BioGov.net
Governance & Upskilling for a
Stronger Bioeconomy

Designing Biobased Education

A step-by-step guideline for developing training programmes in co-creation with stakeholders.

Consortium

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@biogovnet
info@biogov.net www.biogov.net

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Guidelines for developing biobased training programmes in co-creation with stakeholders, including a step-by-step overview of instruments for collaborative learning and exchange of experiences.

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Final version	Pieter Schep Mara van Eijndhoven Myron Koster Ayse Terzi

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info@biogov.net www.biogov.net

Contributors

NAME	ORGANISATION
Henk Spies	Avans University of Applied Sciences

Peer Reviews

NAME	ORGANISATION
John Vos	BTG Biomass Technology Group BV
Yaprak Kurtsal	Alma Mater Studiorum - Università di Bologna
Norbert Steinhaus	Wissenschaftsladen Bonn e.V.

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Executive Summary

This document is a cornerstone of the BioGov.net project, aimed at creating a guideline for the development of training programmes within the bioeconomy. This guideline is designed for parties with a goal or problem for which an educational intervention is (part of) the perceived solution. It provides a step-by-step guideline on *how* to design biobased training programmes in cocreation with stakeholders.

The development steps that education designers can take are explained and illustrated using the 'Eight Fields Model' originally developed by Kessels and Smit (1996) and further elaborated on by Deen, Rondeel and Kessels (2017). This model provides a practical approach to designing educational interventions.

The eight fields of the model can be seen as a checklist of steps that you as an educational designer can go through and tick off to ultimately develop an impactful and measurable biobased training. To make this visually clear, this guideline is summarized on the next page in a one-page visual. It can help you to determine what steps you haven't yet covered. This can be prioritized in your reading. The checklist can also be downloaded as a separate PDF file via the official BioGov.net website.

This document also focuses on the governance part of developing and realizing an educational intervention in cocreation. It addresses inclusivity by integrating marginalized and disadvantaged groups into governance mechanisms. Furthermore, it uses the arts, humanities, eco-design and culture as tools to increase public engagement and understanding of bioeconomy concepts. Practical recommendations include transferable frameworks, flexible educational models and interdisciplinary approaches.

This outcome bridges the gap between bioeconomy education needs and actionable training methodologies, ensuring alignment with the broader objectives of the BioGov.net project, while promoting sustainability, equity and innovation.

Designing Biobased Education

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Goals & Problems

- [ ] Clarify the **actual challenge** or problem (organizational/societal) before suggesting learning solutions.
- [ ] Formulate **organizational/societal goals**, not just learning goals.
- [ ] Avoid the "training reflex"—question whether an educational intervention is truly the best solution.
- [ ] Explore alternative or complementary interventions (e.g., organizational redesign, new tools).

Scenario 1
Integarting bioeconomy in policy

Scenario 2
Adressing unemployment & skills gaps

Future Work Context

- [ ] Analyse the **future work environment** thoroughly.
- [ ] Identify and specify **Knowledge, Skills, and Attitudes (KSA)**.
- [ ] Use diverse methods (interviews, focus groups, shadowing).
- [ ] Involve stakeholders for shared understanding and buy-in.

Scenario 1
Competences for policy innovation

Scenario 2
Entry-level industrial skills & soft skills

Required Competences

- [ ] Analyse the future work environment thoroughly.
- [ ] Identify and specify Knowledge, Skills, and Attitudes (KSA).
- [ ] Use **diverse methods** (interviews, focus groups, shadowing).
- [ ] Involve **stakeholders** for shared understanding and buy-in.

Scenario 1
Competences for policy innovation

Scenario 2
Entry-level industrial skills & soft skills

Learning Situation

- [ ] Choose appropriate **learning theories** (e.g., behaviourism, constructivism, connectivism).
- [ ] Select a **learning context**: formal, informal, or blended.
- [ ] Ensure inclusive and culturally responsive design.
- [ ] Integrate **art** and **biomimicry** into methods and delivery.

Scenario 1
Knowledge-building for policymakers

Scenario 2
Practical, workplace-based learning

Organisational/Societal Impact

- [ ] Track key indicators linked to the original goals (e.g., innovation, sustainability).
- [ ] Interview stakeholders to assess perceived impact.
- [ ] Measure pre/post data to analyse the success/failure.
- [ ] Schedule long-term evaluations (1 month, 6 months, 1 year).

Scenario 1
Influence on bioeconomy policy

Scenario 2
Reduced unemployment, increased inclusion

Work Performance

- [ ] Assess if learners apply competencies at work.
- [ ] Use supervisor interviews, observation, and learner logs.
- [ ] Gather case studies of workplace improvement.
- [ ] Enable peer learning sessions and reviews.

Scenario 1
Application in real policymaking

Scenario 2
Job performance on-site

Learning Results

- [ ] Define **measurable learning outcomes** tied to required competencies.
- [ ] Use **practical assessments** (role plays, work samples).
- [ ] Incorporate **peer** and trainer **feedback**.
- [ ] Collect and **evaluate learning portfolios** or **assignments** submitted by learners.

Scenario 1
Policy design knowledge evaluation

Scenario 2
Competency tests & observation

Learning Process

- [ ] Gather **real-time feedback** from learners and trainers.
- [ ] Use **observation** and **engagement metrics**.
- [ ] **Adjust program** design based on learner experience.
- [ ] Employ **reflection tools** (journals, digital logs).

Scenario 1
Interactive, policy-relevant format

Scenario 2
Practical, workplace-based learning

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Introduction

The world stands at a critical juncture. The imperative to transit from a fossil-fuel-dependent economy towards a sustainable, bio-based one has never been more urgent. The bioeconomy, encompassing the production, utilization and conservation of biological resources, offers a pathway to address pressing global challenges such as climate change, resource depletion and food security. However, realizing the full potential of the bioeconomy hinges on a well-educated and skilled workforce, capable of driving innovation and implementing sustainable practices. This guideline aims to provide a framework for designing effective educational programs that foster the knowledge, skills and values necessary for a thriving bioeconomy.

Inspiration: Education as a Catalyst for Change

- The Role of Education: By **Leading the Way**; education can be a frontrunner, proactively shaping the future of the bioeconomy. It should not merely react to emerging trends but actively anticipate and drive them. Educational institutions have a unique opportunity to cultivate a generation of bioeconomy leaders, innovators and practitioners (Rieckmann, 2017).
- **In Line with Societal Needs & Expectations**. Bioeconomy education must be inclusive and equitable, addressing the needs and expectations of all members of society, including minorities and vulnerable groups. It should empower individuals from diverse backgrounds to participate in and benefit from the bioeconomy. By doing so, we can enable a just and sustainable transition (United Nations, 2015).
- **Learning from Predecessors** and reusing educational materials where applicable, can help accelerate biobased education. Early involvement of stakeholders such as universities and creating education with a long time-horizon in co-creation are strong building blocks for success (Mayorga, Lewandowski & Urmetzer, 2022).
- **Education from Internal Motivation and External Incentives**. Effective bioeconomy education fosters both intrinsic motivation and provides external incentives. It should ignite a passion for sustainability and inspire learners to become agents of change. Simultaneously, it can offer clear pathways to professional development with recognized and rewarded achievements, such as diplomas and certificates.

The bioeconomy is essential for a sustainable future, addressing global challenges like resource depletion and climate change. By utilizing renewable biological resources for food, materials and energy, it reduces a dependency on fossil fuels and drives economic growth, job creation and environmental sustainability (European Commission, 2018).

To unlock its full potential, we need education programs that equip professionals with bio-based expertise. Current curricula often lack interdisciplinary bioeconomy training, creating an urgent need for structured learning. This document serves as a guideline for designing bio-based education, ensuring future generations can drive the transition to a sustainable, circular economy.

How the guideline is structured

For the development of this guideline the insights from all the project activities (organised focus groups, co-design, co-creation and regional policy workshops) and collected case studies have been incorporated and linked to the Eight Fields Model of Kessels and Smit (Deen et al., 2017). Read Steps for designing education, page 17, for more explanation about the model.

This guideline is designed for parties with a goal or problem for which an educational intervention is a perceived solution. The first part of this document explores the governance context and the essential prerequisites for a successful educational intervention. It highlights key aspects of the governance framework (from BioGov.net document 4.1 - Guidelines for developing the training governance framework) that may be relevant depending on the specific situation. Drawing from the experiences of various multi-stakeholder collaborations, this section provides insights in designing effective biobased education initiatives to address pressing challenges and achieve goals.

Once the governance side is suitably addressed the document moves on to the actual designing of a biobased training programmes. A step-by-step methodology is presented ranging from tools and questions to determine competences needed for the future, all the way to guidance for designing assessments or determining how to measure outcomes on an organisational as well as societal level. Special attention is given to implications of facilitating marginalized groups within educational interventions and the facilitating role that art can play in the programme design.

Scope

This guideline will be focusing on the process of *how* to design biobased training programmes in cocreation with stakeholders. The guideline pays attention to the different design steps that an educational designer carries out to develop biobased educational interventions. The governance section ties into the context awareness of the designer and guides the reader to get the right ingredients for successful education in place.

Target audience

This guideline is meant for stakeholders who want to set up regional training and mentoring programmes targeting the local bio-systems, regulators and policies for building the bridge between knowledge, skills, bioeconomy and good governance. Even though the whole ecosystem related to education should be involved: from academia, government, industry, civil society and environmental organizations (quintuple helix). In the co-creation process this guideline is aimed as an instruction for the designer(s) of the educational interventions.

More specifically this document has been created for the following target groups:

1. **Research, Vocational and Higher Education Organisations**: To provide them with guidelines for designing biobased training programmes. Their clients would be the individuals that would receive the education (with emphasis on marginalized groups).
2. **Bio-Systems Stakeholders**: To empower them with training frameworks and better feedback loops with training providers and administrators.
3. **Industry and Businesses (SMEs)**: To support them with flexible training programmes and development of skills leading to novel business models.

While not specifically written for them, the guideline can also be relevant for the following audiences and their stakeholders:

4. **Policy Makers and Administrations (Governance)**: To offer them guidelines for a well-functioning governance model which supports mentoring and training programmes in the bioeconomy.
5. **NGOs and Wider Society**: To engage them in the transition to bioeconomy by offering training and mentorship and provide them with opportunities for social innovation and inclusion.

Governance for educational designers

Effective governance is essential for impactful bioeconomy education programs. It facilitates strategic alignment, inclusivity and collaboration among key stakeholders. The governance framework presented in figure 1 is based on BioGov.net document 4.1 - Guidelines for developing the training governance framework - and was validated in the European Policy Workshop held in October 2024. It provides educational designers with tools to assess and enhance the context in which they operate, fostering multi-stakeholder partnerships, social inclusion, cocreation and interdisciplinary learning. By integrating diverse perspectives from academia, industry and policy. Governance structures can strengthen educational initiatives, making them more responsive to sectoral needs. Additionally, governance supports quality assurance, sustainable financing and regulatory coherence, all of which are critical for the long-term success of bioeconomy training programs.

This chapter gives advice and helps designers to assess and improve the quality of the context they start operating from. The governance framework can be used as a guide to improve the organization and ensure the right elements are consciously considered. This chapter is aimed specifically at designers of educational programmes. The structure of this chapter consists of all components of the Bioeconomy Education and Training Governance Framework presented in figure 1.

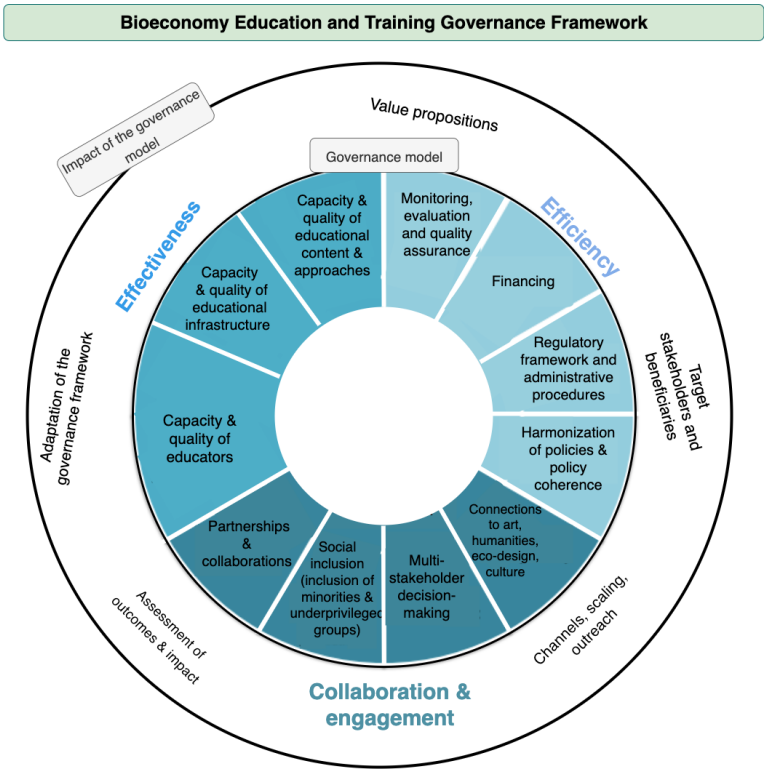

Figure 1. Bioeconomy Education and Training Governance Framework

Collaboration and engagement in bioeconomy education

Fostering strategic partnerships and collaborations

Collaboration is a cornerstone of bioeconomy education governance. Establishing multi-stakeholder partnerships strengthens governance structures and enhances knowledge exchange.

Partnerships should encompass diverse actors, including universities, vocational education and training providers, industry leaders, NGOs, local communities and professionals from the bio-based sector. Expanding international cooperation, facilitating academic exchanges and incentivizing joint courses between institutions from different countries further enrich bioeconomy education. Additionally, public-private partnerships can play a crucial role in bridging the gap between theoretical knowledge and practical application.

Enhancing regional, cross-sector and international collaborations through collective projects fosters best practices and accelerates innovation. To support long-term engagement, an independent coordinating body can help streamline communication, build trust and ensure that collaborative efforts remain aligned with shared objectives. Recognizing and celebrating achievements within partnerships can reinforce motivation and attract new stakeholders.

Ensuring social inclusion and equity

A governance framework for bioeconomy education must prioritize diversity, equity and inclusion, ensuring that marginalized and underprivileged groups have a voice in decision-making processes and are taken into serious consideration for education.

Barriers such as unequal access to funding, disparities in wages and limited educational opportunities must be addressed through targeted interventions. Social inclusion requires acknowledging that different individuals and groups face varying challenges in accessing opportunities. Levitas (2005) identifies four key approaches to facilitate social inclusion:

- Redistributive strategies provide resources to enable individuals to achieve their goals.
- Social integration strategies focus on developing competencies necessary for participation.
- Moral underclass strategies emphasize behaviour adaptation to align with societal norms.
- Social innovation strategies aim to enhance problem-solving capacity through alternative solutions.

Applying Sen's (1985) capability approach, policies should enhance individuals' competencies, social networks and opportunities. Targeted initiatives, such as funding for female entrepreneurs, flexible work arrangements and anti-discrimination measures, can encourage broader participation in bioeconomy education.

Educational interventions must be tailored to the specific needs and motivations of different target groups. While competence-building strategies benefit those who are motivated but lack necessary skills. Directive interventions may be more effective for individuals who struggle with engagement. Co-creative interventions, which leverage participants' unique talents, can further strengthen the learning experience. A nuanced approach prevents disengagement and facilitates meaningful participation.

Multi-stakeholder decision-making

Inclusive governance requires active involvement of all relevant stakeholders in shaping bioeconomy education. Integrating perspectives from academia, government, industry, civil society and environmental organizations (Quintuple Helix approach) fosters comprehensive decision-making.

Clearly defining roles and responsibilities through formal agreements strengthens accountability and embeds strategic alignment. A well-structured governance framework should outline challenges, objectives and concrete steps to advance bioeconomy education while facilitating collaboration across policy, industry and community sectors.

Integrating arts, humanities and eco-design

Incorporating arts, humanities and eco-design methodologies into bioeconomy education can enhance engagement and interdisciplinary collaboration. Creative approaches, such as storytelling, visualizations and interactive installations, make complex bioeconomy concepts more accessible and relatable.

By fostering dialogue between diverse stakeholders, artistic interventions can help bridge knowledge gaps and stimulate innovative problem-solving. Partners in the art field can be considered to facilitate the co-design processes, in which multiple actors collaboratively develop solutions. This can strengthen participatory engagement and help educational initiatives align with real-world challenges with a broad consideration of variables.

Enhancing the effectiveness of bioeconomy education

Capacity and quality of educational content and approaches

To improve the effectiveness of bioeconomy education, curricula must integrate innovative learning methodologies, including:

- Blended learning approaches that combine formal, informal and non-formal education
- Work-integrated learning through internships, mentorships and apprenticeships
- Modular programs that allow for flexible, student-centred learning

Embedding transversal skills such as digital literacy, problem-solving and interdisciplinary collaboration within educational programs makes learners well-equipped for emerging challenges. Additionally, targeted certifications and micro-credentials should be designed to evolve with sectoral needs, enhancing their relevance and applicability.

The accessibility of bioeconomy education can be improved by offering short courses and micro-degrees, which provide adaptable learning pathways. Digital platforms can further promote visibility and facilitate coordination among stakeholders.

Capacity and quality of educational infrastructure

Strengthening educational infrastructure is critical for scaling bioeconomy training initiatives. Learning spaces, whether physical (schools, knowledge hubs, community centre's) or digital, should be equipped to deliver high-quality education.

Developing local hubs where students, entrepreneurs and industry professionals collaborate on real-world challenges enhances experiential learning. These hubs can serve as innovation ecosystems, enabling mentorship, coaching and direct industry engagement. Public-private partnerships can further reinforce educational infrastructure by providing specialized training resources. It is recommended to use already existing facilities within the network where your educational interventions should make a difference.

