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# Moocs And In-Service Teacher Training: Towards An And Andragogical Design Framework

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***Abstract***
*Despite the growing importance of MOOCs (Massive Open Online Courses) in the contemporary educational landscape, their theoretical foundation, particularly with regard to their use for the continuing education of practicing teachers, remains relatively understudied. However, the quality and effectiveness of these programs depend heavily on a solid conceptual framework capable of guiding their pedagogical design. This study aims precisely to fill this gap by proposing a structured theoretical framework for the design of MOOCs dedicated to teacher training and professional development, drawing on adult learning theories. It emphasizes an integrative approach, based on the analysis of six adult learning models frequently used in the scientific literature: Knowles's andragogical model, Tough's model, Schön's reflective practitioner model, Mezirow's transformation model, Kolb's experiential model, and the situated cognition model. The methodology adopted combines qualitative and comparative analysis, structured around two complementary axes. On the one hand, a comparative and systemic approach allows us to identify the fundamental principles and convergences between different learning models. On the other hand, a model-based instructional design approach allows us to translate these theoretical principles into concrete design tools, such as learning scenario diagrams. These tools allow us to visualize, from the design phase, the training paths adapted to each model or to combinations of models.*
*The results of this study reveal that each theoretical model provides distinct and complementary elements which, when integrated coherently, allow us to design MOOCs that are flexible, relevant, and adapted to the specific needs of adult educators. This approach promotes the personalization of learning paths, taking into account learners' professional experience, their intrinsic motivations, their ability to reflect on their practices, and their learning environment.*
*The originality of this research lies in its desire to go beyond a single-model approach to propose a hybrid and operational theoretical framework applicable to the design of MOOCs geared towards continuing teacher education. This framework constitutes a significant step forward towards more refined and more contextualized educational engineering of digital training devices, in line with the requirements of adult learning.*
***Keywords:*** *MOOC design, teacher training, adult learning theories, andragogical modeling,*

## 1 INTRODUCTION

In the context of in-service teacher training, MOOCs have positioned themselves as an alternative technological solution to the problems and obstacles that constrain face-to-face training, time, generalization, and teacher mobilization. However, despite their enormous technological potential, MOOCs remain limited and subject to several challenges (Shah, J., & Khanna, M. 2022; Lu, Y. ,and al, 2022). Many recent studies show that most MOOCs aimed at teacher training are developed in an ad hoc or technology-driven way, often focusing on content delivery without explicitly addressing how adults learn (Pellas, N.,2025; Pherali, T., 2025 ). Authors such as Lewis and Stavermann point out that MOOCs continue to be provided in the form of video lectures followed by interactive quizzes, without, however, having a referential theoretical framework structured around models of adult learning in their design (Singh, A. B. ,and al., 2023; Stavermann, K.,2025).

The lack of an explicit theoretical framework guiding the design of MOOCs for in-service teacher training is also a major challenge, and several authors have highlighted the importance of using theoretical frameworks modeling adult learning for the relevant and adaptive scripting of teacher training via MOOCs (Rodrigo, C. and al, 2024; Duchaine, M.-P. and al.,2024). The literature on adult learning offers a variety of models, Knowles' andragogical, Tough's self-directed learning, Mezirow's transformative learning, Kolb's experiential learning, etc.( Barhone, J. E. and al, 2024), which are, however, rarely integrated explicitly and comprehensively into the design of these MOOCs (Murray-Johnson, K., & Dewsbury, B. M., 2024).

At the same time, other recent studies have called for the modeling and formalizing of teacher training scenarios via MOOCs and the constructive alignment of technological solutions with pedagogical

dimensions relating to adult learning (Hmedna, B. and al., 2023). It follows that a theoretical and integrative framework combining several adult learning models could advance the upstream design of MOOCs for teacher training, which are centered on the learner-teacher, experimentation, collaboration, and the sharing of cognition.

