Received :19 Dec 2024 | Revised: 14 March 2025 | Accepted: 24 May 2025
DOI: 10.62460/IJEASS/2025.021

OPINIONBASEPAPER

Interdisciplinary Journal of Emerging and Social Sciences

Integrating Communication Tools in SPOC-Based Training: A Scenario-Driven Pedagogical Architecture

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Abstract
This article proposes a pedagogical framework for the integration of communication tools into a SPOC-based (Small Private Online Course) training model. Grounded in educational theory and empirical research, the study explores how a scenario-based architecture can enhance learner engagement, interactivity, and knowledge acquisition in digital learning environments. The model integrates four key communication tools: wiki, forum, chat, and video conferencing, strategically distributed across modular systems and aligned with the phases of learning. By combining pedagogical design principles with technological affordances, this research aims to contribute to the current discourse on the effectiveness and accessibility of online education, particularly in higher education.

Keywords
E-learning; Communication tools; Scenario-based architecture; Pedagogical integration; Higher education. SPOC.

1 | INTRODUCTION

Effectively incorporating communication tools into SPOC (Small Private Online Course)-based instruction can significantly improve both the learner experience and the quality of educational outcomes. Such integration is underpinned by well-structured pedagogical approaches that utilize diverse communication strategies aligned with various learning scenarios. By using digital communication tools, SPOC-based programs can encourage stronger engagement, collaborative learning, and responsive feedback elements that are essential for reaching instructional objectives. Merging scenario-based instructional design with digital communication technologies can greatly enhance the effectiveness of training. Huang and Annamalai, for instance, argue that sophisticated communication platforms are vital for supporting deep learning in hybrid models. In such frameworks, learners first access content online and then participate in face-to-face sessions that reinforce their understanding (Huang & Annamalai, 2024).

Moreover, Zhang et al. report that SPOC implementations across different academic fields have led to notable gains in student motivation and learning performance (Zhang et al., 2023). They promote a hybrid format combining mobile technologies with conventional teaching practices to enrich the learning process. Similarly, Pongen emphasizes that digital tools facilitate increased learner interaction and broaden access to authentic materials, reinforcing their pedagogical relevance (Pongen, 2024). Additionally, García-Sanjuán et al. highlight the role of virtual simulations in preparing medical professionals. They demonstrate how immersive activities, when paired with effective communication tools, can strengthen the essential skills required for clinical interaction (García-Sanjuán et al., 2024). This training model underlines the value of communication in cultivating a more immersive and engaging learning atmosphere.

Online communication fosters a collaborative environment and enhances engagement by connecting learners with course content, encouraging collaboration, providing constructive feedback, and promoting active learning (Ouariach et al., 2024). Online communication tools refer to applications and platforms that enable individuals to communicate and interact across distances (Zahra et al., 2024). This article proposes a

pedagogical framework for the integration of communication tools within a SPOC (Small Private Online Course)-based training model. Drawing on theoretical foundations and prior research, the study explores how a scenario-based architecture can enhance learner engagement, interactivity, and knowledge acquisition in digital learning environments. The objective is to provide a structured yet flexible model that incorporates both synchronous and asynchronous communication tools, aligned with the phases of learning and modular systems. In this work, we have integrated four communication tools: wiki, forum, chat, and videoconferencing. By combining instructional design principles with technological affordances, this article aims to contribute to current reflections on the effectiveness and accessibility of online training, particularly in higher education.

1.1 Pedagogical Integration of Communication Tools

According to the previous research, the management of communication tools within an online learning program through an LMS platform plays a crucial role in promoting interactive and effective learning. Learners have the opportunity to expand their knowledge through educational videos, which provide access to diverse and enriching content. Moreover, their participation in discussion forums allows them to exchange ideas, ask questions, and share reflections, thereby helping to create a collaborative and dynamic learning environment. The use of these tools fosters active learning and deeper reflection. Pedagogical strategies such as group discussions and sharing activities help learners develop critical thinking and analytical skills. For instance, forums can be used to debate key concepts, while wikis enable learners to co-construct knowledge through collaborative project work.

When these principles are applied to an online learning environment using the SPOC (Small Private Online Course) model, the instructional design becomes more complex and presents significant challenges. It is therefore essential to adopt a thoughtful techno-pedagogical model that integrates both asynchronous and synchronous learning components. Asynchronous learning allows learners to progress at their own pace, while synchronous sessions, such as videoconferencing, offer opportunities for real-time interaction and immediate feedback. Each communication tool—whether videoconferencing for live sessions, chats for quick exchanges, forums for in-depth discussions, or wikis for content co-creation—plays a key role in supporting the learning process. These tools must be carefully selected and integrated to align with pedagogical objectives and meet learners' needs. According to Khaldi et al., when designing an online learning scenario, it is essential to consider the different dimensions of learning, including the diversity of learning styles and levels of learner engagement. In this section, we will detail the management of online communication tools within the SPOC framework, taking into account the specificities of each tool and their interaction within the learning process.