Capacity and quality of educators

As bioeconomy education remains a developing field, a shortage of qualified educators poses a challenge. Addressing this gap requires investment in educator training and curriculum development.

Massive Open Online Courses (MOOCs) can provide accessible training materials and standardized lesson plans for educators, ensuring that courses remain up to date with industry advancements. Such courses reduce educators' workload while enhancing the consistency and quality of bioeconomy education. Additionally, accreditation from recognized institutions strengthens the credibility of tailored training programmes.

Efficiency in bioeconomy education governance

Monitoring, evaluation and Quality Assurance

Ensuring the effectiveness and long-term impact of bioeconomy education initiatives requires robust monitoring and evaluation mechanisms. Establishing well-resourced independent institutions dedicated to assessment, equipped with sufficient capacity and instruments, enhances legitimacy and enables data-driven development.

Reliable monitoring systems can contribute to continuous improvement, allowing interventions to be validated, resources to be allocated efficiently and stakeholder engagement to be sustained over time. Several mechanisms support this process. Conducting baseline assessments (zero-point measurements) enables benchmarking of progress and identification of specific learning needs. Dashboards can offer real-time tracking of local indicators, providing a comprehensive overview of ongoing developments. Furthermore, structured feedback loops, such as post-event evaluations, yield actionable insights that refine strategies and reinforce stakeholder commitment. In the chapter Field 8: Organisational results on page 80 you can find a more elaborate overview of assessments and how they can be executed.

Financing sustainable bioeconomy education

A well-structured governance model must secure sustainable funding for biobased education and training systems. Efficient, transparent and timely allocation of financial resources is crucial for ensuring continuity and facilitating scalability. However, financial constraints often hinder the development of educational infrastructure, limit investment in fundamental research and restrict support for entrepreneurs within the sector.

Addressing these funding gaps are essential for fostering innovation and expanding educational opportunities in bioeconomy-related fields. Currently, targeted financial support, including tax incentives, remains limited and inconsistent across regions. Securing regional or European funding often demands broad collaboration, making the process complex and resource intensive. It is recommendable to tap into existing education and related funding to establish long term funding. In some regions you can already connect with coordinated funding networks at national and international levels that can enhance financial sustainability and support long-term capacity building.

Regulatory frameworks and administrative procedures

Regulatory structures should be implemented and enforced in a transparent, accountable manner, ensuring coherence across educational institutions, industries and government bodies.

Facilitating collaboration between ministries, municipalities and private-sector partners can streamline the implementation of regulatory frameworks, fostering synergies across sectors. However, regulatory environments vary significantly between regions and industries, requiring ongoing adaptation to legislative changes. Administrative burdens

may also pose challenges. It is recommended to request guidance from local authorities to provide practical tools and insights that support compliance and regulatory alignment.

Harmonization of policies and policy coherence

Effective governance in biobased education requires coordination across multiple levels, spanning different sectors, regions and educational systems. Aligning biobased education policies with broader regional and industrial strategies ensures consistency and reinforces long-term objectives.

To maintain relevance, involving the right set of stakeholders and continuous stakeholder feedback must be incorporated into policy design and implementation. This enables evolving industry needs and academic requirements to be reflected in educational initiatives, strengthening the connection between training programmes and real-world applications.

Steps for designing education

In this guideline the Eight Fields Model developed by Kessels and Smit (Kessels, Smit & Keursten, 1996 and more recent versions) offers the foundation for designing training and mentorship programmes for the bioeconomy. The model is built to support the analysis, development and improvement of learning processes, with a strong emphasis on aligning these processes with organisational or societal goals and assessing impact.

One of its key strengths is its comprehensive evidence-based scope. The model addresses all essential elements involved in developing effective training and mentorship, making it highly adaptable to the dynamic and varied needs of the bioeconomy sector. Its flexibility means it can be tailored to suit specific regional, sectoral, or local contexts.

Another notable feature is its focus on stakeholder involvement. The model highlights the importance of engaging all relevant actors, industry experts, policymakers, educators and learners, in both the design and delivery of learning programmes. This collaborative approach is especially valuable in the bioeconomy, where innovation depends on input from a wide range of disciplines.

Importantly, the model embeds continuous improvement at its core, encouraging regular evaluation and refinement. This ensures that training and mentorship initiatives remain responsive to feedback and evolving industry demands. In a fast-developing field like the bioeconomy, such adaptability is vital to keeping programmes relevant and impactful.

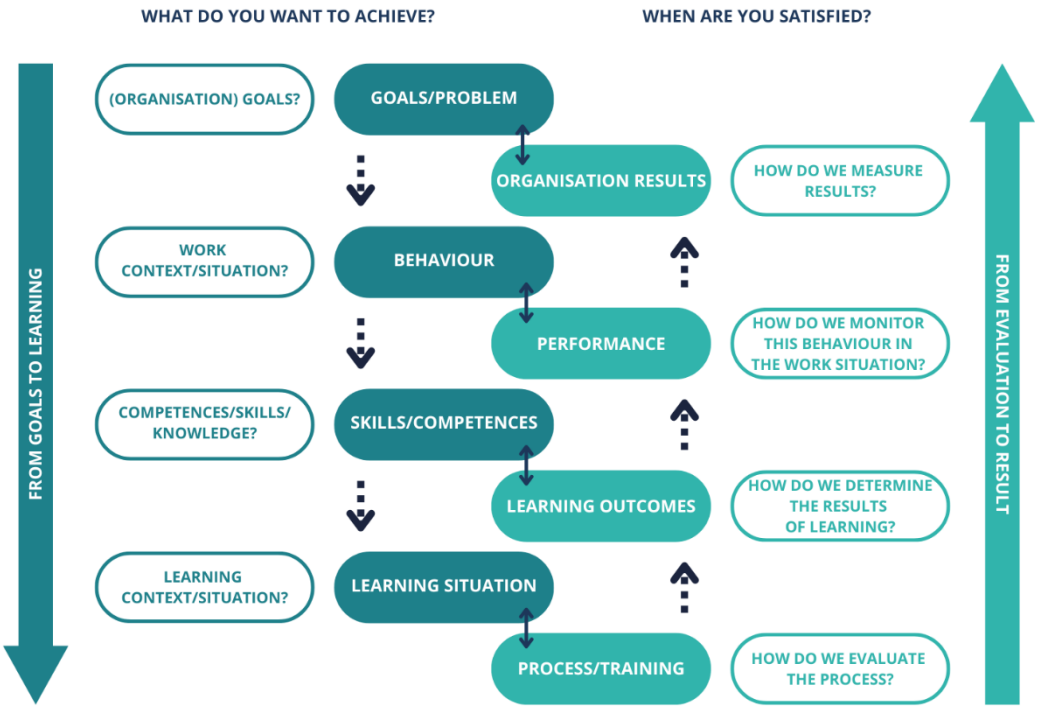

Figure 2. Eight Fields model of Kessels and Smit

How to read the model

The Eight Fields Model serves as a practical workflow for designing learning programmes. It follows a step-by-step path shaped like a "U": starting in the top-left field and moving downward through the left-hand column, then transitioning to the right-hand column and moving upward to evaluate results across four progressively complex levels.

While the model can be read in this U-shaped sequence, its design-logic is built around the interaction between corresponding left and right fields. Each pair, linked by horizontal arrows, should be addressed in parallel during the design process. In short:

- **Field 1 ↔ Field 8**: When defining the central goals or problems to be tackled (Field 1), it's equally important to consider how success will be measured (Field 8). At this level, think in terms of organisational or societal impact: which performance indicators will demonstrate the programme's effectiveness?
- **Field 2 ↔ Field 7**: When envisioning the future work context (Field 2), what the world of work might look like in light of the problem or goal, you should also define the desired behaviours within that context (Field 7). This means identifying how newly acquired competences (knowledge, skills, attitudes) should be applied in real-world job performance. Doing so makes it possible to assess the transfer of learning from training to practice.
- **Field 3 ↔ Field 6**: While analysing the gap between current and future required competences (Field 3), you must also consider how these competences translate into concrete learning outcomes (Field 6). This includes the assessment whether participants have truly developed the intended competences.
- **Field 4 ↔ Field 5**: When designing the learning programme itself (Field 4), based on learning theories and contextual factors, you also need to create an accompanying evaluation plan (Field 5). This evaluation should be conducted during and immediately after the programme to guide adjustments in real time and strengthen learning outcomes.

How to read the next chapters

The chapters below contain the different steps of the model. the subchapters are the relevant elements per field. These subchapters are recommendations and tools that can support the design of educational interventions. The checklist that can be found at the start of this document can be used as a tool to assess which of the fields you have covered least in your educational development thus far and require most attention.

The chapters follow the following structure:

- Short explanation of the field and source of information.
- Learnings and recommendations for consideration.
- The steps of the model are illustrated by design examples. It is discussed through all steps of the eight fields model and provides a translation to the bioeconomy based on a challenge and stakeholders from practice.

Design examples – introducing two scenarios

To get to grips with the Eight Fields Model and its content two scenarios with accompanying design examples are provided. During each step of the model, these scenarios will serve as examples for activities that can be undertaken in relation to the model. The scenarios were created to illustrate the applicability of the Eight Fields Model in two distinct situations. They differ when it comes to the original goal, the stakeholders, participants and the content matter. Keep in mind that these design examples are rooted in real world situations with real world stakeholders yet are hypothetical by nature since they combine various case studies.

The first scenario deals with the challenge of enabling/empowering policy makers to incorporate bioeconomy considerations in their policy making process. The second design example deals with the challenge to provide learning (and job) opportunities for marginalized groups in a specific region. The goal is to enable participants to become more strongly embedded in society and provide for themselves on the one hand, while reducing the labour shortage, unemployment and use of benefits on the other.

Origins of the first scenario

The origins of the first scenario can be traced back to a study conducted on behalf of the EU (BioVoices) that aimed to make an inventory of what is needed to stimulate Bioeconomy. One of the key findings was that policy makers currently (inadvertently) do not take bioeconomy into account in the policy making process, which prevents outcomes associated with bioeconomy. This conclusion led several national and regional government officials wanting to address this situation.

Origins of the second scenario

The origins of the second scenario are found in the challenges faced by both local businesses and the regional government. Businesses located at an industrial park struggled with a persistent labour shortage, unable to fill vacancies in process operation and logistics. The chemical and agricultural industries, which dominated the region, required a workforce with specific skills that were in short supply. At the same time, the local government was responsible for a group of citizens who faced barriers to employment, including marginalized groups and individuals with limited access to formal education or professional opportunities. The government’s objectives included economic independence of citizens, social participation and emancipation, ensuring that all citizens had a pathway to meaningful employment. During discussions between industry representatives, government officials and local educational institutions, a mutual interest was identified: businesses needed workers, while the government sought to support its citizens in securing stable employment. The idea of a structured educational intervention emerged, one that would combine on-the-job learning in an apprentice-mentor model with formal education delivered on-site. This approach would not only provide businesses with the workforce they needed but also helped the participants gain long-term employability in an evolving industry.

Additionally, the industry itself was transitioning toward more sustainable practices, exploring ways to use residual flows and integrate bioeconomic principles. If the education program addressed these developments, participants would gain knowledge and skills that aligned with future industry needs, making their training even more valuable.

Click here to jump to read the first design examples – Field 1, page 23

Field 1: Goals/problems

Figure 3. Underlying questions in the Eight Fields Model - Field 1

Exploring learning needs & challenges

In this chapter, we take a closer look at the Eight Fields Model and its value as a framework for analysing organisational and societal challenges within the context of the bioeconomy. The aim is to identify effective and efficient strategies for addressing these challenges. The model helps determine when and how learning processes can contribute to achieving broader goals related to the bioeconomy.

Ambitious goals often invite a wide range of possible solutions, designing, organising and facilitating learning is just one of them. It is the responsibility of learning designers to clarify this to their clients, whether they are organisations, governments, or educational institutions. Too often, designers are presented with a pre-defined solution, typically a training or educational programme, without a clear understanding of the underlying challenge or the goal it is meant to support.

This is why it's essential to pause and ask a few key questions first: What exactly is the challenge? What goal has been set in response to that challenge? And is an educational intervention truly the most appropriate way to achieve it, or might other types of interventions be more effective?

Determining what is to be achieved and what is the expected contribution of learning?

Investing in learning only becomes meaningful when it contributes to achieving a goal or solving a problem within an organisation or society. Before we can discuss the expected contribution of learning, it is essential to clarify what we mean by *learning*. A consolidation of definitions could be: *"Learning is the process through which individuals acquire, develop and refine knowledge, skills and attitudes, enabling them to perform effectively in their professional or personal contexts."*

The first step in defining what needs to be achieved is formulating a clear and achievable goal. Such goals should be articulated in organisational or societal terms, *not* in terms of a solution. The method of addressing the issue should remain open at this stage.

Unfortunately, goals are often expressed in terms of desired knowledge and skills, or the intended learning programme itself. Examples include: *"Employees need to gain more insight in…"*, *"people need to complete an e-learning course on…"*. These kinds of statements already assume that knowledge is the issue or that an educational intervention is the answer. In effect, they present a *solution* rather than a *goal*.

Experience shows that jumping to this conclusion too quickly often results in launching a learning programme that lacks a solid organisational or societal foundation, or worse, where learning alone won't be enough. In both cases, investing solely in education may not yield meaningful outcomes. That's why it is so important to clarify, from the outset, *what* the goal is that an educational intervention might support.

Even when the goal is clear, there's another pitfall. Clients often request a training solution without fully exploring the nature of the problem, looking for a quick fix. This tendency is sometimes referred to as the *training reflex*. For example, when service quality is low or innovation is lagging, the assumption is often that employees simply lack the right knowledge or skills. And so, a call for a training programme is made.

In these situations, the learning designer must guide the conversation, ensuring the focus remains on the work itself, not the proposed training. What, exactly, in the work environment is preventing improved service or greater innovation? That's where the real diagnosis begins.

When are you satisfied with the results?

The left side of the Eight Fields Model shows the correlation between goal, the perceived future situation, the knowledge & skills needed and the actual educational intervention itself. The right side of the model takes shape based on the question *"when are you satisfied?"* which can be put forward at all four fields on the right side of the model.

In evaluating the educational intervention, you assess a similar correlation as on the left side, but now in reverse order. The educational intervention should lead to a learning process whose outcomes correspond to the necessary knowledge and skills. With this knowledge and skills, participants should influence their (future) performance in such a way that the future work situation can change or is changed and that the desired impact on the original 'goal' (as ascertained on the left side of the model) is achieved. Explanation field 5 – 8: Designing the evaluation, page 60, will further delve into the components on the right side of the model.

Design examples – Field 1: Problems and goals

Example one

Based on the finding of the BioVoices study researchers found that policy makers do not take bioeconomy into account when creating or directing policy. If the main aim of the government is to move the economy towards, for example, full circularity it is necessary for policy makers to craft the right policies that support these goals. This research highlights misalignment between these two disciplines. The question then becomes what causes the situation and is 'education' a (partial) solution for the problem? It did not seem to be malintent that caused policy makers to disregard considerations regarding the bioeconomy it was more something along the lines of "out of sight, out of mind". Thus, getting bioeconomy and everything attached to it "in sight" would contribute to solving the issue and education would be a good tool to achieve this. If effective, this should yield results on a societal level: the incorporation of the possibilities of bioeconomy in policymaking processes and more policies supporting the bioeconomy.

Example two

The labour shortage in the industrial park and the low workforce participation among certain groups of citizens created a situation in which businesses struggled to fill essential roles while a segment of the population remained unemployed or underemployed. The challenge was not simply a lack of job openings but a mismatch between industry demands and workforce readiness.

To determine whether an educational intervention could serve as a solution, the designer consulted business managers, government officials from various offices and experts in vocational education. These discussions helped clarify the underlying causes of the problem and assess whether training could bridge the gap between industry needs and workforce availability. From these conversations, two key issues emerged:

- Many potential workers lacked the necessary qualifications for even entry-level roles in process operation and logistics. The absence of technical knowledge, safety awareness and familiarity with industrial work environments made it difficult for them work in these industries.
- Traditional education pathways had failed to reach this group effectively. Many participants had limited formal education or had been out of structured learning environments for a long time. A conventional classroom-based program would likely not be suitable or effective.

Given these findings, the designer had to determine whether an educational approach could provide a meaningful solution. A formal education program on its own would not be sufficient; however, a practical, hands-on learning model integrated with the workplace could provide a realistic and effective pathway to employment. It was concluded that an educational intervention would be viable, provided that it:

- Took place within the work environment, ensuring direct exposure to real-world job tasks.
- Followed an apprentice-mentor model, allowing participants to learn from experienced workers.
- Included structured, job-specific instruction provided on-site by a regional vocational education institution.
- Focused on relevant technical and soft skills, preparing participants for basic roles in process operation and logistics but also helping them in coping with everyday life.
- Avoided unnecessary formal assessments/test, ensuring accessibility for individuals with limited prior education.

Additionally, the local government would support and facilitate the participants on a case-by-case basis based on their needs and challenges.

With this approach, education would not only address skill gaps but also increase workforce participation, helping both businesses and the local government achieve their goals e.g. a reduction in open vacancies (outstanding job openings reduced by 30%, 50 vacancies filled) for businesses and a reduction in government dependency and reducing local unemployment (-3%) for the municipality. The stakeholders evaluated if their ambitions matched before committing to them.

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Field 2 and 3: Behaviour and Skills/competences

Figure 4. Underlying questions in the Eight Fields Model - Field 2 & 3

Analysing required knowledge, skills & attitude for the future job

These fields of the model focus on defining the *future (work) situation* and identifying what participants need to be successful and effective in that context.

Exploring the challenge and determining whether a learning intervention is needed gives the designer an initial understanding of what must change in the work context to achieve the goal. In Field 1: Goals/problems, page 21, we saw that the need for learning is partly determined by the question: do participants require new knowledge and skills to realise the desired changes in their work, or to adapt to the future context? If the answer is *yes*, the next step in the design process is to explore the specific knowledge, skills and attitudes required.

