modern buildings.
- Analyze real-world case studies to identify best practices in energy production and supply systems, applying theoretical knowledge to practical scenarios in smart building design and operation.

5. Assessment Strategies and certificates

In nZEBRA course, a well-rounded assessment strategy will be provided including a mix of formative and summative assessments, clear and relevant criteria, timely feedback, and continuous improvement to ensure fair, inclusive, and effective evaluation of student learning.

5.1. nZEBRA workflow

The nZEBRA project workflow can be summarized as follows (Figure 4):

- [1] **Application and Admission:** Participants apply, and there are two admission periods managed by HH and TUHH. Selection follows based on these applications.
- [2] **Online Modules:** Selected participants undergo two weeks of online modules, covering various topics such as climate change adaptation, circular economy in construction, LCA, energy production and supply, smart buildings, and ESG. The online modules consist of 100 total hours of instruction, divided into 30 hours of teaching and 70 hours of student self-study. Each topic includes 16.5 hours of learning, with 5 hours of teaching and 11.5 hours dedicated to self-study. The teaching component will feature pre-recorded lectures on specific topics, complemented by a flexible range of exercises, assignments, and online tests. Assessments will be aligned with the defined objectives of each topic and tailored to the specific teaching methods used.
- [3]
 - i. **Assessment:** Participants complete assignments or exams online. If a participant fails, they are allowed to re-attempt.
 - ii. **Participants have the flexibility to choose one topic that best suits their interests.**
- [4] **In-Class Training (Summer School):** This phase comprises 1-2 weeks of intensive, in-person training sessions hosted at HH and TUHH, equivalent to four weeks of standard education. The in-class training follows a flipped classroom model to maximize student engagement and collaboration during in-person interactions. The structure and duration of the training will be determined by the internal regulations of the host institutions (HH and TUHH). At TUHH, the first nZEBRA summer school will span one week, providing 50 hours of in-class training across all topics.
- [5]
- [6] **Interactive Learning:** Groups of students focus on a specific topic, participating in interactive and practical sessions.
- [7] **Project Work:** Students collaborate on projects using either Problem-Based Learning (PBL) or Challenge-Based Learning (CBL) approaches, depending on the design of the chosen topic.
- [8] **Final Presentation:** At the end of the summer school, students present their work through final presentations and poster sessions.

Successful completion of the project, along with adherence to host institution regulations, awards students with a certificate of 7.5 ECTS credits. Additionally, a certificate of attendance is provided upon successful participation.

The pedagogical approach for the nZEBRA project is designed to be flexible and adaptable, allowing partners to select and implement the most suitable methods for their specific modules. The following pedagogical practices are recommended:

- **Constructivist Learning:** Emphasizes student-centered learning where students construct knowledge through experiences and reflections. Modules can include projects, case studies, and problem-solving activities that require students to apply concepts in real-world contexts.
- **Blended Learning:** Combines face-to-face instruction with online learning to maximize flexibility and engagement. Online resources such as video lectures, discussion forums, and virtual labs can complement in-class sessions, offering a mix of synchronous and asynchronous learning opportunities.
- **Collaborative Learning:** Encourages group work and peer interactions to enhance understanding and problem-solving skills. Group assignments, peer reviews, and collaborative projects can be integrated to facilitate teamwork and knowledge sharing.
- **Experiential and Hands-On Learning:** Focuses on practical, real-world activities that require active participation and critical thinking. Practical workshops, field visits, and simulations can provide hands-on experiences that reinforce theoretical knowledge.
- **Continuous Feedback and Reflective Practice:** Provides ongoing, constructive feedback and encourages students to reflect on their learning experiences for continuous improvement. Regular quizzes, feedback sessions, and reflective journals can help students track their progress and identify areas for improvement.