The aim of this article is precisely to analyze six models of adult learning most cited in the adult education literature, synthesize their contributions, and formalize them in a visual pedagogical model. This model explicitly structures MOOC scenarios for teacher training, promoting relevance and coherence between the adult learning model and the training scripting model. The originality of the study lies in the fusion of various theories on adult learning in the upstream design of MOOCs, and the implementation of a new approach to the use of pedagogical engineering in one area of MOOC design for teacher training.

## 2 LITERATURE REVIEW

### *2.1 MOOCs and teacher training*

The literature confirms the growing role of MOOCs in teacher training. MOOCs have been used to overcome resource constraints and geographical barriers, particularly in underserved regions. According to Misra, P. K. (2018): 'the use of MOOCs for teacher professional development is increasing in different parts of the world', providing cost-effective mass training opportunities. Empirical studies by Yoon et al (2020), Sezgin (2020), Phan and Zhu (2020), Anghel et al (2024), and Stutchbury et al (2023) confirm that the majority of teachers see MOOCs as an environment conducive to self-training and the diversification of didactic approaches, promoting autonomy and the construction of new skills, particularly digital skills (Cerveró-Carrascosa, A., 2022; Zou, X., et al., 2024).

Despite this promise, systematic reviews have identified several challenges associated with the use of MOOCs for in-service teacher education (14. Misra, P. K., 2018; Wurth, S, et al., 2023 ). The most common issues are low completion rates, uneven participation and the variable quality of instructional design, in particular, is cited as a critical factor influencing engagement and learning outcomes. Yet many MOOCs adopt a technology- or content-centric approach, without an explicit grounding in learning theory.

As Buhl et al (2018) argue, the 'proliferation' of MOOCs forces us to rethink conventional pedagogy and consider new design conditions. They note that MOOCs can fragment the role of the teacher and transfer responsibilities (e.g. planning, scaf-folding) to other actors. Similarly, the design of MOOCs for in-service teacher training has been characterized by pragmatic guidelines rather than integrated theory: for example, the study by Jahnke et al (2021), presents a set of sociotechnical-pedagogical (STP) heuristics aimed at assessing the usability of online courses for adult learners. These heuristics encompass aspects such as promoting active learning, aligning curricula and promoting collaboration.

Although these guidelines highlight important practices such as authentic tasks, standards-based content and peer interaction, they are not explicitly derived from underlying learning theories

### *2.2 Adult learning*

Adult education research has established key theories that describe how adults learn and what they expect from teaching. Malcolm Knowles' andragogy assumes that adult learners are self-directed, intrinsically motivated and rich in prior experience (Knowles, M. S.,1980). Relevant learning must therefore be centred on authentic problems and must enable autonomy (Pendergast, D., et al, 2024). Kolb's experiential learning theory also emphasises that adults learn through cycles of concrete experience, reflective observation, abstract conceptualisation and active experimentation (Kolb, D. A., 1984). Mezirow's transformative learning theory adds that adults can profoundly change their perspective by engaging in critical reflection on their assumptions (Mezirow, J.,1991). Schön's reflective practitioner model complements this theory by emphasizing that reflection in and on action is fundamental to professional learning (Schön, D. A.,1983). Tough has shown how adults engage in self-directed learning projects, focusing on planning, goal setting and learning strategies such as journaling (Tough, A., 1979).

These theories suggest that MOOCs for teachers should incorporate elements such as problem-based tasks, authentic projects, opportunities for reflection and social learning contexts. The problem is that no single model captures the full complexity of adult learning; each model emphasizes different aspects. Mezirow's emphasis on critical reflection can guide the inclusion of discussion forums, while situated cognition suggests creating authentic tasks linked to real classroom contexts, this is the perspective of situated cognition (or situated learning). Lave, J., & Wenger, E. (1991), further emphasize that adult learning is

intrinsically contextual and often social: learning occurs when individuals participate in authentic communities of practice. Contemporary studies echo these themes: Pendergast et al (2024), note that adult learners thrive on self-direction, relevance, experience and collaboration. More specifically, Knowles' andragogical hypotheses and Kolb's cycle "emphasise the importance of recognizing adult experiences as foundations for learning, with cycles of experience, reflection and active experimentation".