1.2 Techno-Pedagogical Models

When we consider the design of online communication tools, it is generally structured as follows:

- **Synchronous Phase**

This phase typically takes place in real time using videoconferencing tools. Learners engage in interactive learning activities facilitated by the instructor. The instructor may lead in-depth discussions, pose thought-provoking questions, and collaboratively solve complex problems with active learner participation. Collaborative spaces such as virtual whiteboards or breakout rooms are used to allow learners to work together on case studies, hands-on projects, or simulations. The primary goal is to deepen previously acquired knowledge, apply it in realistic contexts, and collaboratively address complex problems.

- **Asynchronous Phase**

In this phase, learners continue their reflection and learning independently. They can ask additional questions and share their thoughts through moderated discussion forums. Complementary activities such as assignments, group projects, or additional readings are provided to reinforce learning.

1.3 Online Communication Tools

- **Synchronous Tools**

These are communication tools that allow multiple users to interact and exchange information in real time. This means that participants can send and receive messages or signals simultaneously, fostering immediate and dynamic interaction. Such tools include instant messaging applications, video calls, online conferences, and other platforms where communication occurs without significant delay.

- **Asynchronous Tools**

These are communication tools that enable users to exchange information at different times, without requiring simultaneous interaction. Participants can send messages, ask questions, or share ideas without needing to be online at the same time. This provides flexibility in response time and allows users to manage their schedules more autonomously.

1.4 Modular Distance Learning Systems

As technology continues to advance and become increasingly pervasive, the way we live and interact with

others is constantly evolving. When a traditional classroom is replaced by distance learning environments, we speak of distance education—an approach that provides a reliable means of expanding access to education while enhancing the quality of instruction. This mode also promotes peer collaboration while giving learners a sense of autonomy and responsibility in their learning journey.

Generally, a training module is defined by its content, but it is globally structured around three major systems:

- **Input System**

This system ensures the effective management of learner flow at the beginning of the module. It provides a brief introduction to the course, including its learning objectives and overall expectations.

- **Learning System**

At this stage, the content and learning activities are carefully designed. The content of a module is not merely a collection of information, but a training framework aimed at meeting learners' specific needs. The goal is to enable them to acquire the necessary skills to complete practical tasks, which should be reflected in the structure and quality of the content provided.

- **Output System**

This system manages learner flow at the end of the module. It focuses on evaluating the knowledge gained, identifying any gaps, and guiding learners toward the parts of the module they may not have fully mastered.

Online courses offer a richer and more balanced learning experience by exposing learners to multiple perspectives on a subject. Unlike traditional classrooms, where learners are often limited to a single point of view, online learning promotes the exploration of both sides of an argument or debate. This approach encourages learners to develop critical thinking skills and to form their own independent opinions.

In the context of designing a scenario-based architecture for communication tools in a SPOC (Small Private Online Course), the modular systems of distance learning are structured to offer a hybrid and dynamic learning experience. This architecture relies on a strategic alternation between asynchronous, synchronous, and consolidation phases, integrating various communication tools to maximize interactivity and pedagogical effectiveness.

2. The four Stages of the Learning Process

An effective teacher within a learning-oriented approach is distinguished by their ability to propose well-structured activities while remaining flexible in managing their plans. They allocate sufficient time to important topics to ensure deep understanding and provide assessments that are aligned with what has actually been taught. They promote interaction by asking numerous questions and offering constructive feedback. As an expert, the teacher adopts a learner-centered approach, positioning themselves as a *facilitator* of learning.

To achieve this, the teacher must integrate a variety of learning activities while taking into account authentic learning processes. Although different programs may assign different names to the same stages, these can be grouped and presented as a coherent and unified set.

The phases considered include:

- Situation
- Conceptualization
- Objectivation
- Transfer

In their 2021 study, Khaldi and his team of researchers presented a model for designing pedagogical scenarios tailored to different types of learning activities. The figure below illustrates the four types of scenarios used during a learning situation.

Fig. 1: Example of the life cycle of a pedagogical scenario for a learning situation (Khaldi et al., 2021)

The life cycle of a pedagogical scenario for a learning situation revolves around four main stages, each comprising specific activities. The first stage marks the launch of the learning module, during which expectations are clarified and foundational concepts are introduced. Diagnostic assessments are conducted to identify learners' initial levels and detect potential gaps, which can be addressed using appropriate educational resources.

The second stage**,** conceptualization, focuses on explaining key concepts through either deductive or inductive teaching approaches, along with the structured organization of information to support assimilation.

The third stage, known as objectivation, involves interactive activities such as group discussions for knowledge sharing and hands-on tasks to reinforce the application of learned concepts. Formative assessments conducted during this phase provide ongoing feedback to help adjust and guide the learning process.