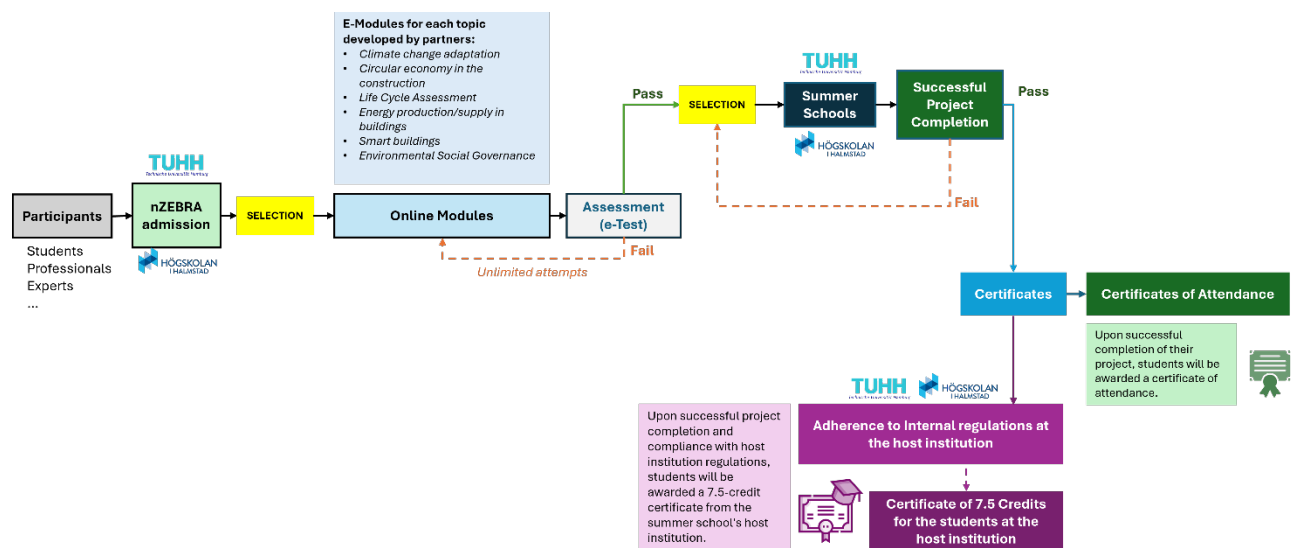


Figure 3. nZEBRA workflow and assessment strategy

5.2. Certificates

As mentioned, nZEBRA will have two demonstrations as Summer Schools at Technische Universität Hamburg (TUHH) and Hogskolan i Halmstad (HH). The summer schools at TUHH and HH provide 'In-Class Training', interconnected to online training (online modules). Upon successful completion of online modules and participation in the summer schools (final presentation), students will be awarded a 'Certificate of Attendance'.

In case of credit certificate, successful completion of the project, along with adherence to TUHH and HH regulations, awards students with a certificate of 7.5 ECTS credits.

5.2.1. Technische Universität Hamburg (TUHH)

At Hamburg University of Technology (TUHH), the assessment strategy for the summer school aligns with the institution's General Study and Examination Regulations (ASPO) and follows the European Credit Transfer and Accumulation System (ECTS). In this system, one credit point equates to an average workload of 30 hours, including lecture time, self-study, and other learning activities. Each module or course component is assigned a specific number of ECTS credits based on the total workload required.

The summer school consists of mandatory e-modules that students must complete prior to attending the in-person sessions. The online modules total 100 hours, with 30 hours of teaching and 70 hours of self-study. Each topic includes 5 hours of pre-recorded lectures and 11.5 hours of self-study, featuring exercises, assignments, and online tests. Assessments are based on the objectives and teaching methods of each topic.

The credit system at TUHH is fully compatible with the ECTS framework, allowing for international recognition and transferability of credits. According to ASPO, credits are only awarded upon successful completion of the respective coursework or examination. The total workload includes lecture attendance, self-study, and preparation for assessments, ensuring a rigorous academic experience.