### *2.3 Andragogical modeling and scenario design.*

In instructional design, the concept of instructional modelling or learning design bridges the gap between theory and practice. An instructional model explicitly represents learning activities, roles and materials in a way that can be translated into lessons. The literature on learning design emphasizes that formalizing an educational process into a 'pedagogical scenario' can ensure alignment between objectives, activities and assessments. Amorós-Poveda et al (2022), explain that a learning design essentially becomes an instructional scenario describing the entire educational experience.

In other words, well-designed scenarios serve as blueprints that incorporate pedagogical intentions. For MOOCs, scenario modelling can help to scale up proven pedagogical strategies: for example, the use of pedagogical modelling languages (UML) or learning design platforms to script teacher training sequences. In the context of teacher MOOCs, a scenario-based approach allows designers to incorporate and sequence elements suggested by adult learning theory (e.g. reflection phases, peer activities, practice) into a coherent narrative.

Despite these possibilities, few studies have attempted to integrate multiple adult learning theories into a unified instructional design for MOOCs. Previous work on MOOCs for in-service teacher education tends to focus on specific dimensions, e.g. collaboration, alignment, or to discuss MOOCs from a technological perspective (Buhl, M. AND AL. ,2018 ). There is a clear gap in a model-driven engineering approach that maps established adult learning principles to MOOC design elements. This study fills this gap by systematically comparing the main theories and synthesizing their strengths within an integrative pedagogical framework.

## 3 RESEARCH DESIGN

### *3.1 Research problem and questions*

The above review reveals a problematic paradox: while adult learning theories and learning design frameworks are well developed, MOOCs for in-service teacher training often lack an explicit theoretical foundation. The field needs models that can translate theory into practical course designs. The specific research question addressed in this study is: How can several adult learning theories be integrated into a coherent pedagogical framework to design MOOCs for in-service teacher training? In service of this question, we also ask: What unique contributions does each model offer, and how can they be combined to support constructive alignment and effective scenario planning in MOOCs for continuing teacher education? This study thus responds to calls for more robust theory-based design in online professional learning (Wurth, S. and al.,2023 ; Amorós-Poveda. and al., 2022).

### *3.2 Method and materials*

To answer these questions, we applied a qualitative and comparative methodology. Drawing on previous work in the field of model-based instructional engineering, we first identified six models of adult learning most cited in the literature: Knowles' andragogy, Tough's self-directed learning, Schön's reflective practice, Mezirow's transformative learning, Kolb's experiential learning cycle, and the situated cognition model. We then carried out a comparative and systemic analysis of the fundamental principles of each model and their implications in terms of design. To do this, we reviewed the fundamental and recent literature on each theory to extract its main objectives (e.g., learner autonomy, reflection), key mechanisms (e.g., critical thinking, authentic experience), and recommended learning activities.

We then synthesized these results in a model-driven design process. We developed pedagogical scenario diagrams for each theory and for plausible "mixed" scenarios that combine elements. These diagrams describe, for example, how a MOOC module might be structured according to a given model (figure references have been omitted for the sake of brevity). By comparing these diagrams, we identified overlapping and complementary aspects of the theories. This iterative analysis enabled us to distill an integrative model: a multi-dimensional visual framework aligning theoretical concepts with pedagogical strategies.

Throughout our design process, we drew on the principles of constructive alignment and scripting. We ensured that the proposed framework explicitly links learning objectives (based on theory) to learning activities and assessments. The material used for this study consists of adult learning literature, as well as design artifacts (tables and diagrams) produced during our analysis. Although the approach is conceptual, it reflects a practical instructional engineering perspective, similar to research approaches on instructional models and learning design.