There's no sharp divide between analysing the (future) work context and analysing the knowledge and skills associated with it. It is difficult to separate what people need to know and do from the environment in which those competences are applied. In fact, analysing one helps reveal more about the other. This is a strength of the process, it allows the designer to build a more complete and grounded understanding of what the educational intervention should include. Moreover, such analysis also helps identify what *additional* factors (beyond learning) must be in place to support the successful application of new knowledge and skills in real work situations.

This chapter outlines several methods for analysing knowledge and skills. Each method's suitability is explained in relation to the type of activities under investigation. The chapter also shows how to describe and document knowledge and skills in a way that provides a solid foundation for the next stages of the design process.

Before diving into the methods, however, we first explore what this analysis step delivers, because its importance extends beyond technical insight.

While the main outcome is, of course, a better understanding of *what* needs to be learned, the process of analysing knowledge and skills together with stakeholders also offers relational benefits. It strengthens mutual understanding and brings diverse perspectives into the conversation, laying the groundwork for a more effective and collaborative design process.

Desired outcomes of analyses

Those aiming to make a real impact within an organisation through learning should begin with a thorough analysis of knowledge and skills, commonly referred to as task analysis. If you investigate the available literature and resources, you'll notice a variety of terms used to describe this process, sometimes inconsistently. For instance, training needs assessment focuses on identifying which skills should be trained; job analysis centres on mapping responsibilities, tasks and required competences within a profession; while work analysis shifts the lens from the profession itself to the tasks being performed.

We align with this last perspective: at this stage in the process, the focus is on analysing the work to be done and the knowledge, skills and attitudes needed to do it effectively. By work, we mean not only tasks carried out within organisations but also projects executed by freelancers, external contractors, or other actors operating in various professional settings.

This type of analysis is most effective when the designer:

- Clearly specifies the knowledge, skills and attitudes participants need to perform (or adapt to changes in) their tasks within an organisational or societal context. Without this foundation, learning interventions often remain too generic and fail to connect meaningfully to the future (work) context and the actual responsibilities of the target audience.
- Establishes evaluation criteria that clarify when participants have sufficiently mastered the intended competences.
- Identifies both supporting and obstructing factors that may affect how easily the desired competences can be acquired and applied in practice.

As mentioned earlier, analysing the knowledge and skills required for work doesn’t just clarify what participants need to learn. It also uncovers the broader environmental factors that support, or hinder, the successful application of those competences. These might include things like organisational strategy, available tools, or existing workflows. Both dimensions, what needs to be learned and the context in which it must be applied, are critical building blocks in the design process. Without this information, a designer may create a technically sound programme that targets the wrong competences or fails to address barriers in the workplace that prevent their application.

When it becomes clear that the work environment itself contains obstacles to learning or applying new skills, such as a lack of time, limited feedback, or no room for reflection, those findings must be addressed. Learning cannot thrive in a vacuum. Conditions like mentoring, coaching, opportunities for practice and structured feedback loops are essential for a rich learning environment.

If these conditions are absent, it is the designer’s role to advise the commissioning organisation on how to adapt the work environment to better support the learning process.

This could involve creating dedicated space for experimenting with new behaviours alongside a peer or mentor or regularly setting aside time for team-based reflection on how work is done and what each person needs to grow. In these instances, the designer shifts into the role of advisor, helping clients consider how learning and working can be integrated meaningfully.

This stage of the design process leads to a clearer understanding of the learning goals and the conditions that influence their realisation. It enables a more precise answer to the question: what knowledge and skills are required to achieve the desired changes in the future work context, or to meet its demands? It also gives the designer sharper insight into how to measure whether those competences have actually been developed. And crucially, it highlights the factors that can either support or obstruct their development and application.

Beyond these analytical outcomes, this phase offers relational benefits as well. Many of the methods described in the following sections involve meaningful conversations between the designer and stakeholders in the learning programme. These discussions allow individuals to share their experiences, expectations and perspectives on the demands of the future work context, and how best to prepare for them. Such dialogue fosters shared understanding around the goals of the learning programme and creates a strong foundation for collaboration.

Collaborative analysis strengthens engagement, even among stakeholders working in different locations. It also expands the designer's social network, as well as that of the participants, through the exchange of insights and connections.

In this way, the analysis yields not just technical insight, but also valuable relational outcomes: a shared understanding of the goals of the educational intervention and the means of achieving them. This external alignment adds real value to the ongoing design process and increases the chances of successful implementation later.

Methods of analysis

Analysis methods are structured techniques which are used to collect, analyse and interpret data that help to understand processes, behaviours or facts. These methods can range from qualitative techniques such as focus groups and interviews to quantitative approaches such as surveys. By using these analysis methods detailed insights can be gathered, hypotheses tested, or systems evaluated to make informed decisions, solve problems, or improve processes.

How they work

Analysis methods generally follow a structured approach that can be broken down as such:

1. Defining the Objective
2. Selecting the Method
3. Data Collection
4. Data Interpretation
5. Drawing Conclusions

Why they are useful

Analysis methods are essential for both decision-making and research, as they offer structured, step-by-step approaches for generating meaningful insights. In the context of training programmes, these methods play a key role in ensuring that the programme aligns with the priorities, experiences and needs of the trainees.

They allow trainers to gather input and perspectives from a range of stakeholders, such as trainees, employees, managers and subject-matter experts. Involving these stakeholders in the analysis process not only enriches the content but also helps foster a sense of engagement and ownership.

Moreover, analysis methods contribute to tailoring the training content to address specific skill gaps and practical challenges. This enhances the effectiveness of the intervention, making it more likely to improve performance in the daily tasks of participants. Finally, some methods can also be used to test and validate assumptions early on, helping to prevent costly misalignments between the training design and stakeholder expectations.

Overview of recommended methods

Table 1. Overview of methods for analysing knowledge and skills, offers an overview of the applicability of several commonly used methods for analysing knowledge and skills. It shows how well each method suits different types of tasks, details that will be discussed later in this chapter.

In addition, the table highlights the extent to which each method produces relational outcomes, thereby contributing to external consistency. In the context of learning programme design, external consistency refers to how well the programme aligns with the external environment in which it is implemented. This includes ensuring the programme meets the needs, expectations and characteristics of the organisation, the target audience and the broader context in which learning takes place.

	Suitability of the method per task type			
Analysis method	Routine tasks	Problem solving tasks	Future tasks (not existing yet)	Contribution to external consistency
Document study	+	+	+	-
Shadowing and thinking aloud	++	++	-	
Critical incidents-method	-	++	+	++
Interview on characteristic practical situation	++	++	+	+
Guerrilla research	+	++	-	++
Focus groups	-	++	-	++
Performing the work oneself	++	+	-	-
Survey	+/-	-	-	-
Simulation	-	++	++	+

Table 1. Overview of methods for analysing knowledge and skills

Routine tasks are tasks that are frequently repeated and follow a fixed, standardised procedure, such as monitoring fermentation parameters in a bioprocessing plant or logging field data for agricultural trials. Because these tasks are relatively straightforward, analysing them may only require shadowing an operator and conducting a short interview, supported by documentation on the work process.

Problem-solving tasks are more complex and require workers to interpret and respond to variable situations, such as a biorefinery technician troubleshooting a processing issue, or an agronomist diagnosing the cause of unexpected crop failure. As the overview shows, multiple analysis methods are suitable for this type of task.

Future tasks refer to tasks that do not yet exist at the time of analysis but are expected to emerge with the introduction of new technologies, services, or products, for example, through the implementation of AI in precision farming, synthetic biology applications, or circular bio-based production systems. Since these tasks cannot yet be observed in practice, simulations are often the best way to explore the knowledge and skills they may require.

Aside from effectiveness, the time and cost required for research often influence the choice of method. Surveys, for instance, are usually faster, more affordable and easier to administer than gathering people for a group discussion on knowledge and skills. These practical advantages, especially the ability to reach large groups, are likely why surveys remain such a popular analysis tool.

However, surveys have notable limitations. They don't allow for follow-up questions, deeper exploration, or uncovering unexpected factors in real time. Furthermore, designing a high-quality survey and analysing its results can be more time-consuming and complex than initially expected.

Finally, the potential relational value of a method should be considered. Shared understanding is more likely to emerge when people engage in direct conversation during the analysis process, as is the case with methods like critical incidents or focus groups. These approaches not only produce data but also foster alignment among stakeholders.

Document Study

This method involves systematically reviewing and analysing documents, such as memos, reports, policy papers, scientific literature and other materials deemed relevant to the topic at hand. Often referred to as desk research, its goal is to gather useful information that can support and inform the study.

For example, a researcher might investigate which skills are critical in the context of biobased textile production by examining existing reports and academic publications. However, the usefulness of this method depends on the quality and availability of the documents; limited or outdated sources may constrain the depth and reliability of the analysis.

Shadowing and Thinking Aloud

Shadowing involves observing someone in their natural work environment as they carry out tasks. The thinking aloud component adds a verbal dimension: the person being observed narrates their thoughts as they work. This allows the observer to gain insight into the individual's cognitive processes, emotional responses and decision-making. This method is particularly useful for understanding behaviour, uncovering problem-solving strategies and identifying implicit knowledge that may not be easily articulated.

Critical Incidents Method

The Critical Incidents Method focuses on identifying specific events or behaviours that have a significant positive or negative impact on a particular outcome. Participants are asked to recall and describe these events in detail, including the actions taken, the surrounding circumstances and the results. By analysing multiple accounts, researchers can identify patterns and underlying dynamics. This technique is widely used in fields such as psychology and customer service, but it can also be valuable in optimising biobased production processes and improving quality.

Interview on Characteristic Practical Situations

This method provides in-depth insights into how people solve problems and respond to routine situations in real-life contexts. Participants are asked to describe specific experiences from their work or daily activities, focusing on the decisions they made, the challenges involved and how they handled them. The strength of this model lies in its practical grounding, offering highly relevant data directly linked to the participants lived experiences.

Guerrilla Research

Guerrilla research is conducted in informal, everyday environments, such as public streets, cafés, or shopping centres. Researchers spontaneously engage with people to ask questions or test prototypes. This approach is cost-effective and does not require formal settings, making it especially useful in the early stages of product development or user experience research.

Focus Groups

Focus groups involve structured discussions with a group of participants (typically 6 to 12), guided by a facilitator. Participants share their views, experiences and ideas on a given topic. The group dynamic encourages interaction and idea exchange, often generating collective insights that differ from those produced in individual interviews. Focus groups are especially useful for exploring attitudes, preferences and perceptions. However, group composition can influence outcomes, dominant personalities or social pressure may shape responses.

Performing the Work Oneself

In this method, the researcher actively engages in the task or job being studied. By performing the work firsthand, the researcher gains a direct understanding of the processes, challenges and thought patterns involved. This immersive approach can reveal inefficiencies, pain points, or improvement opportunities that may not be apparent through observation alone. It is particularly valuable when the goal is to develop a deep, experiential understanding of a specific phenomenon.

Survey

Surveys consist of structured questionnaires distributed to a targeted group of people. They can collect both quantitative data (e.g., multiple-choice responses, rating scales, yes/no answers) and qualitative data (e.g., open-ended responses). Surveys can be administered online, in person, or by phone. They are useful for gathering information about behaviours, opinions, preferences, or demographics. With a sufficiently large sample size, results can be subjected to statistical analysis. However, poorly designed questions can introduce bias and compromise the reliability of the findings.

Simulation

Simulation involves creating a realistic model of an environment, system, or process in order to study its behaviour under various conditions. Simulations can be conceptual, digital, or physical and are often used to train participants, predict outcomes, or test scenarios in a safe and controlled setting. For example, a CAD 3D model might be used to simulate how a structure would behave once constructed, based on physical constraints. The strength of simulation lies in its ability to replicate complex, high-stakes situations with minimal cost and risk compared to real-world testing.

Knowledge skills & attitude (competences) as starting point for educational interventions

The analysis methods described above each offer insights into the nature of work and the skills required, each in their own way. Within the Eight Fields Model, a distinction is made between the work situation and skills, represented in two separate fields. The work situation field focuses on (desired) changes in the work context, while the field beneath it zooms in on the competences needed to function effectively in that (future) context.

This distinction is important. However, as noted in the introduction to this chapter, the two areas often overlap in practice. It is rarely possible to analyse the work context thoroughly without also considering the knowledge and skills required to operate within it. Likewise, examining competences in isolation becomes an overly abstract exercise if the context in which they will be applied is not considered.

In other words, any discussion of specific knowledge and skills is always grounded in what people are, or will be, expected to do in a specific (work) setting.

When it comes to the bioeconomy in particular unique skills that can be considered in the development are:

- Connection to nature and the physical world/surroundings trough field studies
  - Nature Based Solutions involvement
  - Biomimicry
  - Bionics
- Behaviours required
  - Curiosity
  - Trying to find a common vocabulary
  - Communicating about your own skills and field in an understandable language
  - Risk awareness and critical thinking
  - Leadership that helps overcome resistance
- Creating & contributing to a holistic vision
  - Co-creation with multiple stakeholders
  - Context awareness in complex environments

Rich Context Descriptions

The use of different analysis methods aims to generate rich, context-specific descriptions of knowledge and skills. After all, *context shapes the way knowledge and skills are applied*, it determines what is needed for someone to act effectively in each work situation.

Take, for example, the ability to chair a meeting. While it is a general skill that also draws on specific knowledge, how it plays out can vary significantly depending on the context. Whether someone is considered an effective chair depends on the setting and the circumstances in which those skills are used. The knowledge and skills an art director needs to guide a creative discussion among advertising professionals are quite different from those required of a CEO leading a board meeting at a biorefinery.

Similarly, customer-focused work looks very different for a salesperson in a natural soap shop than for a consultant at a bio-based engineering firm.

Keeping the specific context in mind helps prevent knowledge and skills from being described in vague or generic terms that feel disconnected from real work environments. This is a common risk when skills are summarised in generalised competency profiles, as is often the case in large organisations and educational institutions. Without context, these profiles can become abstract and unrecognisable to those doing the work.

Analysing knowledge and skills

An important part of a designer's craftsmanship is the ability to design effective learning situations and choose learning methods that assist learners in acquiring the identified knowledge and skills. To create an effective design and to make the right choices, it is important to analyse the discovered knowledge and skills further. The elements of a skill largely determine the organisation of the learning process necessary to develop that skill.

To act effectively in a (future) work situation, a combination of knowledge, skills and attitude is required. For example, the knowledge and skills to advise a new customer on a suitable disability insurance require, on one hand, the ability to engage in conversation with the customer and gain a clear understanding of their personal situation, desires and needs. On the other hand, it's important that this person has solid knowledge of the products offered by insurers and their characteristics, opportunities and risks, so that the customer's question and the offer can be matched. Additionally, knowledge about social security and labour law is important. Making a distinction between knowledge and skills helps the designer choose and shape an appropriate learning strategy.

For example, expertise in and knowledge about various insurance products can be effectively offered through individual e-learning. But for developing the skill to conduct an effective advisory conversation from a professional and integral standpoint, other forms are more suitable. Forms that help master the skills needed in this situation (such as identifying customer needs or explaining different options clearly). Think of feedback from an experienced colleague after each customer conversation in the first month of work or a role play with an actor. The learning process becomes particularly powerful when these forms are cleverly connected so that the skill is practiced. The role play then extends beyond just practicing advisory and conversational skills, as the learner is also required to present professional expertise clearly during the conversation.

Considering the various elements within a competence (knowledge, skill and attitude), the designer constructs an effective combination of educational interventions to help individuals develop that skill. The elements of a skill must therefore be distinguished from each other, but not separated or isolated. If that happens, there is a high risk of creating a fragmented learning process or allowing certain elements to dominate in that process. This latter scenario often occurs with the ‘knowledge’ element. A complex skill requires thorough knowledge (expertise), making it tempting to allocate a substantial block of theory in an educational intervention. However, the focus should not be on whether someone possesses a lot of knowledge, but rather on whether that person can apply that knowledge: whether the quality of someone's actions is influenced (for the better) by that knowledge.

Design examples – Field 2 and 3: Behaviour and Skills/competences

Example one

In this field the designer sets out to determine what the 'future' looks like in terms of shown behaviour by participants and what competences are required for that. The designer is dealing with policy makers spread out over certain region and acting on different governmental levels. Looking at the analysis tools available the designer chose to conduct document studies (looking at policy and policy making processes). Several interviews with top level officials and regionals officials regarding the policy making process & operationalization were undertaken. Furthermore, the critical incidents method was used to analyse two policy making case studies. Additional specialists on the bioeconomy were interviewed regarding their take on how bioeconomy could fit in policy making processes and what knowledge would be required and policy experts from a university programme in governance were asked for their view on the matter. Looking at the outcomes of the analyses it was determined that in terms of competence the main focus was on knowledge, not so much on skill or attitude. Regarding the 'future work situation' it was determined that the policy design process should incorporate bioeconomy considerations and the policy maker creating policy should possess the required knowledge needed to make 'good' policy and display this capacity when creating policy. This is where the attitude part of competence plays a part. This reinforced the belief that an educational intervention was the way to go.

Example two

The goal of the educational intervention was to prepare participants for entry-level roles in process operation and logistics, ensuring they could function effectively in an industrial work environment. To determine what the future work situation would look like and what competences were required, the designer worked closely with business managers, vocational education experts and industry mentors from the participating companies. To gain insight into the specific skills and behaviours needed for success, the designer used the following methods together with stakeholders:

- Document study, analysing existing job descriptions, training materials and safety regulations to understand the formal requirements of the roles.
- Interviews with current management, to identify key expectations for new hires and common skill gaps observed in the hiring process.
- Interviews with employees in similar roles, to understand the day-to-day realities of the job, the most critical competences and the challenges new workers typically face.

The industrial park consists of chemical and agricultural industries, where employees work in structured, process-driven environments. The work is largely practical and operational, with an emphasis on safety, efficiency and teamwork. Employees are expected to follow standard procedures, handle basic machinery and materials and work in a team-based setting under the supervision of more experienced staff.