The fourth and final stage, transfer, marks the conclusion of the module. It includes in-depth analysis of case studies to evaluate how well learners have integrated the knowledge and skills acquired. Summative assessments validate the achievement of learning objectives and guide the application of newly acquired competencies in future real-world contexts.

This methodology is based on a modular system structured around six main activities**.** Each module incorporates three essential components: an input system**,** a learning system**,** and an output system**.** Based on these theoretical principles, a specific pedagogical architecture has been developed for the design of online communication tools, grounded in the SPOC model (Small Private Online Course)**.** This architecture is designed to adapt to the various activities within an online learning module while offering an interactive approach. By combining the strengths of communication tools with the flexibility and accessibility of online courses, this proposal aims to maximize learning effectiveness while maintaining an immersive and engaging experience**.**

This integrated approach, which combines the life cycle of a pedagogical scenario with a modular structure, offers a solid and adaptable foundation for designing communication tools in a SPOC-based model. By aligning the four key learning phases situation, conceptualization, objectivation, and transfer—with the modular components input system, learning system, and output system it provides a comprehensive framework that guides learners through a structured and progressive learning path**.**

This architecture is designed to maximize learning effectiveness while ensuring that each phase of the educational process is rigorously planned and effectively implemented. By incorporating essential elements such as diagnostic evaluation, conceptual instruction, practical learning, and summative assessment into a modular approach, this framework promotes active, goal-oriented learning**.** By combining the rigor of traditional pedagogical methodologies with the flexibility and interactivity of digital tools, this proposal addresses the demands of contemporary education, offering an innovative solution to today's teaching challenges by merging pedagogical efficiency with technological modernity.

2.1. Pedagogical Scenario Architecture for Online Communication Tools in SPOC Training

The scenario-based architecture for online communication tools within the SPOC model provides a structured and innovative framework designed to enhance the learning experience in this specific pedagogical context. This architecture is built upon several fundamental components, organized coherently to create an interactive and engaging learning environment. At the core of this structure lie the three main systems of a training module: the input system, the learning system, and the output system. These systems are carefully developed to harmoniously integrate the different phases of the learning process, from initiation to evaluation.

The architecture also incorporates several interconnected models, each dedicated to a specific type of activity, ranging from real-time interaction to asynchronous exchanges, including collaborative discussions and formative assessments. This organization is tailored to meet the specific demands of the SPOC format while fully leveraging the potential of online communication tools. It establishes an effective balance between flexibility and structure, autonomy and collaboration, while ensuring a coherent pedagogical progression tailored to learners' needs. The following section will present in detail a specific scenario-based architecture for the integration of online communication tools within the SPOC framework.

2.2. Situation

Diagnostic assessment plays a crucial role in this activity. The instructor uses it to evaluate each learner's level of knowledge and skills prior to the start of the activity. This assessment helps identify both the strengths and areas for improvement of each student. Based on the results, the instructor creates a tailored learning environment by implementing collaborative activities and targeted resources to address the identified gaps. These may include additional explanations, reinforcement exercises, or small group work.

This proactive approach aims to prepare learners even before the actual learning situation begins, ensuring they possess the necessary knowledge and skills to succeed in the upcoming activity. By doing so, the instructor gains a clearer understanding of each learner's profile, which enables the design of the most appropriate next steps to effectively support their development.

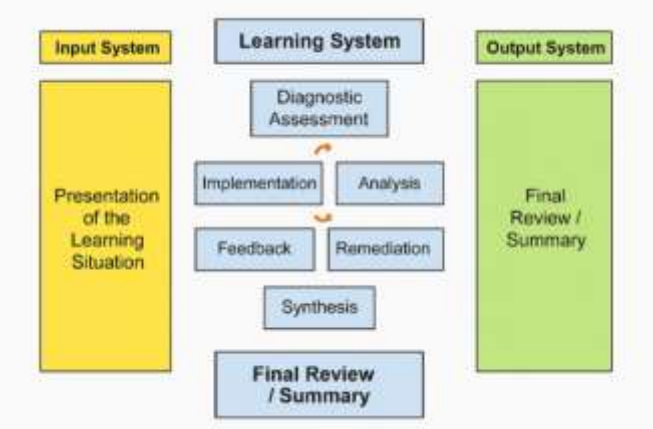

Fig. 2: Situation scenario.

- **Input System**

The input system, corresponding to the asynchronous phase, focuses on the initial presentation of the learning situation. At this stage, the instructor prepares a pedagogical resource in advance, such as a video capsule, in which they clearly define the objectives to be achieved by the end of the activity, as well as the knowledge to be acquired. Designing a clear and detailed input system is crucial to maximizing learner engagement. This involves clarifying what learners will learn, how they will learn it, and when. A significant awareness of the problematic situation is also essential. This often stems from the instructor's intent to deliver effective knowledge and achieve the set learning objectives. As such, learners must be both stimulated and motivated to go beyond their limits and actively engage in the learning process.