## 4 RESULTS AND DISCUSSION

The literature on adult learning highlights a diversity of models that can be grouped into three main complementary categories according to their pedagogical orientation, as shown in Tables 1, 2, and 3. Each category offers its own structuring of pedagogical scripting. Their cross-referencing leads to rich, adaptive, and coherent pedagogical scenarios.

### *4.1 Adult learner-centered model:*

These approaches emphasize personalization and personal transformation, providing a rich, reflective, and adaptive environment.

**Table 1: Adult learner-centered models**

| Model | Key target | Key mechanism | Recommended activities |
|---|---|---|---|
| Andragogy Knowles | - Autonomy<br>- Motivation | - Choice<br>- Contextualization | - Choice of learning paths<br>- Authentic problem situations |
| Tough's auto_direction | - Individualization | - Rich and open resources | - Learning logs<br>- Self-evaluation |
| Transformative learning (Mezirow) | - Change of reference framework | - Critical reflection<br>- Debate | - Critical forums<br>- Cognitive dilemmas |

The diagram in Figure 1 represents a translation of the learner-centered training scripting model. Inspired by the andragogical models of Knowles (1980), Tough (1971), and Mezirow (1991), it is specifically adapted to in-service teacher training. The model is structured in seven progressive stages that reflect the fundamental principles of adult learning.

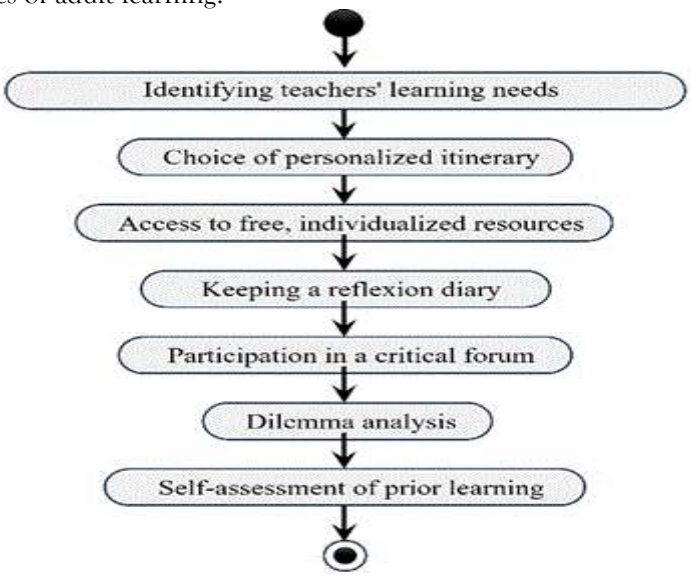


Figure 1: Instructional design diagram for learner-centered teacher training

This figure illustrates a structured professional learning process for teachers, aimed at individualising and optimising their professional development. Here is a step-by-step interpretation:

*Identifying teachers' learning needs*: This is the first key stage in personalising the course. Existing skills and those to be developed are assessed..
*Choice of personalized itinerary*: Depending on the needs identified, each teacher chooses a course adapted to their objectives.
*Access to free, individualized resources* **:** Teachers receive personalised teaching materials to support their learning.
*Keeping a reflexion diary*: The teacher records his or her thoughts, progress, challenges and experiences, which encourages metacognition.
*Participation in a critical forum:* interacting with peers to discuss, compare ideas and improve understanding through dialogue.
*Dilemma analysis* : Study of real or simulated problematic situations, promoting ethical and professional reflection.
*Self-assessment of prior learning:* The teacher assesses their progress and the skills acquired, to become aware of their development.
This figure represents a reflective, personalized, and collaborative approach to continuing education, centered on the teacher. It encourages autonomy, critical reflection, and continuous evaluation, with a view to continuously improving professional practices.

### *4.2 Experience-centered models:*

These models require an action-reflection-action loop, strongly integrated into the progression of the modules.