Shift work is common and depending on the specific company, employees may be expected to work rotating schedules or perform physically demanding tasks.

In this future work situation, participants are expected to:

- Perform basic operational and logistical tasks, such as moving materials, operating equipment at an entry level and assisting in monitoring production processes.
- Follow strict safety protocols, as industrial environments involve hazardous materials, complex machinery and regulated work processes.
- Communicate effectively in a workplace setting, including understanding and following instructions from supervisors and collaborating with colleagues.
- Demonstrate reliability, including punctuality, task completion and the ability to work within a structured environment.
- Adapt to workplace routines and expectations, especially for participants who have little to no prior experience in formal work settings.

To succeed in this work environment, participants need to develop three core competence areas:

Technical Skills

- Understanding basic industrial processes relevant to chemical and agricultural industries.
- Operating entry-level machinery and logistics equipment.
- Applying workplace safety regulations and recognizing potential hazards.

Soft Skills

- Workplace communication, particularly following instructions and seeking clarification when needed.
- Professional behaviour, including teamwork, responsibility and respect for workplace norms.
- Adaptability, as participants must adjust to the structured and regulated nature of industrial work.

Workplace Readiness

- Understanding basic work discipline, including punctuality, meeting productivity expectations and accepting feedback.

By clearly outlining the future work context and required competences, the intervention was designed to help participants transition effectively into industrial employment.

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Field 4: Learning situation

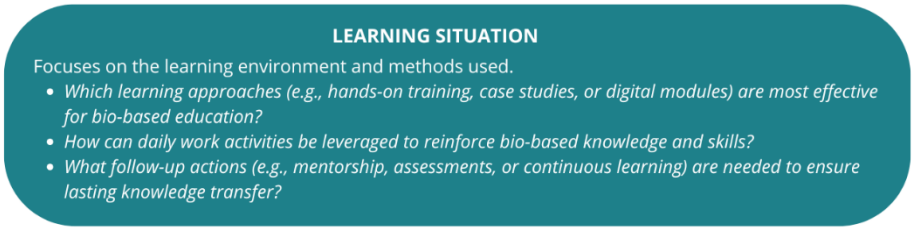

Figure 5. Underlying questions in the Eight Fields Model - Field 4

Making the global design & developing educational interventions

Within the step-by-step approach designers follow when addressing a learning need, we now arrive at the step of designing a learning environment where learners can acquire the intended competences. The key question is: *How can we ensure that participants develop the knowledge and skills they need to perform effectively in a changing work context?*

This brings us to the bottom-left field of the Eight Fields Model: *designing an educational intervention*. At this stage, the designer begins by developing the overall structure, or blueprint, of the learning path. This global design outlines the main components of the intervention and how they work together to support learning.

Figure 6. The Eight Fields Model steps

At this stage, the focus shifts to designing the broad outlines of the interventions needed to support the learning process. In fields like architecture or industrial design, this would be referred to as the preliminary design or sketch design. For learning designers, the challenge is to create an effective, coherent programme that enables learners to develop the desired competences.

This phase involves selecting appropriate learning principles, determining where learning should take place and shaping the components into a compelling, logically structured and feasible programme. By the end of this step, the designer has created a kind of narrative, a high-level overview of how the participant will engage with the workplace, training and other learning activities to achieve the intended outcomes.

This chapter provides key elements to support the creation of such a narrative and to develop a global design. The main design choices to be made include:

- Learning theories and principles: What is the underlying perspective on learning? Which approach best aligns with the learning need?
- Learning context: Where should learning take place? What environments are most suitable?
- Learning sequence: When should learning occur? What is a logical and effective order?

After exploring these three themes, special attention should also be given to the following aspects:

- Designing inclusive learning experiences for marginalised groups
- Integrating art into the design and delivery of educational interventions
- Applying biomimicry as a guiding design principle

Finally, as noted in the chapter Governance for educational designers, page 11, it is recommended that designers collaborate with educational institutions, ideally as part of a quintuple helix configuration. This helps acquire access to the specialised knowledge and skills required to design high-quality educational interventions.

Principles and theories concerning learning

By collaborating with educational partners, a foundational level of pedagogical expertise is ensured. Still, it remains essential to consider recent insights into how training participants learn and how this should shape design decisions. Based on the types of knowledge, skills and attitudes to be developed, and the *future (work) contexts* in which they will be applied, designers must select appropriate guiding principles for the training programme.

Once the required competences have been identified through learning objectives and work analysis, attention turns to structuring the training programme. (In practice, first design ideas often begin to emerge during the analysis phase.)

The designer's perspective on learning strongly influences this process. For instance, a designer who views learning as the acquisition of factual knowledge will structure a programme differently from someone who sees learning as a process of co-constructing meaning within work environments.

It is therefore critical for designers to reflect on their own beliefs about how learning occurs in organisational settings, and to consider what these beliefs imply for the programme's design. Below, we outline several learning theories that can inform this phase.

Learning seen as programming behaviour: Behaviourism

Behaviourism focuses on observable behaviour change and assumes that learning is best achieved through repetition, reinforcement and feedback. Desired behaviours are rewarded; undesired ones are discouraged. Programmed instruction and immediate feedback guide the learner through a step-by-step process. The internal mental process, what happens "inside the black box", is not a concern within this theory. The emphasis lies on doing, practising and responding to clear stimuli.

Learning as information processing: cognitivism

Cognitivism emerged in response to behaviourism's neglect of internal processes. It focuses on how people receive, store and retrieve information. Learning is seen as a cognitive activity: acquiring, organising and integrating knowledge. Cognitivists often compare human learning to how a computer processes information, input, storage and output.

Cognitivism has significantly contributed to our understanding of how to link new information to prior knowledge, organise learning content into mental models and account for memory limitations. However, it can also create a rigid divide between *thinking* and *doing*, increasing the risk of separating theory from practice.

A modern extension of this theory is brain-based learning, which applies emerging insights from neuroscience to align educational methods with how the brain functions. While still rooted in cognitivist principles, it focuses more explicitly on how biological processes influence learning effectiveness.

Learning through doing and experiencing: pragmatism

Pragmatism views learning as something that happens through experience, especially through engaging with real-world problems and reflecting on them. It developed in part as a response to the over-theorisation seen in cognitivism. Pragmatic approaches bring learning back to practice, placing concrete experience and iterative experimentation at the centre of the learning process.

Learning through collaboration: social constructivism

Social constructivism holds that learning emerges through social interaction. Knowledge and skills are developed collectively, through dialogue, shared experiences and co-construction. Learners actively participate in knowledge creation by engaging with others in their environment.

While often used interchangeably, constructivism (without the "social" qualifier) focuses more on individual meaning-making, whereas social constructivism emphasises the communal nature of learning.

Learning through networking and building connections: connectivism

Rooted in social constructivism, connectivism reflects today's highly networked, fast-changing world. It recognises that knowledge rapidly evolves and becomes outdated, making it less about *what* you know and more about *who* you know, *where* to find new information and how to apply it.

Connectivist learning design focuses on enabling learners to access and strengthen knowledge through networks, particularly in and around the workplace. In this view, the ability to continuously acquire and update knowledge is a core competence.

Learning by engaging and enhancing talents

Traditional training often followed a *gap-oriented* model: identifying what someone lacks and focusing on overcoming that deficit. Since the early 2000s, however, talent-based approaches, drawing on positive psychology, have gained traction.

This perspective focuses on recognising and building on individual strengths. Rather than asking "*What is missing?"* it asks, "*What is already strong and how can we grow it further?*" Research suggests that focusing on strengths enhances well-being, productivity and innovation at both individual and organisational levels. In practice, this means designing learning opportunities that develop existing talents and use them as a springboard for mastering new roles or tasks.

Perspective on learning as a guide in the global design

As a designer, you can use these theoretical lenses to inform the global design of a learning programme. While the descriptions above are intentionally simplified to highlight key differences, they demonstrate the diverse range of perspectives available.

There is no one-size-fits-all theory. Each learning challenge, and each learner group, may call for a different approach. For example, designing a process for acquiring job-specific knowledge might benefit from cognitive principles; building a sales pitch might call for a pragmatic approach involving practice, reflection and iteration; and behaviourist principles may be useful for tasks requiring precision and consistency in performance.

The key is not to let personal preference dictate the approach, but rather to match learning principles to the goals, learners and context at hand.

Aligning the approach with the type of question

Views on learning form the foundation for making informed design choices. The learning perspective a designer adopts is highly influential, shaping everything that follows. As case studies demonstrate, a training programme grounded in connectivism looks very different from one based on cognitivist principles.

When selecting a learning approach (or combination of approaches), designers can draw on scientific research and the extensive body of evidence supporting each theory. While we won't explore that evidence in depth here, what matters is that the designer is aware of the key learning principles, understands their theoretical roots, and, crucially, can relate them to the central learning question.

This final point, choosing the approach that best fits the learning need and its context, is essential in shaping an effective global design.

To summarize:

- A behaviourist approach works well in stable work environments where standardised, routine behaviours are required.
- Cognitivism is suited to situations where formal knowledge needs to be made accessible and applicable.
- A pragmatic approach is ideal when the focus is on developing practical, experience-based understanding.
- A social constructivist perspective is appropriate for challenges that require collaborative problem-solving and co-creation of knowledge.
- Connectivism is particularly relevant in fast-changing work environments that call for engaging (international) experts across organisational boundaries to tackle complex, evolving problems.

Learning context: Formal & informal learning

In this section, we explore a key consideration in global design: the learning context. Specifically, we distinguish between informal and formal learning environments.

Informal learning takes place in the workplace. It is usually unplanned and often unconscious, yet it can yield substantial learning through hands-on work and collaboration with colleagues. In contrast, formal learning occurs outside the workplace, in classrooms, training centers, or structured programmes. Unlike informal learning, it is intentional, planned and often leads to certification or accreditation.

While these two forms of learning are sometimes viewed in opposition, they are best seen as complementary. Many effective learning experiences combine elements of both. For this reason, designers should not treat them as mutually exclusive. Instead, the goal is to find the right balance based on the nature of the learning objectives and the workplace context.

One helpful model to support this thinking is the 70:20:10 framework.

The 70:20:10 framework

The 70:20:10 model (Adapted from Arets, Heijnen & Jennings, 2015), has gained traction in recent years as a practical guide for workplace learning. It suggests that:

- 70% of learning occurs informally, through daily tasks and hands-on experience
- 20% comes from collaboration, feedback, observation and peer learning
- 10% is gained through formal training, courses and structured education

The numbers are not meant to be prescriptive or imply that formal learning is less valuable. Rather, the framework highlights that most learning happens on the job or through social interaction, areas often under-recognised in traditional training models.

Although the scientific basis for these specific percentages is limited, the framework is widely appreciated for raising awareness about the importance of informal and social learning. It provides a common language for discussing learning strategies with stakeholders, even those outside the field of education.

Formal learning outside the context of the workplace

When people are asked to describe learning in the context of their work, they often refer to courses, workshops, instructors, exams and diplomas. This traditional view of learning, rooted in formal education, still dominates how many people think about professional development.

While formal learning certainly has its place, this narrow perspective can overshadow the value of informal and experiential learning. That said, there are still important situations where formal, off-the-job training is not only appropriate but necessary. In the sections that follow, we outline several compelling reasons to include formal learning interventions as part of a well-rounded design.

When the risk of errors is too high

A training centre can provide a safe environment to practise new skills without putting people, equipment, or the environment at risk. In the bioeconomy, a good example is a bioprocess technician learning to manage fermentation systems that involve pressurised vessels, bio-reactive substances, or strict contamination controls. Mistakes in such settings could lead to costly production downtime, or worse, safety hazards for staff and environmental harm.

Formal learning environments make it possible to simulate these processes under controlled conditions. For instance, technicians of a biorefinery can practise emergency shutdown procedures or hazardous material handling using digital simulators or mock-up labs, without the consequences of real-world failure.

The same logic applies to soft skills. Communicating complex sustainability trade-offs with clients or stakeholders can have reputational or business consequences if handled poorly. Practising such conversations in a formal training setting, through role play and feedback, reduces the risk of errors during real interactions.

Skilled learning designers understand that certain learning goals come with real-world risks. When practising in the workplace carries a high chance of harm, to learners, co-workers, customers, or the organisation, it is often best to rely on formal, off-the-job training.

Ensuring unique, extensive and uninterrupted practice opportunities

Some skills are difficult to master simply because the opportunity to practise them rarely arises in day-to-day work. In such cases, learners need access to alternative environments where they can build confidence and competence through repetition.

Take, for example, a lab technician in a bioplastics facility who needs to learn how to troubleshoot rare but critical process failures, such as contamination events during polymer synthesis. These situations may only occur once every few years, but when they do, response time and accuracy are crucial. Practising these procedures in a simulated lab setting can dramatically improve readiness and reduce the risk of production downtime or material loss.

The same principle applies to skills that require extensive repetition to master. Consider a drone operator in precision agriculture learning to identify subtle signs of plant disease from aerial imagery. If the opportunity to analyse relevant cases only comes up sporadically during the growing season, it would take years to develop fluency. Structured practice, using curated datasets, annotated examples, or simulated missions, can accelerate this process.

As with advanced wood carvers refining complex techniques, some skills demand targeted, uninterrupted practice to reach a high level of precision. And the workplace is often not well suited for this. Interruptions from colleagues, emails, or environmental distractions can make it hard to focus on learning.

Thankfully, more practice opportunities are becoming available through digital means. Designers can build online libraries of images, videos, or case simulations for roles such as machine operators in bio-based production lines, allowing them to practise fault recognition and response strategies. Simple simulators can also support routine and emergency scenario training for roles like bioreactor operators or logistics planners working with temperature-sensitive bio-based goods.

Still, some skills are best developed through direct interaction with instructors or peers. For instance, a sustainability advisor preparing for high-stakes stakeholder meetings may benefit from role plays and expert feedback to refine communication techniques and manage emotional dynamics. These sessions create a safe space to test and improve responses before facing real clients or partners.

In short, when the workplace doesn't provide enough frequency, focus, or freedom from risk to support effective practice, formal learning environments become a valuable part of the global design.

Deliberately creating a learning-rich environment

Games and simulations are powerful forms of formal learning that enable participants to practise and demonstrate new skills in realistic, high-pressure scenarios, often in ways that aren't feasible in the workplace. These controlled environments allow learners to experience the complexity and urgency of real situations, without the associated risks.

In the bioeconomy, this approach is particularly valuable in areas where workers must make fast, high-stakes decisions, such as in bio-based production facilities, bioreactor maintenance, or supply chain coordination for temperature-sensitive goods.

For example, a bio-based chemical plant might simulate a contamination incident requiring operators to take rapid corrective action to avoid environmental discharge or equipment damage. A simulation environment can mimic system behaviour under failure conditions, testing both technical response and communication under pressure.

These types of learning experiences build not only technical competence, but also decision-making, stress resilience and teamwork, critical capabilities in bioeconomy roles that involve managing complex, dynamic systems.

In short, well-designed simulations lend themselves well to bioeconomy contexts where safety, speed and precision matter, and where learning by doing in the real world may simply be too risky.

Examples of formal educational interventions

- Self-study: article, book, e-book, wiki, video, blog, vlog, app
- Workshop, training
- Conference, congress, study day, lecture
- Learning programme, course, education, class
- Virtual classroom (online learning, synchronous: participants and facilitators are online simultaneously and interact)
- E-learning
- Game
- Simulation, skills lab, role play
- Webinar
- Massive Open Online Course (MOOC) with open enrolment
- Small Private Online Course (SPOC) in a closed environment
- Lecture design collections for educators such as the book Building Tomorrow by Jacobs et al (2022)

Disadvantages and objections to formal learning

While formal learning programmes offer important benefits, they also come with notable drawbacks, especially when the learning environment is disconnected from the workplace.

One of the most widely recognised issues is the transfer problem. Formal, off-the-job learning often takes place in environments that differ significantly from where the new competences are needed. As a result, training participants may struggle to apply what they've learned when they return to their day-to-day roles. This challenge, how to ensure learning transfers to real-world performance, is considered by many learning and development professionals to be one of the most critical hurdles in training effectiveness.

Much has been written about strategies to bridge this gap. Designers can take steps to support the transfer of learning, for example, by incorporating simulations, workplace assignments, or follow-up coaching. However, when the risks or costs of poor transfer are high, it may be more effective to design learning experiences that take place in or near the workplace from the outset.

Another common limitation of formal learning is its tendency to be designed for the "average learner", a concept that, in reality, doesn't exist. Formal programmes often group participants with diverse learning needs, backgrounds and preferences. Because it's difficult to tailor instruction to everyone in such settings, there's a risk that the training will miss the mark for some participants, reducing both engagement and impact.

Beyond these educational concerns, practical challenges also play a role. Formal learning interventions typically require substantial planning, coordination and lead time. As a result, it can be difficult to align training with the moment an issue arises. In some cases, a course may not run until enough participants are enrolled, meaning some people may receive training too late to address an urgent need.

Finally, formal training can be expensive. In addition to design and delivery costs, such as trainers, venues and materials, there are also displacement costs: time away from work, travel and lost productivity. These factors make it essential to weigh the added value of formal learning against its cost and timing constraints.

Informal learning in the context of work

Many professionals in our field, motivated in part by the limitations of formal learning, are actively exploring ways to better integrate learning with work. And with good reason. Embedding learning within day-to-day activities offers several compelling advantages.

Below, we highlight key opportunities and benefits of aligning learning more closely with the workplace.

The workplace as the most effective learning environment

"The workplace is the most powerful learning environment" has become a widely shared view, and for good reason. Learning and development (L&D) professionals are increasingly taking both the work context and the individual learner as starting points for designing learning activities.

When learning is disconnected from the work environment, not only does the transfer problem arise, but learners also miss the benefits of developing skills in authentic situations. Learning in the workplace makes it easier to apply new knowledge and skills because they are developed in the same context where they will be used. Competences constructed in direct interaction with one's work environment tend to be more relevant, durable and readily applied.