To enrich this process and enhance the quality of learning, the implementation of a discussion forum proves to be beneficial. This tool encourages cohesion among learners by allowing them to collectively share knowledge, experiences, and perspectives. Furthermore, it provides a platform conducive to feedback exchange, thereby reinforcing learning quality. Additionally, the forum offers valuable flexibility in terms of time and space management (Depover & Marchand, 2002) and helps reduce the feeling of isolation (Nault, 2001). This approach promotes collaborative and interactive learning while supporting learner autonomy within a stimulating and inclusive educational environment.

- **Learning System**

The learning system, corresponding to the synchronous phase, relies on the use of collaborative tools, such as videoconferencing solutions, to facilitate real-time interaction. During this phase, the instructor introduces diagnostic assessment, a key element of the learning process. This assessment helps identify the difficulties learners encounter and enables the implementation of appropriate solutions. To enhance its effectiveness, the diagnostic assessment should be divided into several subcomponents, which reduces cognitive load for learners. Each completed subcomponent leads to the next stage, ensuring smooth and structured progression.

To support interaction and communication, learners can use tools such as email to contact the instructor directly when needed, as well as chat tools to facilitate peer-to-peer exchanges. These interactions strengthen collaboration and help clarify any misunderstandings.

The remediation process is initiated by the instructor, who begins by precisely identifying the errors made by learners. Once the errors are pinpointed, the instructor determines the most appropriate corrective method, which may include worksheets, concrete examples, or practical illustrations. Learners then practice applying these methods until they are integrated into their procedural memory. Constructive feedback is then provided to confirm that the errors have been addressed, thereby reinforcing understanding.

This phase concludes with a synthesis of the topics covered and the knowledge acquired, allowing learners to consolidate the key content. This approach ensures comprehension is confirmed and fosters analytical thinking, while also establishing a relationship of trust between instructor and learners. A well-designed diagnostic assessment also helps to effectively structure the learning process and consolidate pedagogical progression.

- **Output System**

The output system, corresponding to the asynchronous phase, is based on an in-depth analysis of the results of the initial diagnostic assessment. This evaluation allows instructors to gain a clearer understanding of each learner's knowledge and skill level prior to the activity. This in-depth understanding is a cornerstone of the pedagogical approach, as it enables the design of teaching and learning strategies that are tailored to the specific needs of each learner.

By relying on this data, instructors can continuously adjust the content, methods, and pace of pedagogical activities to meet the specific characteristics of their group. This dynamic personalization of the pedagogical approach is essential to ensure that all learners succeed, regardless of their initial level. It guarantees that each learner can progress effectively and achieve the learning objectives set within the framework of the instructional scenario.

3.Conceptualization / Objectivation

The foundation of this approach lies in the articulation of conceptualization and objectivation activities with theories of learning and teaching. These activities can be carried out either inductively, starting from learners lived experiences, or deductively, by relying on pre-established theoretical principles. They pursue a dual objective: developing new knowledge while enabling the acquisition of transferable skills applicable across various areas of life.

This approach goes beyond the mere transmission of knowledge by aiming to equip learners with practical tools they can mobilize in diverse contexts. By anchoring learning in concrete and meaningful situations, it encourages active understanding rather than passive assimilation. Learners are not simply recipients of information; they develop skills that they can reinvest autonomously.

By connecting conceptualization and objectivation activities to the theoretical foundations of educational sciences, this approach seeks to cultivate learners who are capable of applying their acquired knowledge in the multiple dimensions of their lives, thereby enhancing

their autonomy and adaptability to diverse environments.

3.1. Conceptualization / Objectivation: Deductive approach

The online learning scenario adopts a deductive approach to conceptualize learning processes. As Develaki (2020) emphasizes, this method involves progressing from the general to the specific from fundamental principles to their resulting consequences. The system rigorously analyzes implicit conclusions derived from established premises.

In this context, the process begins with the presentation of a statement defining a concept or rule, followed by the validation of its accuracy through concrete examples. First, the system provides a structured explanation of the concept, tailored to its nature. Then, contextualized examples are introduced to help learners better understand and assimilate the content. Finally, application exercises are offered to test the acquisition of knowledge and its practical implementation, thereby ensuring effective appropriation and meaningful use of the acquired knowledge.