Successful completion of the e-modules is required for participation in the on-site summer school activities. At TUHH, the first nZEBRA summer school will span one week, providing 50 hours of in-class training across all topics (about 8.5 hours per each topic). During the in-person sessions, students engage in interactive and practical learning approaches, such as Challenge-based learning (CBL), problem-based learning (PBL) and group projects. Assessment during these sessions is carried out through group activities, challenge-based tasks, and presentations, ensuring a comprehensive evaluation of the participants' engagement and understanding of the subject matter.

If deemed necessary, TUHH reserves the right to include a written examination as part of the assessment strategy to adhere to internal regulations. Written examinations at TUHH are typically conducted under supervised conditions and may involve problem-solving tasks or other written formats specified by the course syllabus.

TUHH employs a grading scale from 1.0 to 5.0, with grades assigned as follows:

- and 1.3: Very good – Outstanding performance
- 1.7, 2.0, and 2.3: Good – Performance significantly above average requirements
- 2.7, 3.0, and 3.3: Satisfactory – Meets average requirements
- 3.7 and 4.0: Sufficient – Meets minimum requirements despite deficiencies
- 5.0: Fail – Does not meet the requirements due to significant deficiencies

For ungraded assessments, results are recorded as either "Pass" or "Fail." Each module specifies the type of assessment, which may include written exams, oral exams, presentations, or project work. The grades assigned are directly linked to the learning outcomes and performance expectations outlined in the course syllabus.

Participation in the summer school does not automatically guarantee a certificate of credits. All students who complete the program will receive a certificate of attendance. However, certificates of credits will be handled individually on a case-by-case basis. Students seeking a certificate of credits must notify TUHH in advance to facilitate the necessary arrangements. The process for awarding credits will depend on the fulfillment of specific requirements and adherence to the guidelines established in the course curriculum.

TUHH provides flexibility in its examination formats, offering a variety of assessment types such as written exams, oral presentations, practical coursework, and group projects. The course syllabus specifies the examination format, and any changes or additional requirements are communicated well in advance to students. If written examinations are introduced during the summer school, they will adhere to the institution's strict guidelines for transparency and fairness (Table).

Table 6. Assessment criteria for credits certificate at TUHH

Name of the test	Credits	Grading
Online Modules	2	30%
Final Presentation	4	70%
Written examination		



5.2.2. Hogskolan I Halmstad (HH)

At Halmstad University (HH), the assessment strategy for the summer school is designed to align with the university's academic framework and regulations. Students are required to complete pre-summer school e-modules. The online modules total 100 hours, with 30 hours of teaching and 70 hours of self-study. Each topic includes 5 hours of pre-recorded lectures and 11.5 hours of self-study, featuring exercises, assignments, and online tests. Assessments are based on the objectives and teaching methods of each topic. . Successful completion of these e-modules is mandatory for participation in the in-person sessions of the summer school. The second nZEBRA demonstration will be hosted at HH. The duration and details of the in-class training for this summer school are yet to be finalized and will be shaped by feedback from the first summer school at TUHH and the ongoing development of the topics and courses. During the in-person sessions, student performance may be assessed through various methods, such as group work, challenge-based learning activities, and project presentations, ensuring a comprehensive evaluation of their understanding and engagement.

HH reserves the right to define a written examination if necessary, to adhere to its internal regulations. Participation in the summer school does not automatically guarantee a certificate of credits for students. Instead, a certificate of attendance will be issued to all participants. For those seeking credits, certificates of credits will be handled on a case-by-case basis. Students must inform HH of their specific needs if they wish to pursue credit certification.

In Sweden, the credit system (högskolepoäng) operates such that a normal 40-week academic year corresponds to 60 credits, which is compatible with ECTS credits. Halmstad University does not use ECTS credits directly, but its system aligns with ECTS requirements.