The key principle here is contextual alignment: the closer the learning context mirrors the real work context, the more effective the learning. When the goal is to develop work-related competences, the workplace is often the most appropriate place to learn.

This shift transforms the traditional transfer problem. Instead of learning "here" and applying it "there," the learning happens within the real-life situation, significantly improving retention and impact.

Research confirms that only a small portion of the competences required for most jobs, especially in dynamic fields, are acquired through formal learning. This is particularly true in the bioeconomy, where natural materials are often more variable and less predictable than fossil-based alternatives. For instance, bakers perfect their ability to judge the texture of specialty breads by practising directly in the bakery. Likewise, future executives develop leadership capabilities not in classrooms, but by holding key roles, receiving feedback and working with experienced mentors and role models.

The development of high-level professional expertise, or craftsmanship, happens primarily on the job. Mastery is built through repeated exposure to diverse situations, with access to expert colleagues and rich learning conditions. Whether workplace learning actually takes place depends on a few critical factors, including:

- Variety in tasks
- Opportunities for collaboration
- Direct interaction with customers
- Freedom to experiment
- Frequent and high-quality feedback
- Participation in innovation or improvement projects

When these conditions are met, the workplace becomes not just a location for learning, but the best environment for it.

Examples of informal educational interventions

- On-the-job tools (performance support): checklist, procedure, protocol, work instruction, manual
- Google, YouTube, Wikipedia, TED Talks, forums
- Social media networks: WhatsApp groups, LinkedIn, Yammer, X, Facebook, other online communities
- Working out loud: sharing your work so others can observe and contribute
- Mentor, coach, buddy, master-apprentice duos
- Shadowing: observing an experienced colleague or expert at work and questioning them afterward
- Challenging projects, new assignments
- Conducting research in your own organisation or with clients
- Brief daily meetings, daily stand
- Conducting experiments and innovation projects
- Collaborative mind mapping, brainstorming
- Testing prototypes
- Regularly taking time to reflect (online) with colleagues
- Observing colleagues (or competitors) in their work environment
- Giving, asking for and organising feedback
- Peer reviews
- 360° Feedback
- Changing team composition
- Leading teams, rotating leadership
- (Virtual) bulletin boards, idea boxes
- Writing a blog, article, or book
- Emerging in nature and learning from this (biomimicry)
- Creating a vlog
- Giving presentations
- Community of practice
- Peer consultation

It's important to note that informal and formal learning are not mutually exclusive. In fact, research by the Dutch Social and Cultural Planning Bureau (2016) shows that people don't necessarily engage in informal learning just because they're not enrolled in formal education.

Interestingly, the study found that formal education can have a positive influence on informal learning. People are often more capable of learning informally after attending a course or training. In other words, highly educated individuals, who have spent more time in formal learning environments, tend to engage more frequently and effectively in informal learning activities later. This highlights the importance of considering how different types of learning can complement and reinforce one another.

Informal learning: advising on the organisation of work

If learning in the (future) workplace is so powerful, then the rule of thumb for designers is clear: always begin by exploring how learning can be supported in the work environment itself. Only when those options are insufficient, for example, when safety is a concern, when extensive practice is required, or when workplace disruptions must be avoided should formal learning interventions be added to the design.

The more informal learning takes centre stage in a global design, the more important it becomes to shape the workplace as a learning environment. This requires a broader perspective from learning and development professionals. It's no longer just about designing effective training sessions, workshops, or e-learning modules.

A skilled designer also knows how to co-create interventions that foster learning within the flow of work. This could mean redesigning processes, facilitating peer learning, or introducing simple tools that prompt reflection or learning at the right moment. For instance, a well-timed message with a focused tip, sent just before a performance conversation, can help a manager lead a more effective development discussion, turning routine tasks into meaningful learning opportunities.

Learning sequence

Once the learning principles have been selected and the balance between formal and informal learning has been established, the next step is to consider the sequence in which learners engage with learning activities. The way learning is structured directly influences how effectively competences are developed, and how well learners can transfer knowledge into real-world performance.

There are several guiding principles for structuring learning pathways. Each offers unique advantages depending on the goals and context of the programme. Below, we outline three commonly used approaches that support the development of long-term or large-scale learning programmes in organisations.

Following the Work Sequence

One widely used approach is to align the learning trajectory with the natural flow of work. By mirroring how tasks are performed on the job, this method allows participants to build skills in a logical, experience-driven progression.

For example, in a training programme for bioprocess technicians, learners might begin with the selection and preparation of raw materials. From there, they would move on to fermentation or bioconversion processes, followed by training in monitoring bioreactors and adjusting process parameters. The programme would conclude with quality control, data analysis and product refinement. This step-by-step structure helps learners gain competence in the same order they will apply it on the job, making transfer more intuitive.

An alternative is to reverse the work sequence, starting with the end result and working backward through the steps that produce it.

This approach gives learners a clear understanding of the desired outcome from the outset, helping them develop curiosity and context for earlier steps. While experienced

professionals often take this broader perspective for granted, newcomers may benefit from structured guidance to build that understanding.

From Concrete to Abstract

Mastery in most professions involves being able to think and communicate about work in abstract terms. However, for novice learners, abstract concepts can be hard to grasp without first encountering real-world examples. Typically, beginners learn general principles after they've seen them applied in practice.

For instance, a circular economy specialist might begin by working on hands-on projects, such as repurposing agricultural waste for biogas production. Once familiar with these practical applications, they are better prepared to explore higher-level discussions on sustainability policy or economic models of resource efficiency.

In short: abstract principles only become meaningful when grounded in experience. That's why learning programmes often work best when they begin with practical case studies, real-life examples, or hands-on exercises, and only later introduce theoretical frameworks. This progression helps learners build a deeper, more durable understanding.

Concentric Learning

In many professions, tasks remain fundamentally similar but grow more complex over time. A concentric learning model structures training to reflect this progression: learners begin with the basics and revisit the same tasks at increasing levels of complexity as they advance.

Consider the work of a precision agriculture specialist, who regularly cycles through tasks such as soil analysis, applying targeted irrigation, using drones to monitor crops and analysing data to inform decisions. These activities occur whether one is managing a small organic farm or a large-scale commercial operation, but the complexity, scale and technology involved can differ greatly.

In a sustainable agriculture training programme, for example, beginners might start with manual soil sampling and simple visual crop assessments. As their expertise grows, they would progress to using remote sensing, geospatial tools and AI-based optimisation models. This gradual layering of complexity helps learners build confidence and capability step by step, supporting long-term competence development in a scalable way.

Applying the 80-20 Rule in Learning Design

In most professional roles, employees are responsible for a wide range of tasks, but not all of them occur with equal frequency. The well-known 80-20 rule suggests that around 80% of daily work consists of just 20% of all possible tasks.

Take, for example, a bioplastic production technician. While their responsibilities may include a broad spectrum of technical activities, the majority of their time is spent monitoring biopolymer extrusion or injection moulding processes. Less frequent, but still important, tasks such as troubleshooting mechanical issues or adjusting polymer formulations occur only occasionally.

When structuring a learning pathway, this principle suggests focusing first on mastering the 20% of tasks that account for the majority of job performance. Once learners are proficient in these high-impact areas, they can build out the remaining skills gradually, ideally through on-the-job experience as relevant situations arise.

By applying the 80-20 rule in learning design, programmes can be made more efficient and workplace relevant. Learners become productive more quickly and can integrate into their roles sooner. This approach also naturally supports informal, context-rich learning, allowing learners to refine uncommon skills while immersed in real work environments.

Talent-Oriented Learning Sequences

Learners tend to progress most effectively when training builds on their existing strengths. Leveraging natural talents not only enhances intrinsic motivation but also accelerates the acquisition of new competences. In fact, a learner's motivation before, during and after education is a strong predictor of learning success and should be considered when designing learning sequences (Colquitt, LePine & Noe, 2000).

By starting with tasks that learners already perform well, training boosts both confidence and engagement. This positive momentum fosters enthusiasm and energy, making it easier to tackle more complex or unfamiliar competencies over time.

For example, a sustainable food scientist with a strong background in microbiology might begin training by working on fermentation techniques for plant-based proteins. Once confident in this area, they could gradually expand into related domains such as food safety regulation, sensory analysis, or product commercialisation.

By aligning the learning journey with personal strengths, training programmes can create a more motivating, empowering and effective learning experience.

Introducing New Concepts Through Familiar Frameworks

An effective way to introduce new knowledge is by linking it to concepts learners already know. This structuring principle, often referred to as an advance organizer, offers a familiar mental framework to which new information can be connected, making it easier to understand, retain and apply.

For example, when training an algae cultivation technician to work with new strains for biofuel production, instruction might begin with species they already know. Learners can draw on existing knowledge about nutrient levels, light exposure and harvesting techniques and then adapt those principles to the new strains. This approach reduces cognitive overload and supports knowledge transfer to more complex systems.

Similarly, workers learning novel biomaterial production techniques may benefit from comparisons to traditional material processing methods. Once familiar parallels are established, learners can more easily grasp the unique properties and handling requirements of bio-based polymers.

By grounding new concepts in prior experience, this approach helps learners make smoother transitions and strengthens their ability to integrate and apply new information in practice.

Psychological Sequencing in Learning Design

A learning trajectory based on psychological sequencing prioritizes the topics that learners find most engaging or have the most questions or concerns about. By addressing these topics first, the design taps into learners' intrinsic motivation, creating a strong foundation for deeper and more sustained learning.

For instance, in a training programme for biomedical engineers working with new biodegradable implants, the course might not begin with a technical breakdown of material properties. Instead, it starts with hands-on experience in a bio-design lab, where learners can explore the implants' practical application in real-world contexts. This sparks curiosity and makes the learning immediately relevant.

Only after this experiential entry point do participants dive into the theoretical and material science aspects behind the product. By aligning with learners' natural interests and practical needs, psychological sequencing helps a smoother, more meaningful progression into complex content.

Designing educational interventions for marginalized groups

While educational interventions are often designed with the assumption that participants have equal access to education and resources, marginalized groups face structural barriers that require a different approach. These barriers may include financial constraints, limited access to technology, language differences, discrimination, or past negative experiences with education. If not addressed, they can hinder participation, motivation and ultimately, the effectiveness of the intervention.

A learning program designed with inclusivity in mind must go beyond simply providing access; it should actively remove barriers and create opportunities for success. This means considering factors such as flexibility, psychological safety, cultural responsiveness, digital accessibility and long-term career pathways. Below, we explore practical strategies to design educational interventions are truly inclusive and empower marginalized learners to thrive.

Reducing Structural Barriers to Participation

One of the first challenges marginalized learners face is accessibility, not just physical access, but the ability to engage in learning despite time constraints, financial limitations, or digital exclusion. A well-designed intervention adapts to these realities.

For many learners, attending a fixed-schedule training is not feasible due to work commitments, caregiving responsibilities, or transportation issues. Offering flexible learning formats, such as evening classes, weekend sessions, or self-paced modules, allows learners to engage on their own terms. Additionally, financial constraints can be a major obstacle, making it essential to provide scholarships, subsidized fees, or stipends that help cover costs such as transportation, childcare, or learning materials.

Digital exclusion is another critical barrier, particularly for learners who lack stable internet access, digital literacy, or access to the required devices.

Hybrid learning solutions, where online modules are supplemented with offline alternatives such as printed materials, in-person sessions, or smartphone-friendly content, helps lower digital barriers that can exclude participants from learning. If technology is required, incorporating basic digital skills training at the beginning of a program can prevent learners from falling behind.

Accessibility is also about physical and sensory inclusion. If in-person learning is part of the intervention, it is important to ensure that learning spaces are barrier-free, with adaptive materials, sign language interpretation and assistive technologies for learners with disabilities.

Fostering Psychological Safety & Trust

Many marginalized learners carry the weight of negative past experiences with education, often shaped by discrimination, exclusion, or systemic disadvantages. If a learning environment does not feel safe, welcoming and inclusive, learners may disengage before they could succeed.

Building psychological safety in educational interventions starts with representation, learners should see mentors, trainers and role models who reflect their backgrounds and experiences. This not only fosters trust but also reinforces the belief that success is possible for people like them. Additionally, many marginalized learners have faced trauma, whether due to poverty, displacement, or social marginalization, making it critical to adopt a trauma-informed approach. This means creating an environment where learners feel supported rather than judged, where mistakes are seen as part of the learning process and where peer collaboration is encouraged over competition.

The structure of the educational intervention should also reflect non-hierarchical, peer-supported learning rather than traditional top-down instruction. In some communities, group-based learning and storytelling are more effective than individual assignments or written assessments. Being mindful of cultural norms, gender dynamics and social hierarchies can also help create a more inclusive and comfortable learning space.

Ensuring Culturally Responsive Learning

To make educational interventions culturally responsive, content should be adapted to the learners lived realities. This means using examples, case studies and success stories that are drawn from their communities, economies and experiences. For multilingual groups, providing learning materials in multiple languages or offering real-time translation can make a significant difference in comprehension and participation.

Moreover, traditional academic methods may not be the most effective way to transfer knowledge in certain communities. In cultures where oral tradition is strong, using storytelling, role-playing and community-based problem-solving can enhance learning far more than text-heavy materials or formal assessments.

Building Motivation & Confidence

For many marginalized learners, self-doubt is a significant barrier to learning. Years of social exclusion, lack of formal education, or being told they are "not capable" can lead to low self-efficacy. A well-designed educational intervention should counteract this by building confidence at every stage.

One way to do this is through competency-based learning, where learners start with small, achievable tasks before progressing to more complex challenges. By acknowledging and validating learners' existing knowledge, skills and lived experiences, the intervention reinforces the idea that learning is not about starting from zero, but about building on what they already know.

Mentorship and peer support networks can also play a crucial role in motivation. Establishing learning circles, buddy systems, or peer mentorship programs enables learners to support each other, reducing isolation and increasing commitment to the learning process.

Even the way progress is assessed can impact motivation. Instead of rigid, one-size-fits-all exams, alternative methods like portfolio-based assessments, practical demonstrations, or group evaluations allow learners to showcase their growth in ways that align with their strengths.

Bridging Educational & Digital Gaps

Many marginalized learners do not have a strong formal education background, which means educational interventions must be designed with adaptability in mind. This requires simplifying complex information, using plain language, visuals and interactive activities and ensuring that materials are accessible for learners with varying literacy levels.

If digital tools are required, a pre-training module on digital literacy can help ensure that all participants start with a basic level of competency. Additionally, low-tech alternatives (such as printed guides or recorded audio lessons) should be available to learners who lack stable internet access.

Beyond Training: Creating Career Pathways

For educational interventions to create real impact, they must connect to tangible opportunities. Without clear pathways to employment, entrepreneurship, or further education, learners may complete training but remain stuck in the same cycle of marginalization.

A strong intervention goes beyond skills development and incorporates career-building support, such as internships, apprenticeships and job placements with organizations that are open to hiring marginalized learners. In cases where formal employment is limited, training should also include entrepreneurial skills, cooperative business models and access to microfinance to help learners build self-sufficiency.

Long-term learning opportunities, such as refresher courses, alumni networks, or continuing mentorship, can further enable learners to continue developing their skills and confidence beyond the initial intervention.

From Access to Empowerment

Designing educational interventions for marginalized groups requires a shift in perspective, from simply offering access to actively enabling success. It means recognizing that learners do not all start from the same position and that structural barriers, psychological factors, cultural contexts and long-term opportunities all influence whether training will have a meaningful impact.

A well-designed intervention is not just about teaching skills; it is about creating empowerment. By ensuring that learning is accessible, inclusive, relevant and connected to real-world opportunities, training programmes can transform not just individual lives, but entire communities.

Integrating art in educational intervention design and delivery

Art is often overlooked in educational interventions, dismissed as something secondary or reserved for creative disciplines. However, art can serve as both a process and a tool, a way to explore ideas, facilitate engagement and deepen learning. Whether used in the design phase of an educational intervention or embedded within the learning experience itself, artistic methods can unlock creativity, foster deeper reflection and engage learners on a more personal and emotional level.

Within the context of the bioeconomy, where innovation, sustainability and interdisciplinary thinking are key, art can serve as a bridge between scientific knowledge, ecological awareness and human experience. Whether designing training programmes for circular economy specialists, sustainable agriculture experts, or bio-based product developers, artistic methods can bring abstract concepts to life, enhance understanding of complex systems and make sustainability issues tangible.

This chapter explores two dimensions of using art in educational interventions:

1. Using artistic methods in the design phase to develop insightful, innovative and human-centred educational interventions.
2. Integrating art within the intervention itself to create richer, more interactive and experiential learning environments for bioeconomy learners.

Using Art in the Design Phase: A Creative Approach to Educational interventions

Designing a biobased educational intervention requires more than just transferring knowledge about biomaterials, sustainable practices, or regenerative agriculture. It requires engaging learners in systems thinking, ethical reflection and innovative problem-solving. Art-based methods can complement traditional design processes, allowing designers to visualize complexity, explore alternative futures and integrate diverse perspectives. This of course requires designers to cooperate with specialists from the art field, as was discussed in chapter of the governance model.

Co-Creation: Designing with Learners

Embedding co-creation in the design process makes sure that educational interventions are shaped through collaboration rather than imposed structures. By actively involving learners, educators, artists and industry stakeholders, co-creation fosters a sense of ownership, engagement and relevance.

Artistic approaches, such as participatory design workshops, collective storytelling and collaborative prototyping, allow participants to contribute their insights and experiences, enriching both the content and format of the intervention. Whether through group mural-making to illustrate sustainability challenges, theatre-based exercises to explore ethical dilemmas, or interactive installations that evolve through user input, co-creation transforms education into an evolving, participatory process.

This approach not only enhances learning outcomes but also enables the intervention to remain dynamic, inclusive and deeply connected to the needs of those it serves.