**Table 2: Experience-Centered Models**

| Model | Key mechanism | Recommended activities |
|---|---|---|
| Kolb (experiential) | - Experience cycle<br>- Reflection<br>- Theory<br>- Test | - Simulations<br>- Real-life situations<br>- Projects |
| Schön (reflexive) | - Reflection-in-action and over-action | - Case studies<br>- Reflective portfolio<br>- Feedback |

The diagram in Figure 2 formalizes a pedagogical approach based on Kolb's experiential and Schön's reflective models, widely used in teacher professional development. This model begins with the initiation of a concrete activity, in the form of a project or simulation. This active phase forms the empirical basis for learning, in line with the first moment of Kolb's cycle (concrete experience). It is followed by guided reflection on the experience, which initiates the process of transforming action into knowledge.
The next step is to conceptualize the lessons learned through theoretical input (readings, presentations, models). This linking of experience and knowledge enables the learner to structure a transferable understanding. The scenario then provides for re-application in a new professional situation, reinforcing the action-reflection-action loop.

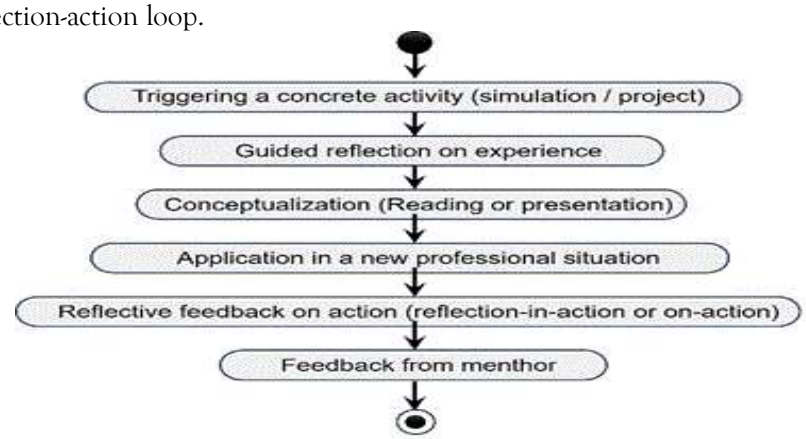


**Figure 2: Instructional Design Diagram for Experience-Based Teacher Training**

The model's innovation lies in reflection-in-action and on-action (Schön, 1983), integrated as an intermediate stage, essential to the analysis of practice. The process concludes with feedback from the supervisor, guaranteeing a complete formative loop. The strengths of this model lie in:

- Its concrete anchoring in professional action;
- The structuring of a rigorous experiential learning cycle;
- The integration of contextualized reflective moments;
- An emphasis on the teaching experience as the main driver of learning.

This model is particularly well suited to immersive devices (workshops, internships, pedagogical simulations), but can be transposed to MOOCs if phases of reflective feedback and real-life situations are included.

### *4.3 Socioconstructivist and techno-pedagogical models:*

These models extend learning beyond the individual scenario by activating social, technological, and collaborative dynamics.

**Table 3: Socioconstructivist and techno-pedagogical model**

| Model | Added value | Recommended scripting |
|---|---|---|
| Distributed cognition | - Co-construction + digital tools | - Collaborative space, shared tools, simulators |
| Situated cognition (Lave/Wenger) | - Community and contextual learning | - Situated activities, learning community |
| Connectivism (Siemens/Downes) | - Networking, dynamic adaptation | - Forums, blogs, IA adaptative, ressources participatives |

The diagram in Figure 3 illustrates a pedagogical scenario rooted in socioconstructivist and connectivist models, adapted to digital environments and open devices such as MOOCs. It is based on the principles of situated learning, the co-construction of knowledge, and the mobilization of networks of actors and resources.

The sequence begins with the activation of an online collaborative space, designed as a place for interaction, shared production, and identity anchoring. Enrolment in a learning community reinforces the sense of belonging and the social dynamics of learning, as proposed by Lave & Wenger (1991) in their approach to peripheral legitimate learning.