Regarding grading, there is no national grading system in Sweden. Institutions determine their grading scales, and no overall grade or ranking system, such as GPA, is used. At HH, the following grading scales may apply:

- Pass or Fail.
- Pass with distinction (VG), Pass (G), Fail (U).
- Pass with distinction (5), Pass with credit (4), Pass (3), Fail (U).
- Criterion-referenced scale: Excellent (A), Very Good (B), Good (C), Satisfactory (D), Sufficient (E), Insufficient (F).

The course syllabus specifies the grading scale used, and scales may vary within the same course. Transcripts will provide detailed information about the grading scales applied. Importantly, no translations or conversions of grading scales beyond what is stated in the syllabus are provided. This flexible yet structured approach ensures both adherence to institutional guidelines and accommodation of individual student needs (Table 6).

Table 7. Assessment criteria for credits certificate at HH

Name of the test	Credits	Grading
Online Modules	2	30%
Final Presentation	4	70%

Written examination		
---------------------	--	--



nZEBRA



6. Conclusions

This report summarized the comprehensive assessment strategy implemented for the nZEBRA project. It outlined how the strategy was aligned with the pedagogical and methodological frameworks defined in Deliverable 2.2, integrating blended learning, collaborative methods, and student-centered approaches. These efforts facilitated both independent and group-based learning, effectively preparing students to address the challenges of climate-neutral building design.

The report also addressed the specific requirements and internal regulations of the two demonstration sites, Höskolan i Halmstad (HH) and Technische Universität Hamburg (TUHH). The assessment strategy was adapted to meet the grading systems and credit structures of both institutions, ensuring compatibility with their academic frameworks while fulfilling the objectives of the project. Certificates of attendance were issued to all participants, with credit certifications handled on a case-by-case basis.

In summary, this deliverable provided a structured yet flexible framework that ensured fair, inclusive, and effective evaluations. By incorporating continuous feedback, a combination of formative and summative assessments, and adherence to institutional requirements, the project delivered a high-quality learning experience. The assessment strategy successfully equipped students with the necessary skills and knowledge to contribute to sustainable and climate-neutral building practices.