Visualizing Bioeconomy Challenges and Solutions

Bioeconomy educational interventions often deal with complex systems, carbon cycles, biomimicry, agroforestry, or circular production loops. These topics can be difficult to grasp in purely textual or theoretical formats. Visual methods such as sketching, systems mapping, or creative data visualization help teams externalize their thinking and see connections between different parts of the system.

For example, when designing a training programme on bio-based packaging, intervention designers can use collaborative mind-mapping to visualize the entire life cycle of bio-based materials, from sourcing plant-based polymers to designing for biodegradability. A group of stakeholders (scientists, farmers, policymakers and consumers) can sketch their interpretation of sustainability challenges, revealing gaps, misalignments and hidden opportunities.

Similarly, storyboarding can be used to map out the learner's journey, identifying how they will progress from awareness of bio-based alternatives to hands-on product design and testing.

Using Theatre and Role-Playing to Understand Learners

A major challenge in biobased education is bridging different stakeholder perspectives, farmers, bio-based industry leaders, policymakers and consumers often view sustainability through different lenses. One way to design interventions that address these diverse needs is through improvisational theatre and role-playing.

For example, when developing a biobased training for regenerative farmers, designers can step into the roles of different stakeholders, a farmer adapting to organic practices, a food company seeking sustainable sourcing, or a policymaker regulating land use. By acting out these roles, designers can better understand the tensions, motivations and barriers learners face.

This method can also reveal power dynamics, such as how small-scale farmers struggle to get fair prices for bio-based raw materials or how consumers misunderstand the benefits of compostable bioplastics. Such insights can shape educational interventions to focus on practical solutions rather than idealized theories.

Engaging Stakeholders Through Artistic Dialogue

Biobased training programmes often requires multi-stakeholder collaboration, yet traditional consultation methods, surveys, expert panels, can feel uninspiring. Artistic approaches, such as collaborative mural painting, symbolic sculpture, or participatory storytelling, can create more meaningful dialogue between stakeholders.

For instance, in a project designing training for algae cultivation technicians, different stakeholders (scientists, investors, policymakers and local communities) could be invited to co-create a visual timeline of algae's role in the circular economy, from carbon capture to biofuel production. This visual approach makes abstract bioeconomic processes more tangible and reveals common priorities between sectors.

Using Art in the Educational intervention: Enhancing Engagement and Retention

Once an educational intervention is designed, art can be used within the training itself to improve knowledge retention, emotional engagement and learner creativity. Bioeconomy topics often involve long-term, systemic thinking, something that can be difficult to teach through traditional lectures alone. Artistic methods can help learners connect with sustainability issues on a deeper, more experiential level.

Art as a Medium for Reflective Learning

Bioeconomy education is not just about technical skills, it requires ethical reflection and systems thinking. Artistic expression, such as visual journaling, poetry, or sculpture, can help learners process their experiences and form a more personal connection to the material.

For example, in a training on soil restoration and agroforestry, learners could be asked to create a visual representation of how degraded land can regenerate over time. This exercise encourages them to think beyond statistics and policies, engaging emotionally with the concept of regeneration.

Storytelling and Theatre to Reinforce Learning

Sustainability challenges often feel distant or abstract, art helps make them personal and relatable. Using storytelling and theatre as teaching tools can make concepts more memorable and immersive.

For instance, in a training program on waste valorisation, learners could role-play as different parts of a circular system, one person as food waste, another as bacteria breaking it down, another as biogas being produced. This embodied approach turns theoretical knowledge into lived experience, reinforcing the interconnections within the bioeconomy.

Similarly, community storytelling, where learners share local experiences with sustainability challenges, can help create a sense of belonging and knowledge exchange. This is particularly valuable when training rural farmers, indigenous land stewards, or waste-pickers transitioning to bio-based industries.

Multisensory Learning: Engaging More Than Just the Mind

Most training programmes rely on reading, writing and listening, but engaging other senses, sight, touch, sound and movement, improves learning retention. Art-based multisensory methods can make bioeconomy concepts more engaging.

For example, in a training program on biodegradable materials, learners could physically interact with different bio-based alternatives, touching and manipulating bioplastics, algae-based textiles, or hemp composites to compare textures, flexibility and decomposition properties.

Likewise, in ocean conservation training, soundscapes of underwater ecosystems can evoke the impact of ocean acidification and marine bioeconomy practices, making them emotionally resonant.

Applying biomimicry in educational intervention design

Biomimicry, the practice of applying nature's designs to human challenges, offers a powerful framework for education, especially in bioeconomy fields like regenerative agriculture and circular economies. Traditional linear curricula can be replaced with dynamic learning ecosystems, where knowledge flows like mycorrhizal networks and learners engage in interconnected, self-organizing experiences. Instead of isolated lessons, students explore interdependent concepts, such as bio-based materials, through hands-on, networked learning.

Inspired by nature's adaptability, biomimetic education fosters self-sustaining learning models. Just as corals build reefs through collective intelligence, learners co-develop knowledge over time. Decentralized problem-solving, peer-led communities and feedback loops mimic the resilience of natural systems. Sensory learning, such as composting to understand circularity or designing biomimetic packaging, bridges theory with real-world application. Ultimately, biomimicry transforms education into an adaptive, experiential process, equipping learners with the systems thinking needed for a sustainable future.

Integrating Art and Biomimicry in Educational Design

Designing an educational intervention through biomimicry means shaping learning experiences that reflect nature's adaptability, interconnectedness and self-sustaining processes. Art plays a crucial role in this, not as a tool, but as a complementary approach that enhances both the design process and the learning experience itself.

Using Art in the Design Process

For designers, engaging with biomimicry through artistic exploration helps translate natural principles into effective educational structures. Some practical ways to incorporate art into the design phase include:

- Sketching and Visualization: Observing and drawing patterns in nature (e.g., fractals, branching systems, or spirals) to inspire learning structures that mirror natural growth and adaptation.
- Sculpting and Modelling: Creating three-dimensional representations of biomimetic concepts, such as interconnected learning pathways modelled after mycelial networks.
- Storytelling and Role-Playing: Exploring ecological relationships by imagining or enacting how different species collaborate, compete, or adapt, providing insights into how knowledge can be structured dynamically rather than linearly.

By incorporating artistic methods into the design process, educators can break away from rigid, linear structures and instead create interventions that function like living, evolving systems.

Art as an Educational Medium

Beyond design, art also enhances how biomimetic principles are taught, offering learners an immersive, hands-on experience of complex systems. Some ways to integrate art into a biomimetic educational intervention include:

- Interactive Installations: Setting up spaces where learners can physically engage with biomimicry, such as a circular economy exhibit where materials flow through different stations mimicking natural cycles.
- Material Exploration Workshops: Allowing learners to experiment with natural and synthetic materials, analysing their properties through sensory interaction (e.g., testing the flexibility of biomaterials vs. plastics).
- Embodied Learning and Theatre: Using movement-based exercises where students physically act out ecological processes, such as water cycles, nutrient flows, or symbiotic relationships.
- Bio-Inspired Design Challenges: Encouraging students to co-create biomimetic solutions through artistic prototyping, such as designing sustainable packaging inspired by seed dispersal mechanisms.

By merging biomimicry with artistic expression, educational interventions become more engaging, intuitive and interconnected, mirroring the very systems they aim to teach. This combination fosters creative problem-solving, deep engagement and experiential learning, equipping learners with not just theoretical knowledge but a felt understanding of sustainability and systems thinking.

Design examples – Field 4: Learning situation

Example one

Given the geographical spread of the participants, their diverse roles and varying educational backgrounds, a 12-month blended learning program was developed. The program follows a 70-20-10 approach, meaning:

- 10% of learning took place in formal settings (e.g., expert lectures, structured assignments).
- 20% of learning occurred through collaboration and peer exchange.
- 70% of learning happened on the job, as participants applied insights from the program in their daily policymaking processes.

To set the stage for the program, a kick-off day was organized in an art museum, chosen to provide an inspirational and creative setting. During this session: The program was introduced, outlining the objectives and expectations. Expert speakers, one specializing in policy design and another in bioeconomy, delivered keynote lectures, focusing on the subject matter as well as the importance of integrating bioeconomy in policymaking.

A metaphor exercise was incorporated to encourage participants to explore their personal perspectives on bioeconomy in policymaking.

In a creative workshop, participants used artistic tools to visualize their experiences as policymakers, mapping out key challenges they had encountered in past policy processes.

Following the kick-off session, participants were given assignments to complete in the months ahead, including:

- Analysing previous policies and identifying where bioeconomy considerations had been overlooked.
- Applying insights from the program in ongoing policy work.
- Reflecting on their initial metaphor exercise and revisiting it at key points in the program to track shifts in their perspective.

The day was concluded with an informal program, where participants had the opportunity to network and engage in discussions in a relaxed setting. This allowed them to build relationships, exchange perspectives and develop a sense of community, which would support collaboration throughout the program. Monthly online modules facilitated ongoing learning, where participants shared progress, discussed experiences and received additional knowledge and materials. Three months into the program, another in-person session was organized, incorporating group discussions and case-based policy challenges, allowing participants to further develop their bioeconomic policymaking approach. A similar session was held at the program’s halfway point.

The program concluded after twelve months with a final session where participants presented their experiences, reflecting on how their understanding of bioeconomy in policy had evolved. No formal test or assessment was conducted, as this was deemed inappropriate for the target group, but participants received feedback on their contributions throughout the program.

Example two

The 70-20-10 model was used as the foundation for structuring the learning approach, ensuring that participants developed their skills in a practical, workplace-integrated manner. Given the characteristics of the participant group and the need for immediate applicability in the industrial setting, the intervention prioritized hands-on experience and learning through mentorship, complemented by structured instruction. The programme ran for a total of six months, allowing participants to gain essential competencies within a compressed but structured timeframe. It is possible to work part time and join the program for a more extensive period to allow for a broader adoption by the target audience. Learning was distributed according to the 70-20-10 framework:

- 70% experiential learning, where participants learned by doing, taking on real tasks under the supervision of mentors and gradually assuming more responsibility in the workplace.
- 20% social learning, in which participants worked alongside experienced employees (“masters”) from participating businesses. This allowed them to observe, discuss and reflect on work practices in a guided setting.
- 10% formal learning, delivered by the regional vocational education institution in a dedicated learning space on the industrial park. This included theoretical instruction on industrial processes, workplace safety and logistics fundamentals. The approach here was fine tuned to cope with the wide range of diversity of the participants. There for example were cases where participants had one on one calls with the educator(s) due to logistical restrictions of the target audience.

Special attention was given to the order in which learning experiences were introduced, ensuring that the training aligned with real-world work sequences. The intervention was designed using two complementary principles:

The learning programme was structured to mirror the natural order of tasks performed in the workplace, allowing participants to build their skills in a logical, experience-based progression. This ensured that learning followed a familiar, real-world flow, making it easier for participants to connect theory to practice. For example, in process operation training, participants first learned how to handle and transport raw materials before moving on to operating entry-level machinery. As they became comfortable with these tasks, they progressed to monitoring processes and troubleshooting minor issues, gradually building towards more independent work. Alternatively, in logistics roles, participants began by understanding warehouse layouts and basic material movement, then learned to use industrial transport equipment and finally progressed to inventory control and process optimization tasks.

This step-by-step approach caused the participants not to be overwhelmed by complex tasks early on but instead gained competence progressively, increasing both confidence and efficiency in their roles. To maximize efficiency and workforce integration, the 80-20 principle was applied in structuring learning content. Analysis of workplace activities showed that a small number of key tasks accounted for most of the daily work demands. As a result, training focused primarily on mastering the core 20% of tasks that participants would use most frequently. For example:

- In process operation, this included monitoring machinery, handling materials and following safety procedures, tasks that formed the foundation of daily operations.
- In logistics, priority was given to inventory movement, scanning and basic warehouse management, as these tasks represented the bulk of operational activity.

More specialized or less frequent tasks, such as handling rare equipment failures or advanced troubleshooting, were introduced gradually and left to be developed through on-the-job experience once participants had entered the workforce.

By structuring the learning experience around real work sequences and prioritizing the most relevant tasks, the program enabled participants to be work-ready in a short time span possible while still allowing for continued skill development on the job.

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Click here to jump to the next design examples – Field 5, page 67

Explanation field 5 – 8: Designing the evaluation

Once the learning need has been analysed and the intended goals are clearly defined, the next step is to design the evaluation strategy. This shifts the focus to the right-hand column of the Eight Fields Model.

The four levels of evaluation in this model align closely with the well-known framework developed by Kirkpatrick. At each level, the core question is: *What outcomes will indicate that the programme has been successful?* It's essential to answer this question before designing the training itself. When you clearly define what success looks like, and which criteria you will use to measure it, you can ensure the design actively supports those outcomes. This alignment strengthens both the relevance and the impact of the programme, while also making it easier to assess its effectiveness at a later stage.

Figure 7. The Eight Fields Model steps

Evaluation is often associated with the idea that "measuring is knowing." But evaluation is not the same as measurement. A measurement expresses information in numbers, whereas evaluation involves making a judgment about that information, such as deciding whether something is "sufficient." The word evaluation originally means assigning value to something. So, a key question becomes: to whom is the value assigned? An inclusive approach that involves all stakeholders in the learning programme is recommended. This approach is considerate of the interests of the stakeholders when deciding how the programme's value is assessed.

Although most professionals agree that evaluation is important, in practice, evaluation criteria and methods are often only developed after the training programme has already started. This means missing the opportunity to have concrete discussions, during the design process, with clients, managers, participants and other stakeholders about what successful workplace behaviour will look like. How will you know whether someone is applying the desired competences effectively in their role? What methods will make this visible? What changes, improvements, or innovations should this lead to, and how do those outcomes reflect the intended impact?

These are difficult questions, but essential ones. Asking them early helps stakeholders create a shared vision of the future situation in which the learning programme has succeeded. It supports better-informed decisions about the investment in learning and helps clarify how learning contributes to achieving organisational goals. It also provides direction for the design of the educational intervention itself.

There's another reason to focus on the impact of learning on work performance. Learning is increasingly expected to improve performance, or even transform the way work is done, including the development of new products or services. Learning often carries strategic importance. At the same time, designers and advisors frequently aspire to have a strategic seat at the table, alongside decision-makers who shape the organisation's direction. To occupy such a role, designers must be able to make well-founded claims about how learning interventions contribute to the development of the organisation, or even society at large.

Fulfilling a strategic role means that designers must understand the added value of educational interventions for the organisation. But evaluation can also be a sensitive topic. This sensitivity often stems from people's negative experiences with evaluation in schools and training settings. In those contexts, teachers, operating from a position of authority, evaluate learning through tests and exams, determining whether learners are "good enough" to move on. Evaluation becomes a form of selection, with the risk of exclusion for those who don't meet the standard. Add to this the fact that evaluation often focuses on what someone can't do, rather than what they can and it's easy to see why many people feel uneasy about evaluation.

As mentioned earlier, the goal of learning is to acquire and develop competences that support change, improvement and innovation in the workplace. This view connects closely to competency management, where the aim is to determine the minimum competences required to carry out a given role or function. In this context, evaluation focuses on whether people possess these competences and whether they are using them effectively at work.

An alternative view is that of talent development. This approach is based on the idea that people want to contribute to organisational goals when they can develop and apply their talents, especially when those goals align with their personal motivation. The key question becomes: how can we encourage people to use their talents in ways that benefit both the organisation and them?

Talent development is also aimed at aligning individual and organisational goals, but it tends to operate from a more equal and developmental relationship.

The underlying assumption is that most people want to be competent and want to excel in something. In this view, evaluation focuses on organising feedback that helps people continuously improve in using their strengths. Positive feedback and collegial reflection play a key role here. But if the focus shifts too heavily toward meeting external performance standards, dependency can arise. The goal becomes meeting expectations rather than striving to bring out the best in oneself.

That's why this chapter also highlights another perspective: an appreciative and developmental approach to evaluation. In this view, learning is about discovering what is meaningful for both the individual and the organisation, and learners take responsibility for demonstrating what their learning has brought them.

Beneath the tension between learning and performance lie two different paradigms that reflect different views of the profession: the learning approach and the performance approach. The learning approach starts from the idea that performance is the result of learning. Learning comes first and is seen as an investment in people's professional development, skills and motivation. The performance approach, by contrast, begins with identifying the gap between current and desired performance, along with the various factors that influence that gap. Interventions, including educational ones, are then selected based on their ability to address the underlying issues.

Educational interventions can play a role in both approaches. Neither is inherently better than the other; both have value. The key is to understand when and how to apply each.

EVALUATION LEVELS →	**LEARNING PROCESS** Learning Situation	**LEARNING RESULT** Competencies	**FUNCTIONING** Work Situation	**IMPACT** Goal
What do you want to know?	Did the learning situation optimally contribute to acquiring competencies?	Have the competencies been acquired at the correct level? Can they be applied?	Is the work situation indeed changed, and does it help implement the changes in the work?	Has the goal been achieved? Has the organisation been transformed as a result?
Which method?	(Online) Questionnaire, Self-report, Survey	Work Sample, Test, Observation, Competency Interview, Portfolio	Performance review, Observation, Interviews, Product Research, Competency Research, Case Study	Success/Failure Analysis, Competency Measurement, 360-degree Feedback, Simulator, Development Center
Who is involved?	Participants, Instructor/Trainer	Participants, Instructor/Trainer, Colleagues, Experts	Supervisors, Participants, Colleagues, Manager, Trainer/Coach	Supervisors, Director/Management Team, Change Management Team, HR, After one month, six months, one year
In which cases and when?	Immediately after each activity, during learning process	During and after each assignment, immediately after activity	Immediately after assignment, after each work activity, as part of a development/performance interview	After completing each phase, as part of ongoing change management, 6 and 12 months later.