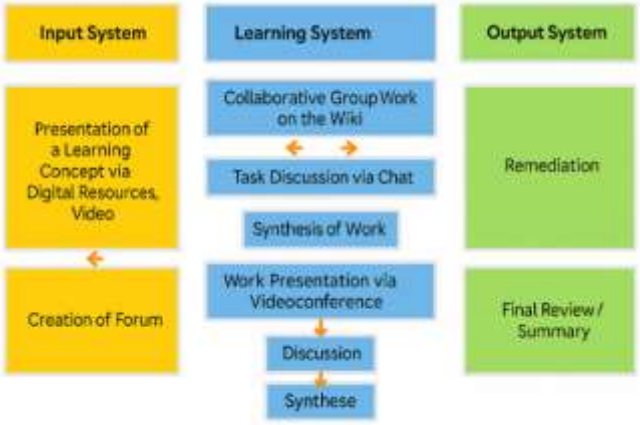

Fig. 3: scenario for the deductive approach

- **Input System**

The input system constitutes the first phase of the learning process. Its primary goal is to prepare learners by providing a clear and structured introduction to the basic concepts and the objectives of the learning activity. This stage begins with the presentation of the concepts through interactive digital resources, such as explanatory videos or multimedia materials. These resources are carefully designed to provide context and support learners in developing an initial understanding of the subject matter. This phase is grounded in the clarity of pedagogical objectives: learners must understand what they will learn, why they are learning it, and how they will engage in the process.

At the same time, a discussion forum is set up to initiate the first interactions among learners. This asynchronous space encourages the sharing of ideas, questions, and early reflections. The forum also serves as a collaborative preparation tool, enabling participants to freely exchange before engaging in more structured activities. This interactive setting lays the groundwork for group dynamics and facilitates the transition to the next stages of the learning process.

- **Learning System**

The learning system represents the core phase of the educational process, during which learners apply the concepts introduced in the input system. This phase is based on interactive and collaborative activities that foster active engagement and critical thinking. It begins with a collaborative group activity conducted on a platform such as a wiki. Learners work together to produce content, co-construct knowledge, or solve problems by sharing their perspectives and ideas. This activity helps develop both academic skills and effective collaboration abilities.

To support this collaborative work, a synchronous communication tool such as a chat is integrated. This tool allows learners to discuss specific aspects of the tasks in real time, ask questions, and exchange on complex topics. The ongoing dialogue via chat helps clarify instructions and resolve potential issues, thereby improving the quality of group work.

Once the collaborative tasks are completed, learners move on to synthesizing their work, summarizing key ideas, and organizing their conclusions. This synthesis serves as preparation for the final presentation, which is conducted via videoconference. During this presentation, learners share their results and receive immediate feedback from the instructor and peers. This direct interaction is followed by an in-depth discussion that allows for further exploration of the topics addressed and strengthens learning. A global synthesis concludes this step, consolidating the knowledge acquired and preparing learners for the final phase.

- **Output System**

The output system, corresponding to the final asynchronous phase, focuses on assessment and consolidation of learning. This phase begins with remediation—a process that identifies gaps or errors that occurred during the previous activities. Based on the results of learners' work, the instructor offers targeted solutions to address the difficulties encountered. These may include additional activities, detailed explanations, or concrete examples to reinforce less well-assimilated concepts. This remediation process ensures that each learner has the necessary tools to progress.

Once the gaps have been addressed, the phase concludes with a final review aimed at evaluating the

overall learning process. This review includes an analysis of the skills acquired, validation of the learning objectives achieved, and a reflection on all the activities carried out. In addition to strengthening learners' understanding, this phase offers a comprehensive perspective on their progress and prepares them to reinvest the acquired competencies in future contexts. By concluding the pedagogical cycle, the output system ensures a smooth and thoughtful transition to new learning opportunities.

3.2. Conceptualization / Objectivation: Inductive approach

The inductive approach involves moving from specific cases to broader general principles (Varpio et al., 2020). It is a scientific method that enables general conclusions to be drawn from individual observations. This approach leads learners to experimentally discover the underlying conceptual meaning of learning activities. In doing so, they move from concrete examples to broader perspectives.

This process of generalization (or objectivation) encourages learners to describe the methodologies used and the operations involved, drawing on metacognitive awareness. They are prompted to analyze their knowledge structures in a critical and holistic manner (Goddiksen & Andersen, 2014). This interdisciplinary process enhances cultural awareness and the development of metacognitive skills.

A dialogic exchange then allows for the coherent compilation and summary of all achieved objectives. Through generalization, learners are able to reformulate individualized techniques and procedures in goal-related language, making them more widely understandable and applicable (McKeough et al., 2013).