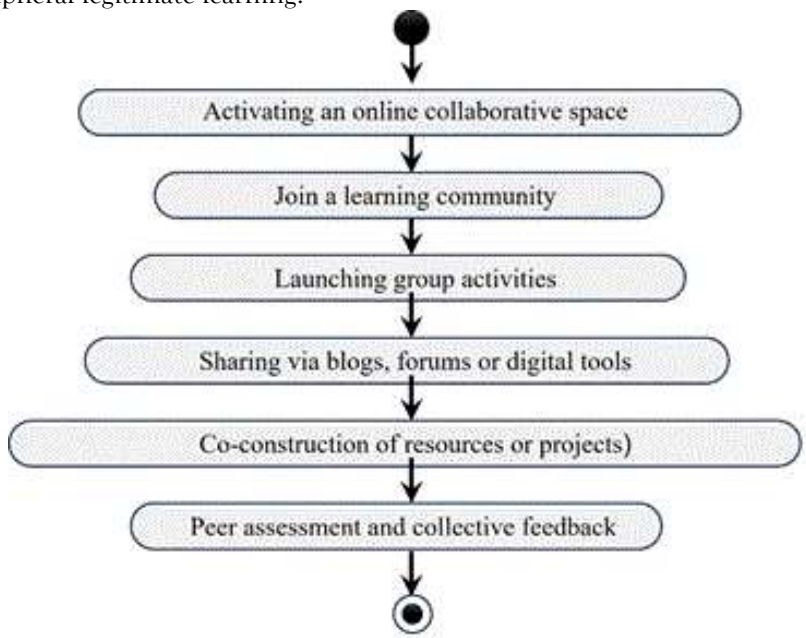


**Figure 3: Pedagogical design diagram for teacher training centered on socioconstrutvism and techno-pedagogy**

Launching group-based activities encourages engagement in contextualized, relevant, and meaningful tasks. Digital tools (forums, blogs, wikis) then facilitate the circulation of knowledge and the traceability of learning, while stimulating synchronous or asynchronous exchanges (connectivist approach).

The step of co-constructing resources or projects enables the pooling of experience, knowledge, and skills, with a view to collaborative production. Finally, the process concludes with peer evaluation, reinforced by collective feedback, guaranteeing cross-validation of learning and reflective feedback on contributions.

- The strengths of this model are:
- A strong social dimension to learning;
- An active mobilization of digital tools to support collaboration;
- The encouragement of an authorial and contributory posture among teacher-learners;
- The creation of a sustainable learning community of practice.

This model is perfectly suited to connected, massive, and distributed environments, particularly in contexts of open continuing education or collaborative distance learning.

### *4.4 Integrative model*

The following diagram presents an integrative model of pedagogical scripting, based on a cross-analysis of the main models of adult learning. It enables three complementary logics to be aligned in a single training scenario: learner empowerment, reflective experimentation, and collaborative and situated learning. The model's starting point is a choice of entry points based on teachers' professional needs, which directs participants towards three parallel entries:

- The self-study pathway (Knowles, Tough) provides access to personalized resources, learning journaling, and self-assessment, fostering autonomy and learning regulation.
- The collaborative pathway (distributed cognition, connectivism) mobilizes a contextualized problem, a critical forum, and then a team project, encouraging co-construction and social engagement.
- The reflective pathway (Mezirow, Schön) uses case studies, guided reflection, and coaching or feedback to stimulate the transformation of frames of reference.

These three paths then converge on a common central phase structured around:

- theoretical contributions (lectures, readings, webinars),
- active experimentation (projects, hands-on experience),
- simulation or role-playing,
- reflection-in-action (Schön), favoring adjustment in context.

Finally, the model provides for cross-assessment, followed by peer assessment, and then a final individual project, shared with the learning community via a collaborative digital space (blog, wiki, practice forum).
The strengths of this integrative model are:

- It offers a differentiated and personalized entry, respecting adult learning profiles.
- It ensures a coherent pedagogical progression, integrating theory, practice, and reflexivity.
- It values individualization, experimentation, and the social anchoring of learning.
- It is structured according to the principles of pedagogical alignment and favors modular and adaptive scripting, relevant to open devices such as MOOCs.