• References

- Bae, Y., Tunstall, S., Knowles, K., & Matz, R. (2019). Alignment Between Learning Objectives and Assessments in a Quantitative Literacy Course. *Numeracy*, 12(2). <https://doi.org/10.5038/1936-4660.12.2.10>
- Bentri, A., Rahmi, U., Hidayati, A., & Supendra, D. (2019). *The Models of Assessment to Accommodate Instructional Domain in Blended Blended Learning*. <https://doi.org/10.2991/icetep-18.2019.39>
- Bock, A., Kniha, K., Goloborodko, E., Lemos, M., Rittich, A. B., Möhlhenrich, S. C., Rafai, N., Hölzle, F., & Modabber, A. (2021). Effectiveness of face-to-face, blended and e-learning in teaching the application of local anaesthesia: A randomised study. *BMC Medical Education*, 21(1), 137. <https://doi.org/10.1186/s12909-021-02569-z>
- Bulut, O., Gorgun, G., Yildirim-Erbasli, S. N., Wongvorachan, T., Daniels, L. M., Gao, Y., Lai, K. W., & Shin, J. (2023). Standing on the shoulders of giants: Online formative assessments as the foundation for predictive learning analytics models. *British Journal of Educational Technology*, 54(1), 19–39. <https://doi.org/10.1111/bjet.13276>
- Dziuban, C., Graham, C. R., Moskal, P. D., Norberg, A., & Sicilia, N. (2018). Blended learning: The new normal and emerging technologies. *International Journal of Educational Technology in Higher Education*, 15(1), 3. <https://doi.org/10.1186/s41239-017-0087-5>
- Hu, X., Zhang, H., Song, Y., Wu, C., Yang, Q., Shi, Z., Zhang, X., & Chen, W. (2019). Implementation of flipped classroom combined with problem-based learning: An approach to promote learning about hyperthyroidism in the endocrinology internship. *BMC Medical Education*, 19(1), 290. <https://doi.org/10.1186/s12909-019-1714-8>
- Kausar, F. N., & Haroon, A. (2022). Relationship between Formative Assessment Techniques, Students' Learning and Academic Achievement at University Level. *Pakistan Languages and Humanities Review*, 6(3), Article 3. [https://doi.org/10.47205/plhr.2022\(6-III\)26](https://doi.org/10.47205/plhr.2022(6-III)26)
- Kickert, R., Meeuwisse, M., Stegers-Jager, K. M., Prinzie, P., & Arends, L. R. (2022). Curricular fit perspective on motivation in higher education. *Higher Education*, 83(4), 729–745. <https://doi.org/10.1007/s10734-021-00699-3>
- Kingston, A. K., Garofalo, E. M., Cardoza, K., & Fisher, R. E. (2023). Designing formative assessments to improve anatomy exam performance. *Anatomical Sciences Education*, 16(5), 989–1003. <https://doi.org/10.1002/ase.2279>
- Liu, Q., Peng, W., Zhang, F., Hu, R., Li, Y., & Yan, W. (2016). The Effectiveness of Blended Learning in Health Professions: Systematic Review and Meta-Analysis. *Journal of Medical Internet Research*, 18(1), e4807. <https://doi.org/10.2196/jmir.4807>
- Mahmud, M., Yaacob, Y., Ramachandiran, C., Shiet, W., & Ismail, O. (2019). *Theories into Practices: Bloom's Taxonomy, Comprehensive Learning Theories (CLT) and E-Assessments*. <https://doi.org/10.26499/iceap.v2i2.91>
- Nasir, M. A. M., Alaudin, R. I., Ismail, S., Ali, N. A. M., Faudzi, F. N. M., Yusuff, N., & Pozi, M. S. M. (2020). THE EFFECTIVENESS OF FLIPPED CLASSROOM STRATEGY ON SELF-DIRECTED LEARNING AMONG UNDERGRADUATE MATHEMATICS STUDENTS. *Practitioner Research*, 2, 61–81. <https://doi.org/10.32890/pr2020.2.4>
- Olumorin, C. O., Yusuf, H. A., Abdulwasiiu, M., Farem, M. F., & Aderogba, A. A. (2023). Lecturers' Perception on The Use of Blended Learning Strategy in University of Ilorin, Nigeria. *Journal of Digital Learning and Education*, 3(2), Article 2. <https://doi.org/10.52562/jdle.v3i2.430>
- Ramzan, M., Zafar, J. M., & Hussain, M. (2023). EFFECT OF BLENDED LEARNING STRATEGIES ON UNIVERSITY STUDENTS' SKILL DEVELOPMENT. *Pakistan Journal of Educational Research*, 6(2), Article 2. <https://doi.org/10.52337/pjer.v6i2.801>
- Rapi, N. K., Suastra, I. W., Widiarini, P., & Widiana, I. W. (2022). The Influence of Flipped Classroom-Based Project Assessment on Concept Understanding and Critical Thinking

- Skills in Physics Learning. *Jurnal Pendidikan IPA Indonesia*, 11(3), Article 3. <https://doi.org/10.15294/jpii.v11i3.38275>
- Sewagegn, A. A. (2020). Learning Objective and Assessment Linkage: Its Contribution to Meaningful Student Learning. *Universal Journal of Educational Research*, 8(11), 5044–5052. <https://doi.org/10.13189/ujer.2020.081104>
- Sharma, V. (2022, August 4). Blended learning—A Transformative Force in the Realm of Education. *FATbit Blog*. <https://www.fatbit.com/fab/blended-learning-transformative-force-in-realm-of-education/>
- Tessier, V., & Zahedi, M. (2019). *ASSESSMENT OF COLLABORATIVE DESIGN: A SOCIOCULTURAL APPROACH*. <https://doi.org/10.35199/epde2019.15>
- Vaughan, N. (2014). Student Engagement and Blended Learning: Making the Assessment Connection. *Education Sciences*, 4(4), Article 4. <https://doi.org/10.3390/educsci4040247>