Table 2. Evaluation methods per evaluation level

Field 5: Process/training

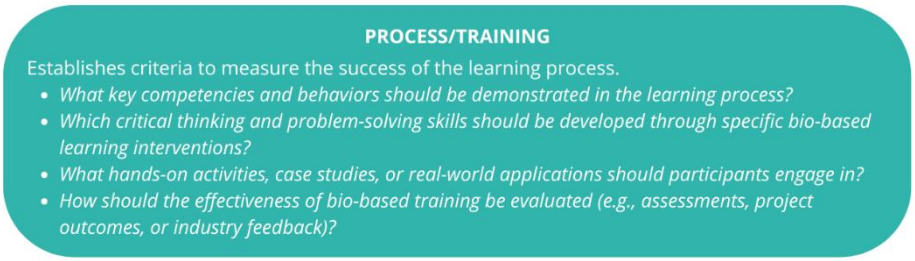

Figure 8. Underlying questions in the Eight Fields Model - Field 5

Evaluation of the learning process

This section focuses on evaluating the educational programme or intervention itself. Gathering input from both participants and organisers can yield valuable insights for improving future learning initiatives.

When evaluating the learning process, participants are asked to give a value judgment on how the learning took place, not necessarily how much was learned. This type of evaluation doesn't indicate the extent to which learning outcomes were achieved, but it does shed light on the conditions that supported or hindered learning.

Relevant evaluation criteria might include:

- To what extent participants were able to practise new competences
- The relevance and quality of the content offered
- Whether a safe and supportive environment was created, allowing participants to experiment and take risks

This form of evaluation is most often conducted at the end of a learning programme, when participants can reflect on the complete experience.

It is also possible to introduce evaluation moments during the programme. If the programme consists of multiple activities or modules, it can be helpful to assess partway through whether participants feel the learning process is supporting their development. This allows for timely adjustments, improving the effectiveness of subsequent activities.

Mid-programme evaluations also give participants an opportunity to influence the conditions under which they learn best. In this way, the design and delivery of the programme can be improved in real time.

Evaluating the learning process typically requires limited time and resources, depending on the chosen method. Most commonly, participants are asked, either orally or in writing, whether they are satisfied with the learning activities. This type of evaluation is often carried out by the learning providers themselves and requires only minimal effort.

Methods for evaluating the learning process

One of the most common tools for evaluating the learning process is the questionnaire. These are often used to gather participants' reflections on how they experienced the programme. Today, a wide range of online tools, such as Microsoft Forms or SurveyMonkey, makes this process quick, accessible and visually informative, with automatic data summaries and charts.

Process evaluation can also be conducted orally, through individual interviews or informal group discussions. In many cases, participants are asked to fill out a brief questionnaire immediately following a workshop or training activity.

Using questionnaires aligns with a relational approach to learning design, as it encourages participants to share ownership of the process. This creates opportunities for designers and participants to work together in identifying ways to improve the quality and effectiveness of the learning experience.

For designers, this feedback is essential: without insights into the learner experience, it is nearly impossible to optimise the learning process.

The term "smile sheet" is often used to refer to this type of feedback tool. While many such questionnaires do focus on participant satisfaction, such as opinions on the venue, the trainer's approach, or the quality of materials, this label can unintentionally trivialise the value of evaluation at this level.

In reality, the conditions under which learning takes place have a meaningful impact on the final learning outcomes. If learners experience the programme as engaging, relevant and well-organised, they are more likely to apply what they've learned. Satisfaction alone isn't enough, but it does influence motivation and long-term engagement.

Still, it is recommended to go beyond satisfaction surveys. Performance-based evaluations and follow-up assessments provide a more accurate picture of the programme's effectiveness (Thalheimer, 2022). These should be prioritised where possible.

Design examples – Field 5: Process/training

Example one

After each major programme part, the participants were asked to give their opinion on several topics ranging from the provided content, assignments, the speakers, the organisation of the module/day. This was done using an online questionnaire at the day following a programme part. The goal of these evaluations was to determine the satisfaction of the participants and to see if changes for the remaining programme modules were necessary.

Example two

To ensure the effectiveness of the educational intervention, continuous evaluation and feedback mechanisms were integrated into the program. After each major learning phase, feedback was gathered from participants, industry mentors and vocational instructors to assess the relevance, clarity and applicability of the training. Short evaluation sessions were conducted at key intervals, focusing on:

- Participant experience and engagement, ensuring the training met their learning needs.
- Industry mentor feedback, assessing participant readiness for workplace tasks.
- Adjustments to the learning sequence, allowing refinements to be made based on real-time observations.

Alongside these educational evaluations, the local government monitored and evaluated whether its support measures, such as transportation assistance and case-by-case social support, were sufficient in enabling participants from marginalized groups and those with a distance to the labour market to complete the program successfully. If needed, adjustments were made to improve accessibility and reduce exclusion due to non-educational barriers.

A final evaluation was conducted at the end of the six-month program, where participants and mentors reflected on skill development, workplace integration and overall training effectiveness. This iterative approach ensured that the program remained practical, relevant and aligned with both industry expectations and government policy goals.

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Click here to jump to the next design example – Field 6, page 73

Field 6: Learning outcomes

Figure 9. Underlying questions in the Eight Fields Model - Field 6

At the level of learning results, the key question is whether participants have acquired the intended competences during the educational intervention, and whether they have mastered them at the required level.

Establishing Criteria

Evaluation criteria at this level provide insight into how competent someone is. A person is considered competent when they demonstrate the right combination of knowledge, skills and attitude to act effectively in an authentic, practical situation. These criteria help translate the competences identified earlier, on the left side of the Eight Fields Model, into concrete indicators of performance.

When formulating evaluation criteria, it's helpful to revisit the analysis conducted to determine the desired new behaviour. This aligns the evaluation with the original learning objectives.

In some cases, it's relatively easy to determine whether learning has occurred. For example, you can assess whether a bioprocess technician correctly initiates and monitors a fermentation cycle following established safety and quality protocols. Or whether a bio-based packaging operator performs start-up and shutdown procedures according to standard operating procedures. These are examples of reproductive skills, where the goal is to correctly apply a predefined method. In such cases, evaluation criteria are often embedded in operating procedures and are straightforward to define.

It becomes more complex when the focus is on productive skills, those that require critical thinking, creativity, or complex decision-making. How do you determine whether a policy advisor in sustainable agriculture has effectively engaged diverse stakeholders to shape a new incentive programme? Or whether a field officer has successfully encouraged behavioural change in land-use practices among local farmers? And when is a production team lead in a biorefinery truly demonstrating "coaching leadership" in day-to-day operations?

In such cases, evaluation requires close alignment with multiple stakeholders: clients, managers, colleagues, customers, and the learners themselves. What does "doing well" look like from each perspective? Which criteria do they consider relevant?

A relational approach is especially valuable here. People often have implicit ideas of what effective performance means, but these views may vary and are rarely discussed explicitly. Starting this conversation offers a valuable opportunity. By aligning evaluation criteria with the intended learning outcomes, you contribute to the development of a shared vision of what competent performance looks like.

Once evaluation criteria are in place, it's important to regularly discuss and clarify how they are interpreted by different assessors. This promotes intersubjectivity: a shared understanding among those who need to make judgments about learners using the same criteria. Such clarity improves the fairness, consistency and overall quality of the evaluation process.

Methods for evaluating learning results

To evaluate learning results effectively, a competency test is preferred. In such a test, the learner demonstrates the acquired competencies in a real or realistic, complex work situation. At this evaluation level, the goal is to determine whether someone truly possesses the required competencies, and the most reliable way to do this is by observing them in action.

A robust competency test ideally consists of multiple evaluation methods. Each method offers a different lens: some focus on knowledge acquisition, while others aim to assess observable skills or behaviour. By combining multiple methods and evaluation moments, you gain a more complete picture of the learner's development and cover all relevant aspects of the competency.

In Table 3, several examples of methods are presented that can be used separately or in combination as part of a competency test. Consider, for example, a competency test for a biorefinery team leader. This test might consist of a work sample, a simulation and a knowledge test.

The work sample could involve overseeing the start-up of a fermentation process, including monitoring environmental conditions and making in-process adjustments.

The simulation might involve responding to a hypothetical system failure, testing both technical decision-making and coordination under pressure. Simulations are particularly useful here, as they allow for safe practice of scenarios that involve risk, while also incorporating ethical or organisational dilemmas.

The knowledge test equips the team leader with a solid theoretical foundation in bioprocess engineering, safety protocols and quality control.

In this example, the simulation might be used formatively, to provide feedback to the learner on their performance, while the knowledge test and work sample are summative, determining whether the learner is ready to take on full responsibility in the role.

These kinds of evaluation setups are increasingly applied in lab, pilot plant and production settings across the bioeconomy, where safe experimentation and critical reflection are essential.

For many of the methods listed in Table 3. Examples of methods for evaluating learning results, learners can be involved in shaping the criteria and even the design of the evaluation method. This not only promotes a sense of ownership but also encourages learners to take responsibility for showing that they are competent. For example, during the design of a work sample, learners may be asked: What should be observed when someone is performing this task well? Their answers will often differ from those of experienced professionals who may assess from an “unconscious competence” perspective.

Making evaluation criteria explicit is, in itself, a valuable learning moment. It helps to surface different perspectives on what “good performance” looks like, something that is rarely discussed openly in organisations, even though expectations often exist implicitly.

Learners are often the ones who best understand how to demonstrate their competence. That’s why, in some cases, the design of a competency test can be entirely entrusted to the learner. This gives them maximum influence over the conditions and criteria under which they are evaluated.

In this view, evaluation is no longer something that is done to you by others, it becomes a meaningful opportunity to show that you are ready for a specific role or challenge.

In the appendix a Step-by-Step plan for designing a Competency Assessment, is provided at page 86.

METHOD	EXPLANATION	ADVANTAGES	DISADVANTAGES/CONSIDERATIONS
Work sample	Task performed by the learner in a real work environment under normal conditions, at a set time. One or more assessors observe the learner's behaviour and the process used during the task. "Hands-on" experience is key.	- Realistic and representative: behaviour is assessed in the most natural form. - High acceptance among learners and assessors.	- Time-consuming to conduct and assess. - Every situation is different, making it difficult to have global assessment criteria. - You directly observe whether the learner displays the intended behaviour.
Criterion-oriented interview	An individual interview where the assessor probes into the knowledge that the learner has and their reasoning behind their actions. Often used in conjunction with a work sample or portfolio.	- The learner demonstrates conscious competence. - Useful in combination with direct observation of the learner's actions (work sample).	- The learner must articulate the reasoning behind their choices and dilemmas (language skills). - Requires significant verbal and interpretative skills.
Simulation	Task performed by the learner in (partially) simulated situations: on a training site, in the workplace, with simulated elements.	- Ability to elicit relevant behaviour in critical, complex work situations. - Ability to create a safe environment where the learner can also practice, e.g., with a client or patient. - Conditions are controlled and consciously influenced. - Possibility to establish clear criteria in advance; therefore, easier to assess.	- Less lifelike than a work sample. - Requires significant preparation and execution time and resources (e.g., actors, equipment). - A simulator often works well but can be expensive.
Case study	The learner develops an approach to solve a case drawn from the workplace. Problem-solving, decision-making and	- Ability to serve larger groups simultaneously, making it efficient. - Explicit focus on the cognitive process of	- Knowing how to do something is no guarantee that you will do it correctly in practice. - Requires an up-to-date set of cases.

	application of expert knowledge are central: knowing how to act.	the learner and the use of acquired knowledge.	
Knowledge test	The learner answers questions that test their factual knowledge, insight and understanding. (paper-based, computer-based, or oral). Knowledge is central: in multiple-choice questions, recognizing the correct answer is key.	- Explicit focus on the knowledge needed to address real-world problems. - Most relevant for work situations where knowledge reproduction is an important element. - Every learner takes the same test. - Useful for arithmetic and analytical tasks.	- Focus on reproduction and memorization. - Uncertain whether the learner can apply reproduced knowledge in work situations. - Little real-world application; rather school-like.
Portfolio	The learner gathers evidence showing that they possess specific competencies (products, video recordings, received feedback, etc.). The instructor may discuss the evidence with the learner in a portfolio review (clarification and justification).	- Promotes self-direction and responsibility of the learner in demonstrating competence. - Motivating. - Evidence often comes from regular work.	- Sometimes difficult to collect direct evidence where behaviour is visible (like video recordings) due to privacy or organisational limitations. - Low reliability due to difficult-to-control conditions. - Risk of unstructured and extensive portfolios.

Table 3. Examples of methods for evaluating learning results

Design examples – Field 6: Learning outcomes

Example one

The goal here was to determine whether the participants possessed the required competences to incorporate bioeconomic principles into the policy creation process. There was no formal test or assessment. What did happen was that the participants were tasked to apply acquired knowledge from the programme during their regular duties and to hold a TED talk style presentation to share their experiences with their fellow participants. From a design point of view this method and testing is in between a case study and a portfolio. These 'talks' were 'judged' on several criteria: The level of incorporation of bioeconomy in the policy creation process, the application of innovative ideas/approaches. The level of evaluation demonstrated whether the participants had successfully acquired the required knowledge pertaining to bioeconomy and policy creation. Educators could overwrite the evaluations if necessary to guarantee a minimum level requirement and protect the quality of the educational program.

Example two

Since formal testing was not appropriate for this participant group, learning outcomes were assessed through practical, workplace-based evaluations rather than written exams.

Throughout the programme, industry mentors and vocational instructors observed participants during their daily tasks, providing ongoing feedback on their ability to perform job-specific activities, follow workplace protocols and integrate into the work environment. Progress was discussed during regular check-ins, where participants reflected on their experiences, challenges and skill development. At the end of the six-month program, a final evaluation session was held in which:

- Participants reviewed their own progress, discussing their confidence in applying what they had learned.
- Mentors provided feedback on participants' readiness for employment, focusing on practical competence, workplace behaviour and adaptability.
- Supervisors assessed whether participants could independently perform the most critical tasks required in their future roles.

This practical, observation-based approach ensured that participants were evaluated in a way that was fair, relevant and aligned with real workplace demands, while also allowing for personalized feedback and further development opportunities where needed.

Click here to jump to the previous design examples – Field 5, page 67

Click here to jump to the next design examples – Field 7, page 80

Field 7: Performance

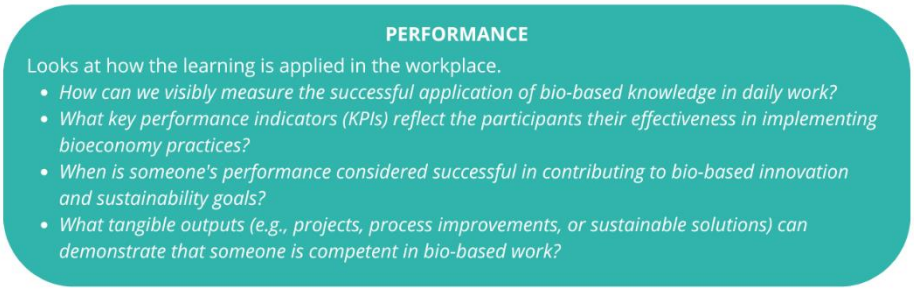

Figure 10. Underlying questions in the Eight Fields Model - Field 7

When evaluating performance, the central question is whether individuals who have completed a bio-based training programme are able to apply their acquired competences in the workplace, and whether they are doing so in the desired way. The goal is to connect learning as closely as possible to actual work, so that newly developed skills can be integrated and implemented immediately.

When learning and working are closely linked, the risk of transfer problems is significantly reduced. Learning only becomes meaningful when it leads to observable changes in the setting where it is needed most, the workplace. This means that changes in behaviour or performance can often be seen right after a learning programme concludes, rather than after weeks or months.

In fact, if no change is observed within the first few days, it is worth asking whether that change is likely to emerge later. Research supports this: the most significant gains in the transfer of learning to practice occur when the learning is embedded into existing work processes (Blume, Ford, Baldwin & Huang, 2010).

That said, it is also true that sustainable behaviour change takes time. Embedding new habits and behavioural patterns into the brain requires repetition and consistent practice. That's why it is advisable to evaluate performance again after a few weeks, to see whether the new behaviour has truly taken root and become part of day-to-day routines.

In some professional fields, including production technicians, lab analysts and quality assurance staff in the bioeconomy, there is also a formal expectation that workers be able to demonstrate their competence and continued development. This often involves documenting diplomas and participation in professional learning activities in certification systems or quality registers.

While these systems can confirm that someone has met certain learning requirements or attended accredited programmes, they do not necessarily provide insight into whether that learning has had an impact on job performance or on organisational outcomes. Competence registration captures the evidence of learning, but not the effect of learning.

Determining criteria

It can sometimes be difficult to clearly distinguish between the criteria for evaluating learning outcomes and those for assessing workplace performance or behaviour. The following clues can help:

- For **learning outcomes**, the focus is on whether the learner has mastered the desired competencies. These criteria help determine: *Can the person do it*?
- For **performance or behaviour**, the focus is on whether the learner uses and applies the competencies in their actual work. These criteria help determine: *Does the person do it?*

Evaluation criteria for performance can often be derived from the description of the desired work situation and the observable behaviours linked to that context, as outlined on the left side of the Eight Fields Model. In addition, the initial training needs analysis offers valuable insights for formulating relevant performance criteria.

It is important to recognise that acquiring knowledge or skills does not automatically lead to behavioural change. Whether someone applies what they've learned depends not only on individual readiness but also on the work environment, which can either support or hinder transfer.

Ideally, these enabling or blocking factors have already been identified during the earlier analysis of the work context and required competencies. Research highlights several conditions in the work environment that support the successful integration of new behaviour into day-to-day performance. These include:

- The employee's own motivation and readiness to change
- A supportive learning and work environment, especially encouragement from supervisors and colleagues
- Clear, specific and challenging goals related to new behaviours
- Constructive and regular feedback, particularly from direct supervisors
- Recognition of progress, even when improvement happens gradually

These are not just background conditions, they can also be translated into evaluation criteria. For example:

- How often do supervisors and colleagues provide positive feedback when employees try out new behaviours?
- How much attention is given to small but meaningful improvements?
- To what extent do team members have the time and space to support and coach each other through behavioural change?