This model thus offers a complete and theoretically grounded pedagogical engineering, capable of guiding the design of online training devices for teachers, while remaining compatible with hybrid or contextualized environments.

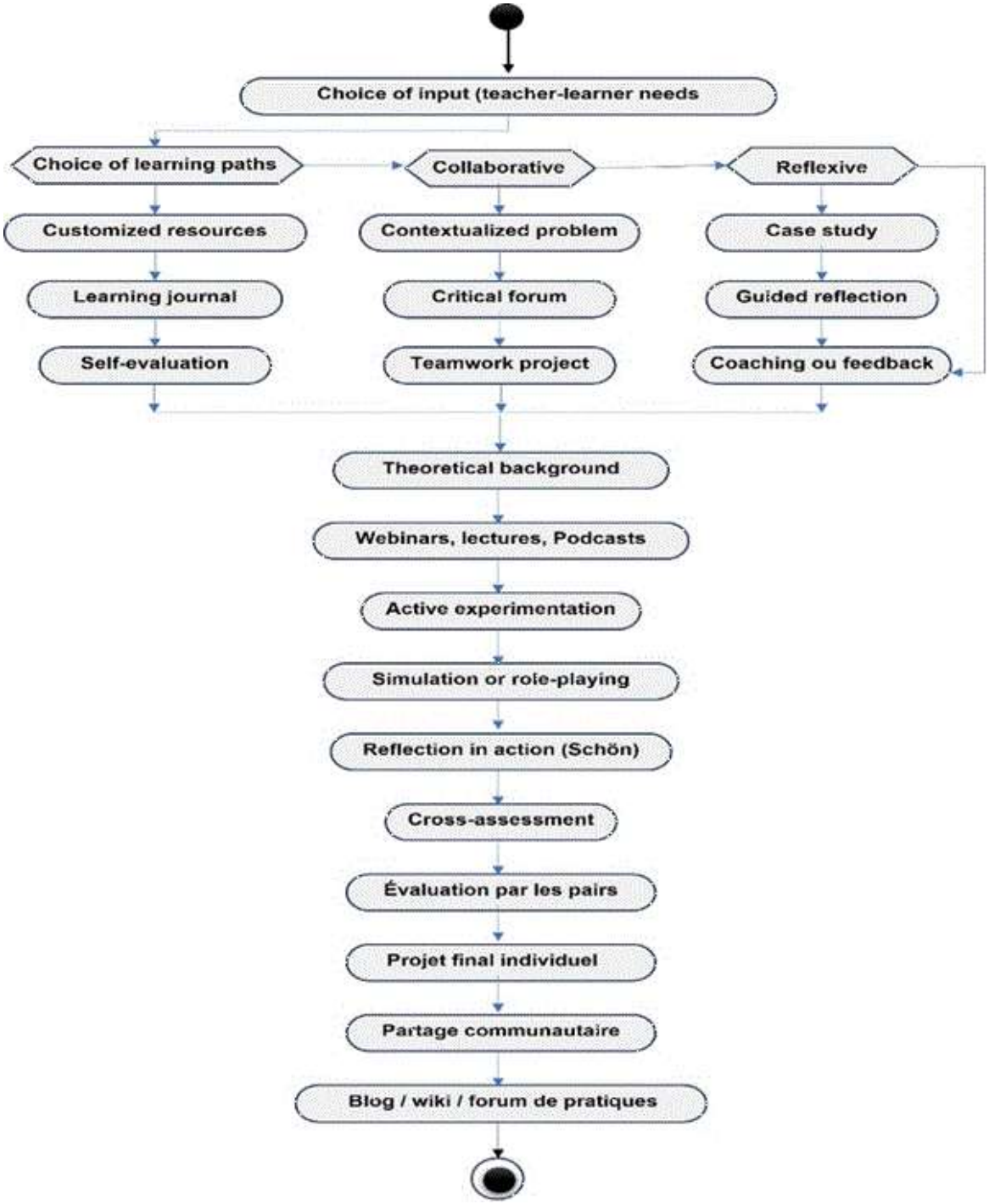


**Figure 4: Pedagogical scripting model taking into account all the pedagogical dimensions of adult learning**

Figure 4 represents a developed and differentiated model of professional development for teachers, based on their specific needs. It highlights a modular approach, integrating different learning styles (autonomous, collaborative, reflective), varied resources and active teaching methods.

The starting point: Choice of input (teacher-learner needs): allows for the identification of learning needs, then a division into three main learning axes:

A. Autonomous

- Choice of learning paths: Choice of adapted learning paths.
- Customized resources: Personalized resources.
- Learning journal: Reflective learning journal.
- Self-assessment: Self-assessment

B. Collaborative

- Contextualized problem: Problem situated in a real-world context.

- Critical forum: Forum for critical discussion.
- Teamwork project: Collaborative group project.

C. Reflective
- Case study: Analysis of case studies.
- Guided reflection: Guided reflection.
- Coaching or feedback: Supervision and formative feedback.

These three axes then converge towards a common core of training activities.
Then a central training phase:
- Theoretical background: Theoretical foundations.
- Webinars, lectures, podcasts: Multimedia content.
- Active experimentation: Active practice.
- Simulation or role-playing: Role-playing or simulations.
- Reflection in action (Schön): Reflection in action (Donald Schön model).
- Cross-assessment: Peer-to-peer assessment.
- Peer assessment: Mutual self-assessment.

Finally, a final product and community anchoring:
- Individual final project: Development of a personal project.
- Community sharing: Sharing of products and learnings with the community.
- Blog/wiki/practice forum: Tools for disseminating and capitalizing on professional knowledge.

In conclusion, this figure illustrates a hybrid and integrated professional development model, combining:
- Individualization (courses and resources),
- Collaboration (forums, projects, cross-assessment),
- Critical reflection (guided, contextualized), and community anchoring (via collaborative platforms).