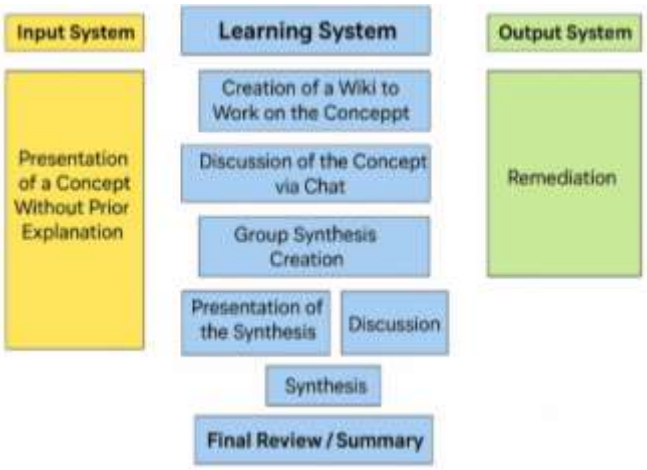

Fig. 4: Conceptualization / Objectivation: Inductive approach

- **Input System**

In an inductive approach, the input system is based on presenting a concept without prior explanation, allowing learners to explore and discover its aspects on their own. Unlike a deductive approach, where rules or principles are introduced first, this phase encourages learners to think independently and formulate hypotheses about the subject. The teacher acts here as a facilitator, providing resources or posing open-ended questions that prompt learners to explore the concept. This absence of initial explanation stimulates curiosity and engagement, motivating learners to take active ownership of the knowledge. This phase sets the stage for exploratory and collaborative learning in the following steps.

- **Learning System**

The learning system lies at the heart of the inductive approach, as this is the phase in which learners actively build their understanding of the presented concept. It begins with the creation of a wiki—a collaborative space where learners can document their ideas, share their discoveries, and organize their reflections on the concept. This activity promotes co-construction of knowledge, as learners are encouraged to contribute collectively, engage in debate, and enrich the created content.

Simultaneously, learners discuss the concept through a chat, a synchronous tool that allows for real-time exchanges. These discussions help clarify ideas, raise questions, compare viewpoints, and deepen collective understanding. Once learners have explored the concept, they proceed to group synthesis creation, where they organize and structure their ideas coherently. This step is essential for transforming raw discoveries into a shared and in-depth understanding.

The synthesis is then presented during a presentation session, where learners share their conclusions with the whole group. This presentation is followed by an interactive discussion, allowing peers and the instructor to ask questions, offer observations, and provide additional insights. Finally, a global synthesis is developed to integrate all contributions and achieve a refined collective understanding of the concept.

- **Output System**

The output system concludes the learning process by consolidating acquired knowledge and offering an opportunity for remediation and evaluation. In an inductive approach, remediation is particularly important, as it helps correct misunderstandings or errors resulting from earlier explorations. Based on the work produced and discussions held, the instructor identifies learning gaps and offers targeted solutions, such as specific exercises or additional explanations. This phase ensures that all learners reach a satisfactory level of understanding before moving to the conclusion of the process.

Finally, a comprehensive review is conducted to

assess the overall learning experience. This review includes reflection on the learning journey, the competencies acquired, and areas for improvement. Learners are also encouraged to consider how they can apply the knowledge and skills gained to other situations. This final step reinforces learners' autonomy and their ability to transfer their learning to varied contexts.

4. Transfer

The transfer of learning refers to a learner's ability to mobilize and apply the knowledge, skills, and strategies acquired in one context to new environments or different situations. This phase often considered the most complex in the learning process requires that the learner be able to:

- Recognize similarities and differences between situations;
- Adapt and mobilize their prior knowledge in a flexible and relevant manner;
- Solve new problems by drawing on previous learning.

Transfer is essential to prevent knowledge from remaining confined to a specific context, enabling its effective reinvestment in a variety of environments. It is a central objective of any teaching-learning process, as it fosters deep understanding and lasting mastery of knowledge—far beyond simple recall or repetition.

Within this framework, we propose three types of activities:

Formative Assessment

- Conducted throughout the learning process
- Helps identify learners' strengths and weaknesses
- Supports the regulation of learning (feedback, adjustments)
- May include quizzes, question-and-answer sessions, formative exercises, etc.

Case Studies

- Complex and realistic problem-solving situations
- Enable the application of knowledge in real-world contexts
- Promote the transfer and mobilization of learning
- Can be carried out individually or in groups
- Encourage analysis, reflection, and problem-solving

Summative Assessment

- Conducted at the end of a module or learning sequence
- Evaluates the achievement of learning objectives
- May include exams, projects, presentations, etc.
- Used for certification and validation of acquired competencies

4.1. Formative Assessment

Formative assessment is a key component in the field of education, aimed at enhancing student learning by providing continuous and constructive feedback throughout the educational journey. As Morrissette explains, this approach is grounded in a sociocultural perspective, where formative assessment is viewed as a communicative process embedded directly within teaching and learning activities. This perspective emphasizes the importance of social interactions and educational contexts in the development of students' competencies (Morrissette, 2014).

What sets formative assessment apart is its primary objective: to support learning rather than merely evaluate outcomes. Research has shown that this method enables better identification of students' needs and allows for the adjustment of teaching strategies accordingly, thereby promoting more effective self-regulation of learning (Lepareur & Grangeat, 2019; Clark, 2012). For instance, it has been demonstrated that teachers who implement formative assessment practices help students make greater progress by offering personalized feedback and actively involving them in their own learning processes (Bourgeois, 2017).