Evaluating these contextual factors helps build a clearer picture of how learning translates into action, and whether the environment is doing its part to sustain the change.

Methods for evaluating real world performance

Various methods can be used to evaluate how learners apply their competencies in real-world work situations. These include observation, interviews, quality assessment of products or services and customer feedback. Table 4. Methods for evaluating , provides a brief explanation of each of these methods.

As noted earlier, this list is not exhaustive. In fact, several methods commonly used to evaluate learning outcomes, such as work samples or portfolios, can also be applied to assess real-world performance (see Table 4).

In the following section, we will take a closer look at some of the most relevant methods for evaluating professional functioning.

METHOD	EXPLANATION	ADVANTAGES	REMARKS
Observation	Observing the performance/behaviour in the workplace.	- Low-threshold. - Own experience of choices. - Involving context increases engagement and creates openness.	- Time consuming. - Not all aspects of performance can be observed. - People may behave differently when observed.
Peer evaluation	Colleagues evaluate each other's performance and behaviour in the workplace.	- Promotes involvement and openness. - Encourages self-reflection through feedback from peers.	- Evaluator may lack competence. - Risk of subjectivity due to group dynamics. - Can be influenced socially.
Interview	Conversation about performance and behaviour with the person and possibly colleagues or a supervisor.	- Provides direct feedback. - Allows insight into choices and context. - Offers reflection on situations.	- Indirect assessment. - Requires skilled interviewers. - Relies on openness of participants.
Quality of product or service research	Evaluation of the delivered product or service by customers.	- Efficient for service roles. - Provides insight into external performance. - Encourages continuous improvement through feedback.	- Focuses on product/service quality. - Limited insight into internal performance.

Customer research	Assessment of customer satisfaction with products or services.	- Effective in-service settings. - Easy to implement with digital tools. - Encourages open communication with clients.	- Low response rate for surveys. - Doesn't focus on individual performance. - Attention may be product-focused.

Table 4. Methods for evaluating performance

Observation

Since the evaluation of performance and behaviour focuses on how well individuals apply newly learned skills in their work, it is logical to observe them directly in the workplace. Observations, often referred to as performance evaluations, are typically conducted as planned, agreed-upon assessments between the evaluator and the employee.

To take this a step further, mystery observation can be used. In this approach, the person being observed is unaware that their performance is being evaluated. A common example is the assessment of customer service skills in hotel, retail, or hospitality settings, where a “mystery guest” interacts with staff and later evaluates the experience based on predefined criteria.

This method is especially suitable for evaluating behavioural patterns, particularly those involving customer or client interaction. Because it captures behaviour in a more natural, unfiltered context, it can offer valuable insights into how people perform when they are not actively "on guard." However, mystery observation also raises an important ethical question: *Do you want to evaluate people without their knowledge?*

This question deserves serious consideration, especially in contexts that value openness, trust and developmental feedback. While mystery methods can provide realistic data, they may also undermine the psychological safety of the learning environment if not handled transparently or constructively.

Peer evaluation

In this method, colleagues evaluate each other’s performance or behaviour, often using a questionnaire based on competencies and related behavioural indicators. Peer evaluation supports the principle that learners are responsible for their own learning process, and, by extension, for evaluating its results.

It makes sense, then, to assess the application of learned skills in the workplace not through a top-down or external process, but by involving learners and their peers. People learn from the feedback they receive from one another and from observing the work behaviour of colleagues. This exchange of perspectives serves as a powerful stimulus for further development.

Peer evaluation not only fosters the ability to evaluate others constructively, but it also encourages individuals to reflect on what successful performance looks like, helping them better assess the quality of their own work.

Although peer evaluation has its origins in educational settings, it can be applied effectively in workplace organisations as well. When implemented thoughtfully, it promotes ownership, feedback literacy and a collaborative learning culture.

Quality of product or service research

In this type of evaluation, the focus is on a product created or a service delivered by an employee, where the application of newly developed work behaviour is essential.

For example, in a bio-based plastics facility, the quality of polymer components produced by machine operators may be assessed to determine whether they are applying what they learned in a training on equipment calibration and process optimisation. By comparing product quality before and after the training, it becomes clear whether the newly acquired skills are being effectively applied in the workplace.

This method can be applied across a variety of contexts. A logo, for instance, may reflect the designer's ability to translate a concept into visual identity, thereby demonstrating their competence. Similarly, a sustainable housing consultant might present a tailored sustainability plan that shows their ability to align resident needs, technical possibilities and eco-conscious solutions.

In many organisations, not just designers but a wide range of professionals regularly assess the quality of products, services and processes. The methods they use, whether formal or informal, can also serve to evaluate the impact of learning on performance. The goal, as always, is to bring learning and working as close together as possible.

For this reason, it often makes sense to align evaluation practices with existing quality measurement frameworks used in the workplace, such as Lean or Six Sigma. Both are grounded in principles of continuous improvement, where learning plays a key role.

Ideally, such evaluation efforts are developed and conducted collaboratively, with involvement from supervisors, colleagues and even stakeholders from other departments. This not only strengthens the validity of the evaluation but also reinforces a shared commitment to learning-driven improvement.

Customer research

Customer research is a widely used method in service organisations to assess the performance and behaviour of employees. For example, national rail operators may evaluate how well conductors inform passengers during a journey, or helpdesk providers may collect feedback on the friendliness and effectiveness of their staff.

A common tool in such evaluations is the Net Promoter Score (NPS), which measures the likelihood that a customer would recommend the product or service to others. These kinds of insights can provide valuable information about how well employees are applying their competencies in practice.

Importantly, customer research doesn't always have to be initiated by the organisation itself. The internet is full of independently shared reviews, on platforms covering products, online stores and hospitality services, where customers share their impressions freely. These informal data points can also shed light on employee performance and service quality.

In the context of evaluating the impact of learning, customer research can help determine whether the original organisational goals have been achieved. For example, if a training programme aimed to increase customer satisfaction, customer research offers a direct way to assess whether that goal has been met.

In this way, customer feedback becomes a valuable performance indicator, not just for quality assurance, but for measuring the real-world effects of learning and development efforts.

Design examples – Field 7: Performance

Example one

The goal of the educational intervention was, as described in Field 2/3, to have policy makers incorporate bioeconomy into their policy creation processes. When clarifying the 'future work situation,' top-level officials were asked about what they wanted to see in future practice. Now that the intervention is concluded, it is time to assess whether actual transfer has taken place. One immediate way to evaluate this is through performance management within the HR cycle. Policy makers' managers assess whether new behaviour is displayed during job appraisals, based on observations and evaluation of work quality. This provides an initial indication of knowledge transfer and behavioural change. However, because policy impact develops over time, a long-term approach is necessary. To measure sustained application of bioeconomy principles, follow-up evaluations will take place one and two years after program completion. These follow-ups include:

- Document analysis of enacted policies to determine whether bioeconomic considerations are consistently incorporated and if policies supporting bioeconomy were adopted. Word count is used to give a sense of increased focus on the bioeconomy.
- Interviews with policy makers and their managers to assess ongoing application of knowledge and perceived effectiveness.
- Stakeholder consultations (e.g., with bioeconomy experts, industry representatives) to evaluate whether changes in policy are visible in practice.

Integrating these longitudinal evaluations helps the intervention to move beyond short-term learning and facilitates a lasting impact on policy-making processes.

Example two

The ultimate goal of the program was for participants to successfully transition into employment and maintain their positions in the long term thus leading to organisational but also societal benefits. To measure whether the newly acquired skills and workplace behaviours were being applied effectively, performance management structures within the participating businesses played a key role in monitoring progress. Once participants entered the workforce, their supervisors and mentors continued to provide feedback, assessing their ability to:

- Independently perform core job tasks in process operation or logistics.
- Follow workplace protocols and safety regulations.
- Adapt to work routines and collaborate effectively with colleagues.

These evaluations were integrated into regular workplace performance management cycles, ensuring that skill application and professional growth remained an ongoing process rather than a one-time assessment. The local government provided commitment and funding for the reporting cycles.

Recognizing that some participants might face challenges in maintaining long-term employment, the local government maintained a support structure to intervene if relapse or difficulties with job retention arose. If a participant struggled to adjust to the work environment or required additional support, they could access coaching, additional training, or social assistance to help them stay on track.

This combined approach, industry-driven performance monitoring and government-backed support for long-term integration, ensured that participants were not only placed into jobs but also had the tools and resources needed to sustain their employment and build stable careers.

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Click here to read the next design examples – Field 8, page 85

Field 8: Organisational results

Figure 11. Underlying questions in the Eight Fields Model - Field 8

This last field, Field 8 is aimed at organisational and societal results and how they can inform the design of education and training programmes. This chapter presents several strategies, along with a step-by-step guideline, to help establish a strong and meaningful link between learning design and broader organisational outcomes.

Evaluation of organisational & societal impact

This section dives into the organisational results and how they can be measured. These results include societal impact which affect potential organisations in the collective which develops education or are part of the broader context in which these organisations operate. This chapter is based on Deliverable 5.1 from the BioGov.net project.

Organisational impact can best be defined by using annual reports and annual plans of the organisation. Specific intended results can be derived from these types of reports. Metrics such as revenue generated or costs reduced might be indicators that align with specific organisational goals. It becomes more complicated when it is about societal impact. What follows in this chapter is focussed on the societal impact. The steps could also be used for organisation specific goals. Societal goals are often organisational goals for institutions such as municipalities or the local government. By involving parties with goals that relate to the societal impact alignment can be reached and potential resource exchanges can take place. Specific (government-funded) subsidy programmes and funds also commonly have targets that represent societal impact. In this manner these types of funds also help an educational organisation align with societal goals by applying to such grants.

To effectively measure the societal impact of bioeconomy education tracks, focus should be shifted to an individual learner's success and delve into how participants are contributing to broader societal goals. Instead of solely tracking an individual's career advancement, concentrate on how participant contribute to environmental sustainability as well as social causes. For example, *are they developing and implementing innovative solutions minimalizing environmental impact within the bioeconomy sector? Are they actively reducing their carbon footprint and promoting sustainable practices in their professional roles?*

Metrics can be defined by following these key steps:

- **Define** (Societal) Impact Outcomes: clearly articulate how participants and potentially educators will contribute to environmental sustainability, economic growth, social equity (such as food security, access to healthcare, or poverty alleviation) and community development.
- **Choose** Appropriate Measurement Methods: utilize a combination of methods, including case studies, SROI analysis, community partnerships and longitudinal studies.
- **Collect** Data from Multiple Sources: gather data from various sources, such as employer surveys, peers, coaches, making use of alumni engagement tracking and media analysis.
- **Analyse** and Interpret Data: utilize both qualitative and quantitative data analysis techniques to gain a comprehensive understanding of (societal) impact.
- **Communicate** Findings Effectively: develop compelling narratives and reports that showcase the (societal) impact of participants and advocate for the continued development of bioeconomy education.

To effectively measure these societal impacts, collaborate closely with local communities, non-governmental organisations (NGOs) and businesses. Conduct in-depth case studies that showcase how your graduates are applying their knowledge and skills to address real-world societal challenges through innovative bioeconomy solutions.

Consider utilizing the Social Return on Investment (SROI) framework to quantify the social and environmental value created by your graduates' work. This approach allows you to assess not only the financial returns but also the broader social and environmental benefits generated by your educational programmes. Specifically, to the biobased industry metrics can be added related to revenue in the bioeconomy, circularity (virgin material usage) and interdisciplinarity.

Conduct longitudinal studies to track the long-term career trajectories of participants and assess their ongoing contributions to societal impact over time. This will provide valuable insights into the enduring impact of your educational programmes on the biobased sector and society.

By focusing on these societal impact-driven approaches, you can effectively demonstrate the value of bioeconomy education programmes to stakeholders, including funders, policymakers and the public. It helps to showcase how participants are not only building successful careers but also making a significant and positive impact on the world through their work in the biobased sector.

Recommendations

- Start with a focused approach: Begin with a few key societal impact indicators and gradually expand the measurement framework as the programme matures.
- Involve stakeholders throughout the process: Seek input from learners, employers, community members and other stakeholders to achieve a higher likelihood that impact measurement efforts are relevant and meaningful.
- Continuously refine the approach: Regularly review and refine the impact measurement strategies based on the findings and the evolving needs of the bioeconomy sector.

By implementing these strategies, the societal impact of biobased training programmes can be shown, and they help contribute to the development of a more sustainable and equitable future.

Design examples – Field 8: Organisational Results

Example one

To determine whether the educational intervention has achieved its goal and addressed the problem identified in Field 1, multiple evaluation methods will be used.

One approach is to repeat parts of the original BioVoices study to examine whether policy makers continue to be seen as a barrier to bioeconomic development or if improvements have been made. A policy analysis will also be conducted on newly enacted policies to assess whether they align more closely with bioeconomy principles and whether policy documents explicitly reference bioeconomic considerations.

However, because policy outcomes are shaped by multiple external factors, a more comprehensive approach is needed. To strengthen the evaluation, two additional methods will be employed:

Qualitative Follow-Up

- Semi-structured interviews with policy makers and key stakeholders (e.g., bioeconomy experts, industry representatives and policy advisors) will provide insights into how bioeconomic principles are being applied in practice.
- Focus groups will be held with participants from the intervention to discuss challenges and success stories, helping to uncover whether bioeconomy is now seen as an integral part of the policy-making process.

Comparative Benchmarking between regions

- To better isolate the impact of the learning intervention, policy-making practices in the participating regions will be compared with non-participating regions.
- This will help determine whether the observed improvements in bioeconomy-related policymaking can be attributed to the educational intervention rather than external factors such as broader governmental priorities or economic trends.

By integrating both quantitative (policy document analysis) and qualitative (interviews, focus groups) methods, along with a comparative approach, this evaluation becomes an accurate measure whether the intervention has led to sustained improvements in bioeconomic policymaking.

Example two

The effectiveness of the programme was evaluated on two levels: the organisational results for participating businesses and the broader societal impact for the region. For businesses in the industrial park, success was measured by whether the intervention effectively addressed labour shortages and contributed to a more stable workforce. Key indicators included:

- Labour force up to strength – More vacancies filled with trained employees, reducing hiring bottlenecks.
- Increased productivity – Workers trained specifically for their roles, reducing onboarding time and improving efficiency.
- Cost reduction – Less reliance on expensive temporary staffing solutions and lower recruitment costs due to a steady supply of skilled workers.
- Revenue impact – With a stable workforce, businesses could operate at full capacity, reducing downtime and improving overall output.

For the local government, the program's success was measured by its ability to help citizens achieve economic self-sufficiency and reduce reliance on government assistance. Societal benefits included:

- More economically self-sufficient citizens – Participants gained stable employment, leading to financial independence.
- Reduced use of social benefits – As more individuals entered the workforce, reliance on unemployment benefits, welfare and other government handouts decreased.
- Lower demand for social support services – With participants successfully integrated into the labour market, there was less strain on municipal employment and social aid programs.
- Reduced unemployment rates – The program contributed to a more inclusive workforce, lowering the number of individuals classified as long-term unemployed.

By addressing both business needs and societal challenges, the programme created a sustainable employment pipeline that not only strengthened the local economy but also improved social mobility and economic participation for marginalized groups.

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Final remarks

The Eight Fields Model offers a robust, evidence-based and adaptable framework used to develop this guideline for designing bioeconomy training programmes tailored to the unique needs of diverse regions and stakeholder groups.

By integrating insights from local case studies, policy workshops and interdisciplinary approaches, this model facilitates inclusivity, practicality and alignment with the overarching goals of the BioGov.net project.

We encourage stakeholders, educators, policymakers, industry leaders and community organizers, to engage actively and work together with this model. Its structured, yet flexible methodology facilitates collaboration, innovation and long-term sustainability in bioeconomy education. By embracing the model, you contribute not only to the development of effective training programmes, but also to fostering social inclusion and driving transformative change within the bioeconomy sector.

Let this model be a catalyst for meaningful action, inspiring partnerships and equipping individuals with the skills and knowledge to build a sustainable future.

Appendix

Step-by-Step plan for designing a Competency Assessment

The design of a competency assessment proceeds in several steps. These are listed below. The first and second steps are crucial in making the right choices regarding the circumstances under which the evaluation takes place and the methods to be used. Then follows the concrete elaboration of the selected methods and the specification of evaluation criteria.

Step 1: Choose the most suitable and feasible situation to assess competencies

The situation that best ensures that the learner can demonstrate the desired competencies. The work environment is often most suitable, but in some cases, this is not feasible. The feasibility is also determined by:

- Financial considerations
- Organisational considerations
- Availability (of the desired people and resources)
- Ethical considerations (e.g., privacy of clients, patients)
- Safety risks
- Choose appropriate evaluation methods

Step 2: Choose fitting evaluation methods

Often, one method is not sufficient to get a good picture of the learner's competencies. In that case, a combination of methods is desirable; we call this a method mix. Choose the methods that best match the (aspects of) competencies that the learner must demonstrate.

Step 3: Develop Tasks/Tests

- Develop per method the task(s)/tests that the learner must perform. Clearly state what is expected of him or her.
- Describe per task the tools available to the learner during the activities/tests (computer, manual, instructions, materials).
- Check whether the task contains all the desired elements: does the task elicit the desired behaviour? Is the task representative and realistic?

Step 4: Work out the evaluation criteria per task/test

- Formulate per task the criteria based on which the competencies will be assessed/tested. Describe these criteria in terms of observable behaviour and/or product characteristics.
- Describe these criteria in terms of observable behaviour and/or product characteristics. Keep the number of criteria limited, especially if it is an observation (work sample). Align the criteria with the sequence of actions.

Step 5: Develop per task/test an assessment form and scoring instructions

Develop an easy-to-use and clear form on which the assessor can record the score based on the criteria. Consider how you want to score (yes-no, sufficient-insufficient, five-point scale, etc.). Indicate how the score should be converted into an overall rating (for example, by calculating a total score). Add an instruction to the form on how it should be used.

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