It is a holistic model that aims to empower teachers while engaging them in a collective dynamic of ongoing professional development.

## CONCLUSIONS

This work forcefully underlines the importance of an explicit theoretical framework rooted in adult learning theories for the design of distance learning devices for teachers. All too often, MOOCs are developed without clear reference to fundamental pedagogical principles, which undermines their effectiveness and capacity for professional transformation. By mobilizing proven models - such as those of Knowles, Mezirow, Schön, Kolb, Tough, and Lave & Wenger - this framework provides a solid basis for structuring training paths that are relevant, adaptive, and respectful of the specificities of adult learners.

The originality of this research lies in the systematic translation of this theoretical framework into scenario diagrams. This visual modeling makes it possible to represent possible learning paths, anticipate learning flows, and ensure alignment between objectives, activities, resources, and assessments. It provides designers with an operational framework for structuring and managing training engineering right from the design stage. The use of UML diagrams, in particular activity diagrams, is a relevant pedagogical innovation, as it facilitates the formalization of scenarios and their reuse in complex digital environments.

The prospects opened up by this work are numerous. The next step will be to operationalize these models in a technological platform capable of dynamically implementing the scenarios designed. This MOOC platform will have to integrate a modular and adaptive logic, enabling the generation of scripted modules according to the needs and profiles of teachers. The integration of educational technologies (collaborative spaces, reflective monitoring tools, simulators, adaptive intelligence) should be based directly on the structures described in the diagrams, thus ensuring pedagogical coherence, technical interoperability, and learning efficiency.

In short, this work provides the foundations for coherent pedagogical and technological engineering, where theory, visualization and implementation are articulated in a systemic logic. It provides a methodical response to the challenges of large-scale teacher training, and lays the foundations for a scientifically sound, visually structured, and technologically effective e-learning environment.

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