Furthermore, formative assessment is often part of broader frameworks for pedagogical regulation. Lopez and Laveault highlight that this approach must incorporate cognitive, communicative, and didactic dimensions to allow for optimal regulation of learning (Lopez & Laveault, 2014). This integration is essential to creating an educational environment where students feel supported and encouraged to engage in their own development.

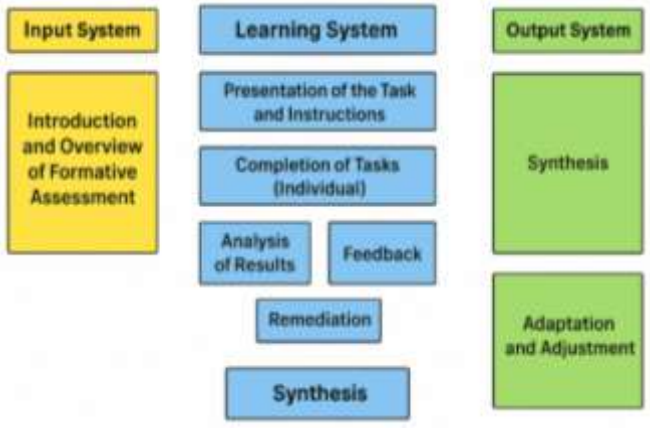

Fig. 5: formative assessment scenario

4.2. Case studies

The case study is a qualitative research method frequently used in the field of education. It involves a detailed exploration of one or more specific cases in order to better understand a phenomenon, situation, or complex educational process. This approach allows for a thorough examination of the characteristics, interactions, and contextual elements that influence an

event, program, activity, or individual within a given educational setting. The primary goal is to generate in-depth, contextualized knowledge rather than to reach broadly generalizable conclusions.

In educational contexts, case studies can address a wide variety of topics, such as the analysis of innovative teaching practices, students' learning experiences, the challenges faced by teachers, or the internal dynamics of an educational organization. This method often relies on the extensive collection of qualitative data, including direct observations, interviews, and the analysis of relevant documents.

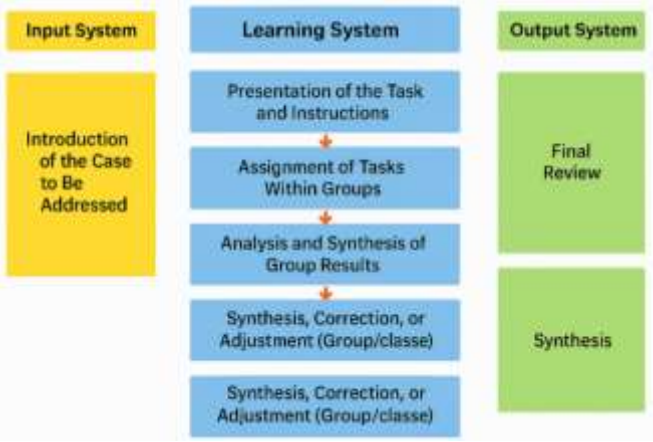

Fig. 6: case study scenario

4.3. Summative Assessment

Summative assessment is a method aimed at evaluating students' learning outcomes at the end of an instructional process, typically through exams or tests. It focuses on measuring final results, thereby determining whether the intended educational objectives have been achieved. Often used for grading or certification purposes, this type of assessment plays a central role in the educational system by providing key insights into student performance and the effectiveness of instructional programs.

According to Luisoni and Monnard, summative assessment plays a fundamental role in reviewing learning outcomes and adjusting teaching practices (Luisoni & Monnard, 2020). It is considered a tool that reports on students' acquired competencies by comparing them to established standards or reference frameworks (Turcotte et al., 2021). Moreover, Fontaine and Loye emphasize that, to be truly effective, summative assessment must be rigorous and well-structured in order to reliably reflect the learning that has taken place (Fontaine & Loye, 2017).

Research also shows that various factors can influence summative assessment, including teachers' perceptions of fairness and justice in evaluation (Grandchamp et al., 2020). For example, studies on reforms related to summative assessment in physical education have highlighted mixed reactions among teachers toward new evaluation practices, which can impact their implementation (Grandchamp et al., 2020).

Although summative assessment is sometimes criticized for the pressure it may place on students, it also offers significant advantages by providing actionable data for improving educational programs and pedagogical methods (Grandchamp et al., 2018). Finally, it is essential to distinguish between formative and summative assessment: the former aims to support learning, while the latter seeks to measure final outcomes (Cogérino & Mnaffakh, 2008).

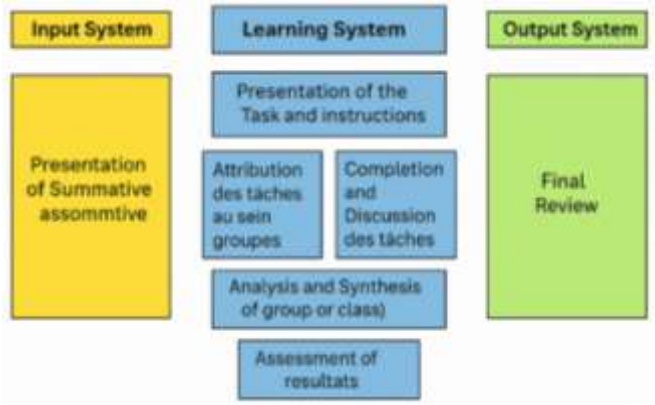

Fig. 7: scenario for summative assessment

The various scenarios presented underline the importance of aligning teaching activities with the four key phases of learning - situation, conceptualization, objectification and transfer - while ensuring that assessment tools are both formative and summative in nature. This integrated approach ensures that learning is not only progressive and structured, but also tailored to the individual needs of learners. By combining theory and practice, and encouraging active engagement through a variety of tools, this scenario-based architecture offers a flexible yet rigorous pedagogical model suited to e-learning environments such as SPOCs.

5 | DISCUSSIONS AND LIMITATIONS

This proposed scenario-based architecture for the pedagogical integration of communication tools in a SPOC training framework raises several key discussion points. The use of structured scenarios allows for contextualized learning, aligning with the principles of situated learning as described by Lave and Wenger (1991), where knowledge is constructed through participation in authentic communities of practice. This theoretical perspective supports the use of realistic scenarios as a foundation for integrating communication tools.

The proposed architecture addresses the

challenges identified by Guo and Reinecke (2014) regarding engagement and retention in MOOCs by offering a more personalized and interactive approach characteristic of SPOCs. The integration of both synchronous and asynchronous communication tools fosters what Garrison et al. (2000) describe as "social presence" in their Community of Inquiry model, a critical element for effective online learning.

However, the technical complexity of this architecture raises concerns about learners' cognitive load. According to Sweller's Cognitive Load Theory (1988), the addition of multiple communication tools may create extraneous cognitive load, potentially hindering learning. It is therefore essential to design an intuitive interface and provide adequate user support.

The collaborative dimension of this approach is consistent with Dillenbourg's (1999) work on computer-supported collaborative learning. The author emphasizes the need to structure interactions to ensure they are pedagogically meaningful. Thus, the proposed scenarios must be carefully designed to promote high-quality interactions rather than superficial exchanges.

Several significant limitations can be identified in this proposed architecture. The first concerns the complexity of both technical and pedagogical implementation. As Anderson and Dron (2011) have pointed out, integrating multiple educational technologies requires advanced technical skills and a substantial investment of time and resources, which can be a major barrier for many institutions.

Accessibility is another critical limitation. Seale (2006) highlights the challenges of ensuring digital accessibility in online education, especially when several tools are integrated. The proposed architecture must guarantee accessibility for all learners, including those with disabilities, adding further complexity to the design.

Managing the workload for instructors is a major practical limitation. According to Cormier and Siemens (2010), facilitating online courses using a variety of communication tools requires an almost constant presence and specific digital pedagogical skills. Without adequate institutional support, this workload may become unsustainable.

Assessing learning outcomes in such a complex environment also poses challenges. As noted by Spector and Anderson (2000), assessment in technology-rich learning environments requires innovative approaches that go beyond traditional methods. Tracking learner interactions and evaluating their pedagogical value remain unresolved issues.

Finally, user resistance to change—both from learners and instructors—can hinder the effective adoption of this architecture. Rogers (2003), in his diffusion of innovations theory, emphasizes that the adoption of new educational technologies largely depends on their compatibility with existing practices and the perceived ease of use.

5.1. Conclusion

This article has outlined a scenario-based pedagogical framework designed to optimize the integration of communication tools within SPOC-based training environments. By aligning synchronous and asynchronous tools with structured learning phases and modular systems, the proposed architecture supports both cognitive engagement and collaborative learning. The integration of wiki, forum, chat, and video conferencing tools demonstrates the potential for creating interactive and learner-centered online courses.

As a continuation of this work, our future research will focus on the implementation of this model within a Moodle-based online training environment. This next phase will follow the ADDIE instructional design model to systematically integrate communication tools into the learning space, ensuring instructional alignment, technological feasibility, and pedagogical effectiveness.

Acknowledgements

We want to extend our thanks to the editorial board and the anonymous reviewers from the journal. Their feedback and insights were incredibly helpful in improving our manuscript. The current study did not generate or analyze any datasets; thus, data sharing does not apply to this article.

Authors contributions

Ms, Ouariach Fatima Zahra drafted the original manuscript. Professor Nejjari Amel and Professor Khaldi Mohamed provided academic guidance, validated the findings, and participated in the final review and approval of the manuscript.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data Availability Statement

Data sharing is not applicable to this article, as no datasets were generated or analyzed during the current study.

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